Naval Facilities Engineering Command Mid-Atlantic
Norfolk, Virginia

Technical Specifications

Site 00001 – Former Drum Marshalling Area, OU 2 Groundwater

Naval Weapons Industrial Reserve Plant Bethpage, New York

Phase III - Groundwater Treatment System

ISSUED FOR BID

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SECTION 01 01 00

SCOPE OF WORK

Specifications provided herein may include references to civil work and piping/conduit associated with the RW9 and RW10A Pipelines and the drainage system for this Project. Specifically, the pipelines, manholes, and conduit from the intersection of Twin Lane and the Treatment Plant site to the RW9 and RW10A recovery well vaults, including RW9 and RW10A procurement and installation of the vaults, and the recharge basins are being conducted by other. The contractor for the Treatment Plant Site shall be responsible for the procurement and installation of wiring between the Treatment Plant and these remote locations, as well as all piping, controls, and power within the vaults and power supply and control for the remote pumps, instruments, and other equipment within the vaults and the recharge basins. See Attachment 1 for a Summary of current SOW.

PART 1 - GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall provide all services and materials necessary for the installation of the process equipment and associated appurtenances at the Phase III Ground Water Treatment Facility for treatment of metals, volatile organics and 1,4-Dioxane near the Naval Weapons Industrial Reserve Plant, located in, Bethpage, New York as shown on the General Vicinity Map in the Technical Drawings.

1.1.1.1 General Scope of Work

1.1.1.1.1 Section 1: Mobilization and Demobilization
1.1.1.1.2 Section 2: Site Preparation
1.1.1.1.3 Section 3: Process, Treatment, and Instrumentation Systems
1.1.1.1.4 Section 4: Building Systems
1.1.1.1.5 Section 5: Electrical Systems
1.1.1.1.6 Section 6: Process Control System
1.1.1.1.7 Section 7: Site Work and Restoration
1.1.1.1.8 Section 8: Plumbing System
1.1.1.1.9 Section 9: Fire Protection Systems
1.1.1.1.10 Section 10: Special Requirements

1.1.2 The work shall be complete and includes furnishing, as applicable or required, all Contractor’s safety devices, labor, tool, materials, supplies, and services; and performing all operations necessary for or incidental to a complete project in conformance with the attached Basis of Design Report, Technical Drawings, and Technical Specifications.

1.1.3 The Contractor shall furnish all labor, materials, equipment and incidentals to install the above listed systems and equipment, including the piping, wiring, and instrumentation interconnections between all specified components and auxiliary equipment.

1.1.4 Contractor shall be responsible for the field erection of materials oversized for shipment.

1.2 REFERENCED SPECIFICATIONS

1.2.1 This section refers to all technical specification divisions.

1.3 SUBMITTALS

1.3.1 The Contractor shall submit the following to the RPM/COR and Engineer of Record (EOR) for review, comment, and approval prior to pre-construction meeting in accordance with Section 01330, "Submittals":

1.3.1.1 Contractor's markup drawings.

1.3.1.2 Product information for any proposed additions or changes per the Contractors markup drawings showing all important details, layout of components, materials of construction and dimensions.

1.4 OPERATING INSTRUCTIONS

1.4.1 The initial operations and maintenance of the building and associated processes is part of the Contractor's Scope of Work. Updating the O&M manual is also not part of the Contractor's Scope of Work. The Contractor shall turn over the manufacturer's operating and maintenance instructions that typically accompany equipment to the RPM/COR and EOR.

1.5 TOOLS, SPARE PARTS, AND CONSUMABLES

1.5.1 All special tools, spare parts, and consumables required for normal operation and maintenance shall be furnished in accordance with individual specifications.

1.6 EQUAL PRODUCTS

1.6.1 The Technical Drawings and Technical Specifications are based on a conceptual arrangement of equipment and piping. Should the Contractor propose to furnish equal equipment of a different configuration, the Contractor shall be responsible for all additions and modifications, as approved by the RPM/COR and EOR, necessary to incorporate the proposed equipment into the design and submit all the affected and revised Technical Drawings and Technical Specifications for review and approval by the RPM/COR and EOR prior to their implementation.

PART 2 - PRODUCTS

2.1 The Contractor shall ensure that the individual components, piping, wiring, and instrumentation interfaces are strategically located such that the complete system incorporate straight runs of minimum distance, to the extent possible. In addition, the Contractor shall ensure that

the components and auxiliary equipment fit within the allotted space shown on the Technical Drawings. The Contractor placement of individual units shall allow for adequate access to components within each unit, including instrumentation and valves, to allow for easy maintenance or replacement as may be required.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE OF EQUIPMENT

3.1.1 No shipment shall be made until shop drawings have been submitted to and approved in writing by the RPM/COR and EOR.

3.1.2 All units shall be preassembled to the largest extent possible, compatible with transportation limitations and equipment protection considerations. Skid-mounted assemblies shall be shipped complete, to the extent possible. Where absolutely necessary, some piping may be match-marked and broken down in a minimum number of pieces for field assembly by the Contractor. Pressure gauges, local instruments and primary elements, etc., may be removed for protective shipment and shall be installed in field by the Contractor.

3.1.3 For protection of bearings during shipment and installation, the bearings shall be properly processed. Bearings, if pre-lubricated, shall be protected in accordance with the Manufacturer's recommendations against formation of rust while awaiting installation. Bearings which are not pre-lubricated shall be properly treated in accordance with the Manufacturer's recommendation against formation of rust while waiting installation and start-up by the application of rust preventive treatment.

3.1.4 Manholes, piping, or other fittings shall not be used for lifting.

3.1.5 All lifts for equipment receiving, storage, and placement will be required to comply with NAVFAC Lift Plan requirements.

3.2 INSTALLATION

3.2.1 Installation of units and auxiliary equipment shall be in accordance with the Suppliers and/or Manufacturers' instructions and recommendations, and as described in the Specifications and as shown on the Technical Drawings and approved Contractor markups.

3.3 INTEGRITY INSPECTION AND FIELD TESTING

3.3.1 The Contractor shall perform integrity testing of the new systems, shall be present for initial startup, and shall be present when the new systems are taken on-line with the existing system.

3.3.2 Field inspections and tests may be conducted periodically by the Contractor during installation. Integrity inspection and field testing

shall be performed by the Contractor when the installations of the entire systems are complete and ready for testing.

3.3.3 The Contractor shall hydrostatically test the entire treatment/process system by filling it with potable water and perform blow-off testing.

3.3.4 After testing and following the Post-Construction Startup meeting, the Building and treatment system shall be taken on-line with the Contractor and EOR present at system startup.

3.3.5 Should any part of the new systems fail to perform in accordance with these specifications, the Contractor shall, at his own expense, make such modifications as necessary to provide satisfactory performance of the new systems. If retest still fails to demonstrate conformance with the specifications, the Contracting Officer may elect to require a replacement, a modification, a cost deduction, or a combination of the above.

SECTION 01 01 00

ATTACHMENT "A" - SCOPE OF WORK

PART A - GENERAL SCOPE OF WORK

Section 1: Mobilization and Demobilization

Mobilization and Demobilization consists of the following construction components:

1. Execute, the approved Contractor Remedial Action Work Plan and associated subplans

2. Execute the Accident Prevention Plan / Health and Safety Plan including quality control, spill control, health and safety, traffic control, and site security.

3. Provide permits, bonds, warranties, fees, insurance, and other similar expenses required by the contract.

4. Mobilization and Demobilization of all equipment, tools, materials, supplies, temporary facilities and utilities, and personnel required to perform the work.

5. Compliance with all regulatory requirements.

6. Pre-construction and construction period planning, management, scheduling, submittals, reporting, project closeout, administration and documentation.

7. Close out the project per the Remedial Action Work Plan, Accident Prevention Plan / Health and Safety Plan, and Performance Work Statement, including permits, and record drawings.

Section 2: Site Preparation and Temporary Facilities

Site Preparation and Temporary Facilities consist of the following construction components:

1. Execute the Erosion and Sedimentation Control Plan, and provide and execute a Dewatering Plan, if needed

2. Stake-out limits of construction locations and other important features such as water and sewer centerlines, building corners, and fence relocation.

3. Post project and safety signs, temporary security fencing, tree protection fencing, flagging, and other access restrictions

4. Layout and construct the construction laydown area including stabilized construction entrance.

5. Set up the contractor's office (trailer with power and telephone connections) and coordinate any temporary access and security with the Navy's onsite plant operator.

6. Clear and grub the site utility areas as shown on the Technical Drawings.

Section 3: Process, Treatment, and Instrumentation Systems

Process, Treatment, and Instrumentation Systems consists of the following components:

1. Furnish one (1) underground pre-cast valve vault and top access hinged cover (Recovery Well RW8) with piping, valves, fittings for three recovery wells (RW8, RW9, and RW10A) as shown in technical drawings and described in technical specifications. Each valve vault will be dedicated for housing piping, valves and fittings for flow control from set of recovery wells (RW-8, RW-9 and RW-10A). Piping, conduit, and manholes from the Treatment Plant site to recovery wells RW9 and RW10A, including the vaults and covers for RW9 and RW10A are by others.

2. Provide, install fully functional ground water extraction pumps P-8, P-9, P-10A at all three (3) recovery wells. Provide piping connections into GWTP building from the existing installed buried groundwater extraction lines from all three recovery wells. All wiring, instruments, and equipment within the conduit, manholes, and vaults are to be provided by the contractor. The treated effluent lines, consisting of piping, manholes, and conduit from GWTP to stormwater basins as shown on technical drawings and described in technical specifications are by others.

3. Furnish and install (3) Fiberglass Reinforced Plastic (FRP) vertical storage tanks Equalization tank T-100, LGAC pumping tank T-410, LGAC backwash supply tank T-500 on concrete pad. Furnish and install all associated inlet, outlet, overflow piping, valves, fittings, supports per contract drawing details and specifications. Provide insulation and jacketing for exposed piping inside the building

4. Furnish and install (1) glass fused Backwash waste steel tank T-550 outside building. Furnish and install all associated inlet, outlet, overflow piping, valves, fittings, supports per contract drawing details and specifications. Provide insulation, jacketing and heat tracing for exposed piping outside the building and insulation and jacketing for exposed piping inside the building.

5. Furnish and install three (3) Multimedia Vertical Pressure Filters (MMF) unit vessels operating in parallel inside the building with piping manifold on concrete pad per contract drawings and specifications. Furnish and install all piping, wiring, valves, and other appurtenances.

6. Furnish and install two (2) Horizontal Cartridge Filters on skid operating in parallel inside the building with inlet and outlet piping connections on a concrete pad per contract drawings and

specifications. Furnish and install all piping, valves, and other appurtenances. Furnish cartridge elements and appurtenances as per specifications.

7. Furnish and install one (1) Ozone-Hydrogen Peroxide Advance Oxidation Process (AOP) system including contact tank or reactor/s on skid, AOP system control and monitoring panels, and complete oxygen and ozone generation system components as shown on drawings and specified herein.

   - Furnish and Install two (2) oil free compressors with water-cooled heat exchanger system, condensate drain, piping, valves and appurtenances. Compressors shall be rated for 140 cfm compressed air with 50 HP motor, manufactured by Kaeser or approved equal.

   - Furnish and Install two (2) heatless desiccant air dryer skid mounted systems with required piping, fittings, valves and appurtenances. Air dryer shall be rated for 165 scfm @ 100 psi manufactured by Kaeser or approved equal.

   - Furnish and Install two (2) filters for the specified air dryer system.

   - Furnish and Install one (1) air buffer tank with sufficient capacity for generating oxygen as specified.

   - Furnish and Install one (1) skid mounted a pressure swing adsorption (PSA) oxygen generator system. The oxygen generator shall be rated for 621 SCFH to generate sufficient oxygen to meet the ozone loading demand. Oxygen generators shall be manufactured by AirSep or approved Equal.

   - Furnish and Install one (1) oxygen receiving tank for above specified oxygen generator.

   - Furnish and install one (1) ozone generator and distributor rated for maximum generation of 6 ppm of ozone, nominal power of 24.6 KW

   - Furnish and install one (1) ozone catalytic destructor system for above specified ozone.

   - Furnish and install one (1) ozone chiller system rated for 6.7 Tons of cooling, nominal power is 12.84 kW. Chiller shall be manufactured by Motivair or approved equal.

   - Furnish and install associated ozone injection tubing, piping, valves, sample ports, hydrogen peroxide static mixer, and appurtenances per contract drawings and specifications.

8. Furnish and install one (1) compressor heat exchange break tank T-650 with approximately 150-gallon capacity along with a 2” Portable water line and a 2” effluent water line after LGAC entering from top of tank as shown on drawings and specifications. Install each pipe with a solenoid valve to open/close these lines based on T-

650 level. Install 2” drainpipe and condensate from each compressor to floor drain.

9. Furnish and installed three (3) Liquid Phase Granular Activated Carbon (LGAC) unit vessels operating in parallel inside the building with piping manifold on concrete pad per contract drawings and specifications. Furnish and install all piping, wiring, valves, and other appurtenances.

10. Furnish and install two (2) MMF Feed Pumps P-100A/B inside building including entire assembly with piping, valves and flow meters per contract drawings and specifications.

11. Furnish and install two (2) LGAC Feed Pumps P-400A/B inside building including entire assembly with piping, valves and flow meters per contract drawings and specifications.

12. Furnish and install two (2) Backwash supply process pumps P-500A/B inside building including entire assembly with piping, valves and flow meters per contract drawings and specifications.

13. Furnish and install (2) vertical building sump pumps P-800A/B inside a new concrete sump for building including entire assembly with piping, valves, supports and appurtenances per contract drawings.

14. Furnish and install one (1) carbon adsorber vessel and media with vent piping from Equalization tank and LGAC pumping tank. Include all associated valves, supports and appurtenances per contract drawings and specifications.

15. Furnish and install two (2) blowers downstream of carbon adsorber vessel including inlet and outlet connection duct to atmosphere, associated valves, fittings, supports and appurtenances per contract drawings and specifications.

16. Furnish and install one (1) side mounted mixer with motor on Equalization tank T-100 as per contract drawings and specifications.

17. Furnish chemical feed systems for Sodium Hydroxide, Sodium Hypochlorite and Hydrogen Peroxide including chemical tank, metering pumps, chemical feed optimizer/analyzers, and monitoring equipment, as shown in the technical drawings and as described in the design technical specifications.

18. Furnish and install all process piping, vent piping, valves and fittings inside building per contract drawings and specifications. Make all piping connections and required piping support including hangers and pipe clamps as detailed on drawings.

Section 4: Building Systems

The Building Systems consist of the following components:

1. Furnish buildings, foundations, and interior/exterior concrete slabs on grade as shown in the technical drawings and as described in the design report and technical specifications. This includes equipment pads with anchor bolts, process/treatment system tie-in (sumps, floor drains, etc.) and under-slab utility coordination.

2. Furnish structural and architectural roof and systems (framing, sheet metal, roof drains, metal decking, hardware, etc.) as shown in the technical drawings and as described in the design report and technical specifications.

Section 5: Electrical Systems

The Electrical Systems consist of the following components:

1. The electrical load for the new Phase III System has been estimated based on the new process equipment shown in the P&ID drawings (Appendix H) and the estimated electrical load is 815A at 480V, 3-phase power system. Considering 15% future growth in accordance with UFC 3-501-01, the estimated load is 940A, so the nearest 80%-rated overcurrent device is 1200A.

2. With above load condition, a 1200A, 277/480V, 3-phase, 3-Wire Service Entrance Type MCC is proposed. This MCC is served by a utility transformer, which must be designed and provided by the local utility company, Public Service Electric and Gas Company Long Island (PSEGLI).

3. The utility transformer will be approximate 1,000 kilovolt amps. This utility transformer can be located on southeast side of the proposed building on a concrete pad and be powered by underground utility service from a new utility pole. Proposed pole shall be fed from existing power #W0220717, however exactly source is to be determined by PSEGLI. A utility meter is located on the transformer mounted current transformer cabinet. PSEGLI must be contacted with a "load letter" to coordinate new power service. However, the final decision to feed the utility transformer or the location is decided by PSEGLI.

4. The MCC will be in the designated electrical room (located on the southside of the Phase III System). The MCC consists of ten sections, each section is 20 inches wide by 20 inches deep by 91.5 inches high. This MCC has seven VFDs, two (2) for the equalization tank pumps (P-100A and P-100B), two (2) for LGAC pumps(P-400A and P-400B), two (2) for the air compressors (AC-610, AC-620), and one (1) for the RW8 submersible pump (RW8). Other loads for the MCC are indicated in the P&ID drawings and Electrical Single Line drawing.

5. The MCC feeds multiple 400A, 277/480V, 3-phase, 3-wire panelboards which power required HVAC and other 480V, 3-phase equipment. Two 208/120V, 3-phase, 4-wire (W) panelboards are also fed from the MCC via a floor mount-dry type transformer. This panelboard feeds all 120V receptacles, lighting, and other 208V, 3-phase or 1-phase equipment/devices.

6. The control room has an enclosure containing a PLC, SCADA system, and internet/cellular gateway to enable off-the site Phase III System process parameters to be monitored and controlled by users authorized by the Navy. A VPN router is used in conjunction with software to configure security and user rights for remote access. The remote pump-motors (capable of being control locally from their respective VFDs) shall also be controlled and monitored by internet-based software via the PLC/SCADA system.

7. Interior Lighting for the new RE108 plant will be LED controlled by occupancy sensors with override wall switches.

8. Exterior wall of the new treatment building and offices will be provided with LED wall pack fixtures and they will be controlled by photocell, timer and a hand-off-auto switch. Each wall pack will be provided with 90-minute battery for emergency egress lighting.

9. The treatment building and offices will be provided with grounding grid and bonded with the electrical grounding system. The building will be provided with lightning protection system.

The recovery/extraction wells (RW) are in three (3) different locations, two remote and one at the treatment building, as shown in the civil and electrical drawings. Each area has one (1) recovery well and each well is equipped with a submersible pump. Separate power sources serving RW9 and RW10A are approximately 250A, 277/480V, 3-Phase and are local NEMA 3R MCCs. RW8 is immediately adjacent to the primary treatment building and is powered from the treatment building MCC. The power system at each location is controlled and monitored by the PLC/ SCADA system.

Section 6: Process Control System

The Groundwater Treatment Plant (GWTP) Process Control System consists of the following components:

1. Furnish and install a fully tested PLC control system for the new Groundwater Treatment System as described in the contract drawings and technical specifications. PLC panels shall contain the PLC, Remote I/O and necessary equipment to interface with all field instrumentation and the SCADA.

2. Furnish and install all process instrumentation as shown on the contract drawings and described in the technical specifications. Install all instruments in accordance with vendor specific installation instructions.

3. Furnish and install all conduit, wiring and other fittings for powering and communication of field instrumentation associated with the new groundwater treatment plant control system as described in the contract drawings.

4. Furnish and install all conduit, wiring and other fittings for control and monitoring of the new groundwater treatment system process equipment.

5. Furnish and install all conduit, wiring and other fittings for

monitoring of the piping heat trace circuits.

6. Furnish and install all SCADA, remote monitoring and networking equipment as described in the contract drawings and technical specifications, including:

   a. Redundant SCADA Servers

   b. Operator Workstation

   c. Engineers Workstation

   d. Network Attached Storage (NAS) backup

   e. Color all-in-one printer

   f. Ethernet Switches

   g. Firewall

7. Provide for all PLC/SCADA programming, networking equipment configuration, remote monitoring equipment configuration and remote alarm notification software as described in the technical specifications. Program all control systems in accordance with the Process Control Description Section of specification 40 60 00. Include all software licenses as needed to make future modifications.

8. Provide for all screen development for HMI screens required for the groundwater treatment system.

9. Provide for overall system functional testing and control system training as described in the technical specifications.

10. Provide and coordinate new FIOS internet connection and service plan with Verizon for the new Ground Water Treatment Plant (GWTP).

The Office Building consists of the following components:

11. Provide and coordinate new FIOS internet connection and service plan with Verizon for the new Office Building at the new groundwater treatment system site. This connection shall be separate from the new GWTP FIOS connection. The Office and GWTP networks shall not be interconnected.

12. Furnish and install all office networking equipment as described in the contract drawings.

13. Provide for testing of the installed network system components and wiring.

Section 7: Site Work and Restoration

The Site Work and Restoration consist of the following components:

1. Furnish all earthwork, including pad excavation and site re-grading, as shown in the technical drawings and as described in the design report and technical specifications.

2. Furnish site utilities, including trenching, as shown in the technical drawings and as described in the design report and technical specifications. This includes stormwater system tie-ins, water service lines, sanitary sewer lines and electrical lines. All utilities outside 5 feet of the exterior of the building, as well as the roof drain tie-ins, may be considered "site work".

3. Furnish all seeding and sodding (topsoil) per technical drawings.

4. Provide fencing around the site consisting of 6-foot chain link along the north, west, and east sides of the site, and a 6-foot aluminum ornamental fence along the south side of the side. Provide an electric slide gate for access to Twin Lane, and a swing gate for access to the tower on the north side of the site.

5. Remove all remaining temporary features such as the office trailer, temporary utilities, laydown area, and stabilized construction entrance.

6. Repair or replace fence, grass, or other permanent site features that were disrupted during construction to visual acceptance or otherwise working condition.

7. Remove all remaining erosion and sediment control, dewatering, and temporary features once the site is stabilized.

8. Close out Erosion and Sediment Control Plan and Dewatering Plan

Section 8: Plumbing System

The plumbing system consists of the following components:

1. For the GWTP a 4-inch sanitary pipe will serve the toilet room. The discharge will be directed outside the building, connecting to the site's main sanitary piping.

2. Multiple floor drains within the facility, serving the treatment plant, will be routed and discharged to a process sump pump.

3. The toilet room will be equipped with a lavatory sink, a low-capacity 1.6-gallon per flush water closet, shower and a floor drain. The janitor's closet will have a mop sink. A proposed 50-gallon electric water heater will provide domestic hot water for the facility. The system will include a recirculating pump and piping to ensure prompt and efficient hot water delivery.

4. Multiple non-potable water hose bibbs shall be installed at designated locations throughout the treatment plant. Non-potable water will be conveyed from BWS Tank

T-500 to each hose bibb through a dedicated pumped distribution line. The system shall be configured to provide reliable supply pressure and flow to all hose bibbs.

5. Natural gas is unavailable to the site; therefore, the domestic water heater will be powered by electricity.

6. Emergency eye washes and emergency showers combos are strategically located throughout the facility to address emergency situations promptly.

7. Stormwater will be retained on-site and directed to dry wells.

8. In addition to the GWTP there will be a standalone office building. A 4-inch sanitary pipe will serve the office building. The discharge will be directed outside the building, connecting to the site's main sanitary piping. A 2” domestic cold water pipe will be run from the GWTP to serve the office building.

9. The office building toilet room will be equipped with a lavatory sink, a low-capacity 1.6-gallon per flush water closet and a floor drain. A kitchen sink will be provided for the Break Room and a utility sink and floor drain will be provided for the Storage Room. A proposed 6-gallon electric water heater will provide domestic hot water for the office building.

Section 9: Fire Protection Systems

Fire Protection systems consist of an addressable fire alarm system and a wet-pipe fire sprinkler system.

The fire alarm system shall consist of the following:

1. Furnish and install a new, complete addressable fire alarm system as shown in the technical drawings and as described in the technical specifications. This includes coordination with Owner and a local alarm system provider.

2. The fire alarm system shall consist of a control panel with battery backup, initiating devices including manual pull stations and smoke detectors, notification appliances including audio/visual horn, strobe, and combination horn strobe devices throughout the facility.

3. The fire pump and sprinkler system shall be monitored by the fire alarm system. Fire alarm devices related to these systems, such as waterflow and tamper switches shall be provided by the sprinkler system installer. Wiring to be completed by the fire alarm system installer.

4. Provide all miscellaneous material and components for a complete system including, but not limited to, wiring conduit, J-boxes, etc.

5. All fire alarm, supervisory, and trouble signals shall be sent through the fire alarm control panel to a receiving station by way of wireless transmitter (cellular communicator), IP, and/or dedicated phone lines or as otherwise determined by the local alarm system provider.

6. The contractor is responsible for all permits, inspections, tests, and approvals related to the fire alarm system as required by all authorities having jurisdiction.

The fire suppression system shall consist of the following:

1. Furnish and install a complete automatic wet-pipe fire sprinkler system as shown in the technical drawings and as described in the technical specifications. Fire sprinkler protection shall be provided throughout the entire facility.

2. The complete sprinkler installation shall include the following components:

    a. All control valves, check valves, double check backflow preventer, alarm and supervisory valves and switches.

    b. Waterflow alarm bell, flow switch, apparatus and tie-in to the building fire alarm system. Wiring to be completed by the fire alarm system installer.

    c. All piping, valves, fittings, and sprinklers including spare sprinklers for the spare sprinkler cabinet.

    d. All inserts, hangers, and supports for piping and equipment.

    e. All exposed sprinkler piping shall be primed and painted with two (2) coats of approved red color.

    f. Provide all miscellaneous material and components for a complete system.

3. Provide a fire department connection (FDC) with two 2-1/2” hose inlet connections.

4. Provide a backflow preventer test header connection with six 2-1/2” hose valve connections, or one hose valve connection for each 250 GPM of system demand or fraction thereof.

5. Furnish and install a new electric, horizontal split case fire pump rated for 1,000 GPM at 40 PSI to serve the fire sprinkler system. Complete fire pump installation shall include the following:

    a. Horizontal split case fire pump.

    b. All piping, control valves, check valves, alarm and supervisory valves and switches.

    c. Soft start fire pump controller complete with fire alarm monitoring points and pressure sensing lines.

    d. Pressure maintenance (jockey) pump complete with isolation valves, check valve, and jockey pump controller.

    e. Fire pump test header and flow meter. Piping shall be arranged to ensure the test header for the backflow preventer can be used as the test header for the fire pump as indicated in the technical drawings.

    f. Provide all miscellaneous material and components for a complete system.

6. The contractor is responsible for all permits, inspections, tests, and approvals related to the fire pump and fire sprinkler system as required by all authorities having jurisdiction.

Section 10: Special Requirements

Contractor shall include in the Bid the following:

1. Include an allowance for programming of the plant PLC to communicate with the vendor supplied PLC for monitoring and control of equipment.

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS
11/11

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Contact Personnel; G

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Activity Regulations

Ensure that Contractor personnel employed on the work site become familiar with and obey work site regulations including safety, fire, traffic and security regulations. Wear hard hats in designated areas. Mark Contractor equipment for identification.

1.2.1.1 Subcontractors and Personnel Contacts

Provide a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.2.1.2 No Smoking Policy

Smoking is prohibited within all buildings on the work site. This applies to field trailers and buildings under construction. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Construction Field Supervisor will identify designated smoking areas.

1.2.2 Working Hours

Routine and non-routine working hours are provided in the NAVFAC PWS.

1.2.3 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in paragraph WORK OUTSIDE REGULAR HOURS.

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, and gas service are considered utility cutovers pursuant to the paragraph WORK OUTSIDE REGULAR HOURS.

d. Connection to Existing Sanitary Sewer Line: Provide positive verification that the existing line conveys sanitary sewer; verify line is not incorrectly connected to a storm drain.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS
08/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

View Location Map; G

Progress and Completion Pictures; G

1.3 VIEW LOCATION MAP

Submit, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.4 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Include aerial photographs. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten views from points located by the Contracting Officer. Submit with the monthly invoice two sets of digital photographs, each set on a separate compact disc (CD) or data versatile disc (DVD), cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Provide photographs for each month in a separate monthly directory and name each file to indicate its location on the view location sketch. Also provide the view location sketch on the CD or DVD as a digital file. Include a date designator in file names. Cross reference submittals in the appropriate daily report. Photographs provided are for unrestricted use by the Government.

1.5 MINIMUM INSURANCE REQUIREMENTS

Provide the minimum insurance coverage required by FAR 28.307-2 Liability, during the entire period of performance under this contract. Provide other insurance coverage as required by State law.

1.6 SUPERVISION

1.6.1 Minimum Communication Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of contract work. In addition, if a Quality Control (QC) representative is required on the contract, then that individual must also have fluent English communication skills.

1.6.2 Superintendent Qualifications

The project superintendent must have a minimum of 10 years experience in construction with at least 5 of those years as a superintendent on projects similar in size and complexity. The individual must be familiar with the requirements of EM 385-1-1 and have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The Contracting Officer may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

For routine projects where the superintendent is permitted to also serve as the Quality Control (QC) Manager as established in Section 01 45 00.00 20 QUALITY CONTROL, the superintendent must have qualifications in accordance with that section.

1.6.2.1 Duties

The project superintendent is primarily responsible for managing and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend NAVFAC Red Zone meetings, partnering meetings, and quality control meetings. The superintendent or qualified alternative must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.6.3 Non-Compliance Actions

The Project Superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

1.7 PRECONSTRUCTION MEETING

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual

understanding relative to the administration of the value engineering and safety program, preparation of the schedule of prices or earned value report, shop drawings, and other submittals, scheduling programming, prosecution of the work, and clear expectations of the "Interim DD Form 1354" Submittal. Major subcontractors who will engage in the work must also attend.

1.8 FACILITY TURNOVER PLANNING MEETINGS (NAVFAC Red Zone - NRZ)

Meet with the Government to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start the turnover process at the Pre-Construction Conference meeting with a discussion of the NAVFAC Red Zone (NRZ) process and convene at regularly scheduled NRZ Meetings. Include the following in the facility Turnover effort:

1.8.1 NRZ Checklist

a. Contracting Officer's Technical Representative (COTR) will provide the Contractor a copy of the NRZ Checklist template prior to 75 percent completion.

b. Prior to 75 percent completion add/delete critical activities to the NRZ Checklist template as necessary to match the project scope, and schedule critical activities and insert planned completion dates in the NRZ checklist for each critical activity. Present the NRZ Checklist to COTR and review during a regularly scheduled QC Meeting.

1.8.2 Meetings

a. Upon Government acceptance of the NRZ Checklist, the Project Superintendent is required to lead regular NRZ Meetings beginning at approximately 75 percent project completion, or three to six months prior to Beneficial Occupancy Date (BOD), whichever comes first.

b. The Contracting Officer will determine the frequency of the meetings, which is expected to increase as the project completion draws nearer.

c. Using the NRZ Checklist as a Plan of Action and Milestones (POAM) and basis for discussion, review upcoming critical activities and strategies to ensure work is completed on time.

d. Coordinate with the COTR any upcoming activities that require Government involvement.

e. Maintain the NRZ Checklist by documenting the actual completion dates as work is completed and update the NRZ Checklist with revised planned completion dates as necessary to match progress. Distribute copies of the current NRZ Checklist to attendees at each NRZ Meeting.

1.9 ELECTRONIC MAIL (E-MAIL) ADDRESS

Establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments as text files, pdf files, and other similar formats. Within 10 days after contract award, provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The

Contracting Officer may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes or terrorist threats. Multiple email addresses are not allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). Promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
08/18

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittal requirements are specified in the technical sections and consist of those submittals not specific to the Remedial Action Work Plan or post-construction submittals. Examples and descriptions of submittals identified by the Submittal Description (SD) numbers and titles follow:

SD-01 Preconstruction Submittals

Preconstruction Submittals are provided in the NAVFAC PWS. SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report that includes findings of a test required to be performed on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report that includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily logs and checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods, or personnel qualifications.
Text of posted operating instructions

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (SDS)concerning impedances, hazards and safety precautions.

SD-10 Operation and Maintenance Data

Data provided by the manufacturer, or the system provider, including manufacturer's help and product line documentation, necessary to maintain and install equipment, for operating and maintenance use by facility personnel.

Data required by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

Data incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.1.2 Approving Authority

Office or designated person authorized to approve the submittal.

1.1.3 Work

As used in this section, on-site and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction. In exception, excludes work to produce SD-01 submittals.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G

1.3 SUBMITTAL CLASSIFICATION

1.3.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, variations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Government.

Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, submittals are considered to be "shop drawings."

1.3.2 For Information Only

Submittals not requiring Government approval will be for information only. Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, they are not considered to be "shop drawings."

1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

As soon as practicable after award of contract, and before procurement or fabrication, forward to the Architect-Engineer: submittals required in the technical sections of this specification, including shop drawings, product data and samples. In addition, forward a copy of the submittals to the Remedial Project Manager.

1.4.1 O&M Data

Submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver O&M data within the time limits specified, the Remedial Project Manager may withhold from progress payments 50 percent of the price of the items to which such O&M data apply.

1.5 PREPARATION

1.5.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to the office of the approving authority using the transmittal form prescribed by the Remedial Project Managerr. Include all information prescribed by the transmittal form and required in paragraph IDENTIFYING SUBMITTALS. Use the submittal transmittal forms to record actions regarding samples.

1.5.2 Identifying Submittals

The Contractor's approving authority must prepare, review and stamp submittals, including those provided by a subcontractor, before submittal to the Government.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location

b. Construction contract number

c. Dates of the drawings and revisions

d. Name, address, and telephone number of Subcontractor, supplier, manufacturer, and any other Subcontractor associated with the submittal.

e. Section number of the specification by which submittal is required

f. Submittal description (SD) number of each component of submittal

g. For a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission

h. Product identification and location in project.

1.5.3 Submittal Format

1.5.3.1 Format of SD-01 Preconstruction Submittals

When the submittal includes a document that is to be used in the project, or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.5.3.2 Format for SD-02 Shop Drawings

Provide shop drawings not less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full-size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless another form is required. Ensure drawings are suitable for reproduction and of a quality to produce

clear, distinct lines and letters, with dark lines on a white background.

a. Include the nameplate data, size, and capacity on drawings. Also include applicable federal, military, industry, and technical society publication references.

b. Dimension drawings, except diagrams and schematic drawings. Prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Submit an electronic copy of drawings in PDF format.

1.5.3.2.1 Drawing Identification

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph IDENTIFYING SUBMITTALS.

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location next to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

1.5.3.3 Format of SD-03 Product Data

Present product data submittals for each section. Include a table of contents, listing the page and catalog item numbers for product data.

Indicate, by prominent notation, each product that is being submitted; indicate the specification section number and paragraph number to which it pertains.

1.5.3.3.1 Product Information

Supplement product data with material prepared for the project to satisfy the submittal requirements where product data does not exist. Identify this material as developed specifically for the project, with information and format as required for submission of SD-07 Certificates.

Provide product data in units used in the Contract documents. Where product data are included in preprinted catalogs with another unit, submit the dimensions in contract document units, on a separate sheet.

1.5.3.3.2 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.3.3.3 Data Submission

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal that is marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will be accepted for expedition of the construction effort.

Submit the manufacturer's instructions before installation.

1.5.3.4 Format of SD-04 Samples

1.5.3.4.1 Sample Characteristics

Furnish samples in the following sizes, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample Volume of Nonsolid Materials: Pint. Examples of nonsolid materials are sand and paint.

f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

1.5.3.4.2 Sample Incorporation

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at the time of use.

Recording of Sample Installation: Note and preserve the notation of any area constituting a sample installation, but remove the notation at the final clean-up of the project.

1.5.3.4.3 Comparison Sample

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle

of range. Mark each unit to describe its relation to the range of the variation.

When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.5.3.5 Format of SD-05 Design Data

Provide design data and certificates on 8 1/2 by 11 inch paper.

1.5.3.6 Format of SD-06 Test Reports

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.5.3.7 Format of SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inch paper.

1.5.3.8 Format of SD-08 Manufacturer's Instructions

Present manufacturer's instructions submittals for each section. Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry, and technical-society publication references. If supplemental information is needed to clarify the manufacturer's data, submit it as specified for SD-07 Certificates.

Submit the manufacturer's instructions before installation.

1.5.3.8.1 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.3.9 Format of SD-09 Manufacturer's Field Reports

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.5.3.10 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.5.3.11 Format of SD-11 Closeout Submittals

When the submittal includes a document that is to be used in the project or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.5.4 Source Drawings for Shop Drawings

1.5.4.1 Source Drawings

The entire set of source drawing files (DWG) will not be provided to the Contractor. Request the specific Drawing Number for the preparation of shop drawings. Only those drawings requested to prepare shop drawings will be provided. These drawings are provided only after award.

1.5.4.2 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse is at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim, and waives to the fullest extent permitted by law any claim or cause of action of any nature against the Government, its agents, or its subconsultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities, or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic source drawing files are not construction documents. Differences may exist between the source drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic source drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. The Contractor is responsible for determining if any conflict exists. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished source drawing files, the signed and sealed construction documents govern. Use of these source drawing files does not relieve the Contractor of the duty to fully comply with the contract documents, including and without limitation the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indication of ownership (seals, logos, signatures, initials and dates).

1.5.5 Electronic File Format

Provide submittals in electronic format, with the exception of material samples required for SD-04 Samples items. Compile the submittal file as a single, complete document, to include the Transmittal Form described within. Name the electronic submittal file specifically according to its contents, and coordinate the file naming convention with the Remedial Project Manager. Electronic files must be of sufficient quality that all

information is legible. Use PDF as the electronic format, unless otherwise specified or directed by the Remedial Project Manager. Generate PDF files from original documents with bookmarks so that the text included in the PDF file is searchable and can be copied. If documents are scanned, optical character resolution (OCR) routines are required. Index and bookmark files exceeding 30 pages to allow efficient navigation of the file. When required, the electronic file must include a valid electronic signature or a scan of a signature.

E-mail electronic submittal documents smaller than 10MB to an e-mail address as directed by the Remedial Project Manager. Provide electronic documents over 10 MB on an optical disc or through an electronic file sharing system.

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of SD-01 Preconstruction Submittal Copies

Unless otherwise specified, submit four sets of administrative submittals.

1.6.2 Number of SD-04 Samples

a. Submit two samples, or two sets of samples showing the range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in the technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of nonsolid materials.

1.7 INFORMATION ONLY SUBMITTALS

Submittals without a "G" designation must be certified by the QC manager and submitted to the Remedial Project Manager for information-only. Approval of the Remedial Project Manager is not required on information only submittals. The Remedial Project Manager will mark "receipt acknowledged" on submittals for information and will return only the transmittal cover sheet to the Contractor. Normally, submittals for information only will not be returned. However, the Government reserves the right to return unsatisfactory submittals and require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Remedial Project Manager from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.8 PROJECT SUBMITTAL REGISTER

A sample Project Submittal Register showing items of equipment and materials for when submittals are required by the specifications is provided as "Appendix A - Submittal Register."

1.8.1 Submittal Management

Prepare and maintain a submittal register, as the work progresses. Do not change data that is output in columns (c), (d), (e), and (f) as delivered by Government; retain data that is output in columns (a), (g), (h), and (i) as approved. As an attachment, provide a submittal register showing items of equipment and materials for which submittals are required by the specifications. This list may not be all-inclusive and additional submittals may be required.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD Number. and type, e.g., SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in each specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting the project requirements.

Column (f): Lists the approving authority for each submittal. Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns and all dates on which submittals are received by and returned by the Government.

1.8.2 Preconstruction Use of Submittal Register

Submit the submittal register. Include the QC plan and the project schedule. Verify that all submittals required for the project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for the approving authority to receive submittals.

Column (h) Contractor Approval Date: Date that Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.8.3 Contractor Use of Submittal Register

Update the following fields with each submittal throughout the contract.

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) Date submittal transmitted.

Column (q) Date approval was received.

1.8.4 Approving Authority Use of Submittal Register

Update the following fields:

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (l) Date submittal was received.

Column (m) through (p) Dates of review actions.

Column (q) Date of return to Contractor.

1.8.5 Action Codes

1.8.5.1 Government Review Action Codes

"A" - "Approved as submitted"

"AN" - "Approved as noted"

"RR" - "Disapproved as submitted"; "Completed"

"NR" - "Not Reviewed"

"RA" - "Receipt Acknowledged"

1.8.6 Delivery of Copies

Submit an updated electronic copy of the submittal register to the Remedial Project Manager with each invoice request. Provide an updated Submittal Register monthly regardless of whether an invoice is submitted.

1.9 VARIATIONS

Variations from contract requirements require Remedial Project Manager approval pursuant to contract Clause FAR 52.236-21 Specifications and Drawings for Construction, and will be considered where advantageous to the Government.

1.9.1 Considering Variations

Discussion of variations with the Remedial Project Manager and Engineer before submission will help ensure that functional and quality requirements are met and minimize rejections and resubmittals. When contemplating a variation that results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out variations may cause the Government to require rejection and removal of such work at no additional cost to the Government.

1.9.2 Proposing Variations

When proposing variation, deliver a written request to the Remedial

Project Manager, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. Include the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.9.3 Warranting that Variations are Compatible

When delivering a variation for approval, the Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.9.4 Review Schedule Extension

In addition to the normal submittal review period, a period of 14 working days will be allowed for the Government to consider submittals with variations.

1.10 SCHEDULING

Schedule and submit concurrently product data and shop drawings covering component items forming a system or items that are interrelated. Submit pertinent certifications at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. The Contractor is responsible for additional time required for Government reviews resulting from required resubmittals. The review period for each resubmittal is the same as for the initial submittal.

b. Submittals required by the contract documents are listed on the submittal register. If a submittal is listed in the submittal register but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Remedial Project Manager does not relieve the Contractor of supplying submittals required by the contract documents but that have been omitted from the register or marked "N/A."

c. Resubmit the submittal register and annotate it monthly with actual submission and approval dates. When all items on the register have been fully approved, no further resubmittal is required. Remedial Project Manager review will be completed within 35 working days after the date of submission.

d. Except as specified otherwise, allow a review period, beginning with receipt by the approving authority, that includes at least 15 working days for submittals for QC manager approval and 20 working days for submittals where the Remedial Project Manager is the approving authority. The period of review for submittals with Remedial Project Manager approval begins when the Government receives the submittal from the QC organization.

e. For submittals requiring review by a Government fire protection engineer, allow a review period, beginning when the Government

receives the submittal from the QC organization, of 30 working days for return of the submittal to the Contractor.

1.10.1 Reviewing, Certifying, and Approving Authority

The QC Manager is responsible for reviewing all submittals and certifying that they are in compliance with contract requirements. The approving authority on submittals is the QC Manager unless otherwise specified. At each "Submittal" paragraph in individual specification sections, a notation "G" following a submittal item indicates that the Remedial Project Manager is the approving authority for that submittal item. Provide an additional copy of the submittal to the Government Approving authority

1.10.2 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of the work. At the same time, submit components of definable features that are interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of the assembly in which the item functions.

1.10.3 QC Organization Responsibilities

a. Review submittals for conformance with project design concepts and compliance with contract documents.

b. Process submittals based on the approving authority indicated in the submittal register.

(1) When the QC manager is the approving authority, take appropriate action on the submittal from the possible actions defined in paragraph APPROVED SUBMITTALS.

(2) When the CRemedial Project Manager is the approving authority or when variation has been proposed, forward the submittal to the Government, along with a certifying statement, or return the submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of the submittal determines the appropriate action.

c. Ensure that material is clearly legible.

d. Stamp each sheet of each submittal with a QC certifying statement or an approving statement, except that data submitted in a bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When the approving authority is the Remedial Project Manager, the QC organization will certify submittals forwarded to the Remedial Project Manager with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number (_____) is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC Manager _____, Date _____"
(Signature)

(2) When approving authority is the QC manager, the QC manager will use the following approval statement when returning submittals to the Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with Contract Number (_____) is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC Manager _____, Date _____"
(Signature)

e. Sign the certifying statement or approval statement. The QC organization member designated in the approved QC plan is the person signing certifying statements. The use of original ink for signatures is required. Stamped signatures are not acceptable.

f. Update the submittal register as submittal actions occur, and maintain the submittal register at the project site until final acceptance of all work by the Remedial Project Manager.

g. Retain a copy of approved submittals and approved samples at the project site.

h. For "S" submittals, provide a copy of the approved submittal to the Government Approving authority.

1.11 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Remedial Project Manager, the Government will:

a. Note the date on which the submittal was received from the QC manager.

b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph REVIEW NOTATIONS and with comments and markings appropriate for the action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date submittals. 2 copies of the submittal will be retained by the Remedial Project Manager and 2 copies of the submittal will be returned to the Contractor.

1.11.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize proceeding with the work covered.

b. Submittals marked "approved as noted" or "approved, except as noted, resubmittal not required," authorize proceeding with the work covered provided that the Contractor takes no exception to the corrections.

c. Submittals marked "not approved," "disapproved," or "revise and resubmit" indicate incomplete submittal or noncompliance with the contract requirements or design concept. Resubmit with appropriate changes. Do not proceed with work for this item until the resubmittal is approved.

d. Submittals marked "not reviewed" indicate that the submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

e. Submittals marked "receipt acknowledged" indicate that submittals have been received by the Government. This applies only to "information-only submittals" as previously defined.

1.12 DISAPPROVED SUBMITTALS

Make corrections required by the Remedial Project Manager and/or Engineer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, give notice to the Remedial Project Manager as required under the FAR clause titled CHANGES. The Contractor is responsible for the dimensions and design of connection details and the construction of work. Failure to point out variations may cause the Government to require rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and resubmit in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.13 APPROVED SUBMITTALS

The Remedial Project Manager's approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.

Approval or acceptance by the Government for a submittal does not relieve the Contractor of the responsibility for meeting the contract requirements

or for any error that may exist, because under the Quality Control (QC) requirements of this contract, the Contractor is responsible for ensuring information contained with in each submittal accurately conforms with the requirements of the contract documents.

After submittals have been approved or accepted by the Remedial Project Manager, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, provide assurance that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those that may be damaged in testing, will be returned to the Contractor, at its expense, upon completion of the contract. Unapproved samples will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make as that material. The Government reserves the right to disapprove any material or equipment that has previously proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Remedial Project Manager and/or Engineer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Replace such materials or equipment to meet contract requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.3	(2016) Tower Cranes
ASME B30.5	(2018) Mobile and Locomotive Cranes
ASME B30.8	(2015) Floating Cranes and Floating Derricks
ASME B30.9	(2018) Slings
ASME B30.20	(2018) Below-the-Hook Lifting Devices
ASME B30.22	(2016) Articulating Boom Cranes
ASME B30.26	(2015; INT Jun 2010 - Jun 2014) Rigging Hardware

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSP Z359.0	(2012) Definitions and Nomenclature Used for Fall Protection and Fall Arrest
ASSP Z359.1	(2016) The Fall Protection Code
ASSP Z359.2	(2017) Minimum Requirements for a Comprehensive Managed Fall Protection Program
ASSP Z359.3	(2017) Safety Requirements for Lanyards and Positioning Lanyards
ASSP Z359.4	(2013) Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components
ASSP Z359.6	(2016) Specifications and Design Requirements for Active Fall Protection Systems
ASSP Z359.7	(2011) Qualification and Verification Testing of Fall Protection Products

ASSP Z359.11	(2014) Safety Requirements for Full Body Harnesses
ASSP Z359.12	(2009) Connecting Components for Personal Fall Arrest Systems
ASSP Z359.13	(2013) Personal Energy Absorbers and Energy Absorbing Lanyards
ASSP Z359.14	(2014) Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems
ASSP Z359.15	(2014) Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems
ASSP Z359.16	(2016) Safety Requirements for Climbing Ladder Fall Arrest Systems
ASSP Z359.18	(2017) Safety Requirements for Anchorage Connectors for Active Fall Protection Systems

ASTM INTERNATIONAL (ASTM)

ASTM F855	(2015) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048	(2003) Guide for Protective Grounding of Power Lines
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA Z535.2	(2011) Environmental and Facility Safety Signs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2018; TIA 18-1) Standard for Portable Fire Extinguishers
NFPA 51B	(2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code
NFPA 70E	(2018; TIA 18-1; TIA 81-2) Standard for Electrical Safety in the Workplace

NFPA 241	(2019) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 306	(2019) Standard for the Control of Gas Hazards on Vessels

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.147	The Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.450	Scaffolds
29 CFR 1926.500	Fall Protection
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

1.2.1 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures with regards to such hazards.

1.2.2 Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA’s Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.3 Competent Person, Cranes and Rigging

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.4 Competent Person, Excavation/Trenching

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.5 Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSP Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.6 Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q, and designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and also has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented and include experience on the specific scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented, minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

1.2.7 Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the training material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The

training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

1.2.8 High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry.

1.2.9 High Visibility Accident

A High Visibility Accident is any mishap which may generate publicity or high visibility.

1.2.10 Load Handling Equipment (LHE)

LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

1.2.11 Medical Treatment

Medical Treatment is treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even when provided by a physician or registered personnel.

1.2.12 Near Miss

A Near Miss is a mishap resulting in no personal injury and zero property damage, but given a shift in time or position, damage or injury may have occurred (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.2.13 Operating Envelope

The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane, the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.2.14 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.2.15 Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the definition requirements of EM 385-1-1 Appendix Q, and ASSP Z359.2 standard, having a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of

designing, analyzing, and evaluating and specifying fall protection and rescue systems.

1.2.16 USACE Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.2.17 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

A LHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents, even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, or roll over). Document an LHE mishap or accident using the NAVFAC prescribed Navy Crane Center (NCC) accident form.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

SD-06 Test Reports

Monthly Exposure Reports

Notifications and Reports

Accident Reports; G

SD-07 Certificates

Contractor Safety Self-Evaluation Checklist

Crane Operators/Riggers

Standard Lift Plan; G

Activity Hazard Analysis (AHA)

Certificate of Compliance

1.4 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the voucher.

1.5 CONTRACTOR SAFETY SELF-EVALUATION CHECKLIST

Remedial Project Manager will provide a "Contractor Safety Self-Evaluation checklist" to the Contractor at the pre-construction conference. Complete the checklist monthly and submit with each request for payment voucher. An acceptable score of 90 or greater is required. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90 may result in retention of up to 10 percent of the voucher. The Contractor Safety Self-Evaluation checklist can be found on the Whole Building Design Guide website at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-35-2

1.6 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, and the following federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6.1 Federal Regulations

1. Conduct all site work in accordance with PL 91-596 and 29 CFR 1910.120, including hazardous waste cleanup or chemical spills.

2. Identify all hazardous wastes in accordance with PL 94-850/98-616 and 40 CFR 261.

3. Manage all hazardous wastes in accordance with PL 94-850/98-616, 40 CFR 260, and 40 CFR 262.

4. Transport all hazardous wastes in accordance with PL94-850/98-616, 40 CFR 263, and 49 CFR 172 through 49 CFR 179.

5. Dispose of all hazardous wastes at off-site facilities which are in compliance with PL 94-850/98-616, 40 CFR 264, 40 CFR 265, and 40 CFR 270.

1.6.2 State Regulations

1. All Contractor activities within the State of New York boundaries shall be in compliance with New York State labor laws.

2. Transportation and disposal of non-hazardous wastes must comply with all State Solid Waste Management Program. Transporters must carry a State Waste Transporter Permit.

3. Transportation of wastes through states other than New York shall be in compliance with all applicable requirements of those states.

4. Hazardous waste treatment and disposal facilities shall be in compliance with all requirements of the state in which they are operated.

1.6.3 Local Requirements

1. Ascertain and comply with all applicable county and municipal ordinances, codes, rules and regulations, and obtain all required permits including building permits, building inspections, public health requirements, and seasonal load limits which may be imposed to cover transportation on certain roads.

1.6.4 Subcontractor Safety Requirements

For this contract, neither Contractor nor any subcontractor may enter into contract with any subcontractor that fails to meet the following requirements. The term subcontractor in this and the following paragraphs means any entity holding a contract with the Contractor or with a subcontractor at any tier.

1.6.4.1 Experience Modification Rate (EMR)

Subcontractors on this contract must have an effective EMR less than or equal to 1.10, as computed by the National Council on Compensation Insurance (NCCI) or if not available, as computed by the state agency's rating bureau in the state where the subcontractor is registered, when entering into a subcontract agreement with the Prime Contractor or a subcontractor at any tier. The Prime Contractor may submit a written request for additional consideration to the Remedial Project Manager where the specified acceptable EMR range cannot be achieved. Relaxation of the EMR range will only be considered for approval on a case-by-case basis for special conditions and must not be anticipated as tacit approval. Contractor's Site Safety and Health Officer (SSHO) must collect and maintain the certified EMR ratings for all subcontractors on the project and make them available to the Government at the Government's request.

1.6.4.2 OSHA Days Away from Work, Restricted Duty, or Job Transfer (DART) Rate

Subcontractors on this contract must have a DART rate, calculated from the most recent, complete calendar year, less than or equal to 3.4 when entering into a subcontract agreement with the Prime Contractor or a subcontractor at any tier. The OSHA Dart Rate is calculated using the following formula:

(N/EH) x 200,000

where:

N = number of injuries and illnesses with days away, restricted work, or job transfer

EH = total hours worked by all employees during most recent, complete calendar year

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year)

The Prime Contractor may submit a written request for additional consideration to the Remedial Project Manager where the specified acceptable OSHA Dart rate range cannot be achieved for a particular subcontractor. Relaxation of the OSHA DART rate range will only be considered for approval on a case-by-case basis for special conditions and must not be anticipated as tacit approval. Contractor's Site Safety and Health Officer (SSHO) must collect and maintain self-certified OSHA DART rates for all subcontractors on the project and make them available to the Government at the Government's request.

1.7 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.7.1 Personnel Qualifications

1.7.1.1 Site Safety and Health Officer (SSHO)

Provide an SSHO that meets the requirements of EM 385-1-1 Section 1. The SSHO must ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Alternate SSHO must be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO and Alternate SSHO must have the required training, experience, and qualifications in accordance with EM 385-1-1 Section 01.A.17, and all associated sub-paragraphs.

If the SSHO is off-site for a period longer than 24 hours, an equally-qualified alternate SSHO must be provided and must fulfill the same roles and responsibilities as the primary SSHO. When the SSHO is temporarily (up to 24 hours) off-site, a Designated Representative (DR), as identified in the AHA may be used in lieu of an Alternate SSHO, and must be on the project site at all times when work is being performed. Note that the DR is a collateral duty safety position, with safety duties in addition to their full time occupation.

1.7.1.1.1 Additional Site Safety and Health Officer (SSHO) Requirements and Duties

The SSHO may also serve as the Quality Control Manager. The SSHO may not serve as the Superintendent.

1.7.1.2 Competent Person Qualifications

Provide Competent Persons in accordance with EM 385-1-1, Appendix Q and herein. Competent Persons for high risk activities include confined space, cranes and rigging, excavation/trenching, fall protection, and electrical work. The CP for these activities must be designated in writing, and meet the requirements for the specific activity (i.e. competent person, fall protection).

The Competent Person identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Remedial Project Manager for information in consultation with the Safety Office.

1.7.1.2.1 Competent Person for Confined Space Entry

Provide a Confined Space (CP) Competent Person who meets the requirements of EM 385-1-1, Appendix Q, and herein. The CP for Confined Space Entry must supervise the entry into each confined space in accordance with EM 385-1-1, Section 34.

Since this work involves operations that handle combustible or hazardous materials, this person must have the ability to understand and follow through on the air sampling, Personal Protective Equipment (PPE), and instructions of a Marine Chemist, Coast Guard authorized persons, or Certified Industrial Hygienist. Confined space and enclosed space work must comply with NFPA 306, OSHA 29 CFR 1915, Subpart B, "Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment," or as applicable, 29 CFR 1910.147 for general industry.

1.7.1.2.2 Competent Person for Scaffolding

Provide a Competent Person for Scaffolding who meets the requirements of EM 385-1-1, Section 22.B.02 and herein.

1.7.1.2.3 Competent Person for Fall Protection

Provide a Competent Person for Fall Protection who meets the requirements of EM 385-1-1, Section 21.C.04, 21.B.03, and herein.

1.7.1.3 Qualified Trainer Requirements

Individuals qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the following subject areas: EM 385-1-1, Electrical Standards,Lockout/Tagout, Fall Protection, Confined Space Entry for Construction; Excavation, Trenching and Soil Mechanics, and Scaffolds in accordance with 29 CFR 1926.450, Subpart L.

Instructors are required to:

a. Prepare class presentations that cover construction-related safety requirements.

b. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five (5) years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.

c. Update training course materials whenever an update of the EM 385-1-1 becomes available.

d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.

e. Request, review and incorporate student feedback into a continuous course improvement program.

1.7.1.4 Crane Operators/Riggers

Provide Operators, Signal Persons, and Riggers meeting the requirements in EM 385-1-1, Section 15.B for Riggers and Section 16.B for Crane Operators and Signal Persons. Provide proof of current qualification.

1.7.2 Personnel Duties

1.7.2.1 Duties of the Site Safety and Health Officer (SSHO)

The SSHO must:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.

b. Conduct mishap investigations and complete required accident reports. Report mishaps and near misses.

c. Use and maintain OSHA's Form 300 to log work-related injuries and illnesses occurring on the project site for Prime Contractors and subcontractors, and make available to the Remedial Project Manager upon request. Post and maintain the Form 300A on the site Safety Bulletin Board.

d. Maintain applicable safety reference material on the job site.

e. Attend the pre-construction conference, pre-work meetings including preparatory meetings, and periodic in-progress meetings.

f. Review the APP and AHAs for compliance with EM 385-1-1, and approve, sign, implement and enforce them.

g. Establish a Safety and Occupational Health (SOH) Deficiency Tracking System that lists and monitors outstanding deficiencies until resolution.

h. Ensure subcontractor compliance with safety and health requirements.

i. Maintain a list of hazardous chemicals on site and their material Safety Data Sheets (SDS).

j. Maintain a weekly list of high hazard activities involving energy, equipment, excavation, entry into confined space, and elevation, and be prepared to discuss details during QC Meetings.

k. Provide and keep a record of site safety orientation and indoctrination for Contractor employees, subcontractor employees, and site visitors.

Superintendent, QC Manager, and SSHO are subject to dismissal if the above duties are not being effectively carried out. If Superintendent, QC Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.7.3 Meetings

1.7.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the preconstruction conference. This includes the project superintendent, Site Safety and Occupational Health officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Remedial Project Manager as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and Government review of AHAs to preclude project delays.

c. Deficiencies in the submitted APP, identified during the Remedial Project Manager's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Work is not permitted to begin until an APP is established that is acceptable to the Remedial Project Manager.

1.7.3.2 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location. The SSHO, supervisors, foremen, or CDSOs must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Remedial Project Manager on request. Notify the Remedial Project Manager of all scheduled meetings 7 calendar days in advance.

1.8 ACCIDENT PREVENTION PLAN (APP)

A qualified person must prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of EM 385-1-1, Appendix A, and as supplemented herein. Cover all paragraph and subparagraph elements in EM 385-1-1, Appendix A. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and health program referenced in the APP in the applicable APP element, and made site-specific. Describe the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices of subcontractors. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to

prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed by an officer of the firm (Prime Contractor senior person), the individual preparing the APP, the on-site superintendent, the designated SSHO, the Contractor Quality Control Manager, and any designated Certified Safety Professional (CSP) or Certified Health Physicist (CIH). The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the Remedial Project Manager. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the Remedial Project Manager 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the Remedial Project Manager, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP is cause for stopping of work, at the discretion of the Remedial Project Manager, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the contract. Changes to the accepted APP must be made with the knowledge and concurrence of the Remedial Project Manager, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e. imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Remedial Project Manager within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSP A10.34), and the environment.

1.8.1 Names and Qualifications

Provide plans in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance.

1.8.2 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.8.2.1 Confined Space Entry Plan

Develop a confined or enclosed space entry plan in accordance with EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

1.8.2.2 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-2 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of 3 months.

1.8.2.3 Multi-Purpose Machines, Material Handling Equipment, and Construction Equipment Lift Plan

Multi-purpose machines, material handling equipment, and construction equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Written approval from a qualified registered professional engineer, after a safety analysis is performed, is allowed in lieu of the OEM's approval. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart.

1.8.2.4 Fall Protection and Prevention (FP&P) Plan

The plan must comply with the requirements of EM 385-1-1, Section 21.D and ASSP Z359.2, be site specific, and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A competent person or qualified person for fall protection must prepare and sign the plan documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum every six months, for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.8.2.5 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section

21.N and ASSP Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.8.2.6 Excavation Plan

Identify the safety and health aspects of excavation, and provide and prepare the plan in accordance with EM 385-1-1, Section 25.A and Section 31 23 00.00 20 Excavation and Fill.

1.8.2.7 Site Safety and Health Plan

Identify the safety and health aspects, and prepare in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

1.9 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Remedial Project Manager. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with EM 385-1-1, Section 1 or as directed by the Remedial Project Manager. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, fall protection, and scaffolding.

1.9.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

1.9.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

1.10 DISPLAY OF SAFETY INFORMATION

1.10.1 Safety Bulletin Board

Within one calendar day(s) after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Remedial Project Manager, that is accessible and includes all mandatory information for employee and visitor review, may be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, Section 01.A.07. Additional items required to be posted include:

1.10.2 Safety and Occupational Health (SOH) Deficiency Tracking System

Establish a SOH deficiency tracking system that lists and monitors the status of SOH deficiencies in chronological order. Use the tracking system to evaluate the effectiveness of the APP. A monthly evaluation of the data must be discussed in the QC or SOH meeting with everyone on the project. The list must be posted on the project bulletin board and updated daily, and provide the following information:

a. Date deficiency identified;

b. Description of deficiency;

c. Name of person responsible for correcting deficiency;

d. Projected resolution date;

e. Date actually resolved.

1.11 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.12 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment in accordance with EM 385-1-1. Government has no responsibility to provide emergency medical treatment.

1.13 NOTIFICATIONS and REPORTS

1.13.1 Mishap Notification

Notify the Remedial Project Manager as soon as practical, but no more than twenty-four hours, after any mishaps, including recordable accidents, incidents, and near misses, as defined in EM 385-1-1 Appendix Q, any report of injury, illness, or any property damage. For LHE or rigging mishaps, notify the Remedial Project Manager as soon as practical but not more than 4 hours after mishap. The Contractor is responsible for obtaining appropriate medical and emergency assistance and for notifying fire, law enforcement, and regulatory agencies. Immediate reporting is required for electrical mishaps, to include Arc Flash; shock; uncontrolled release of hazardous energy (includes electrical and non-electrical); load handling equipment or rigging; fall from height (any level other than same

surface); and underwater diving. These mishaps must be investigated in depth to identify all causes and to recommend hazard control measures.

Within notification include Contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any mishap.

1.13.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS). Complete and submit an accident investigation report in ESAMS within 5 days for mishaps defined in EM 385-1-1 01.D.03 and 10 days for accidents defined by EM 385-1-1 01.D.05. Complete an investigation report within 30 days for those mishaps defined by EM 385-1-1 01.D.04. Mishaps defined by EM 385-1-1 01.D.04 and 01.D.05 must include a written report submitted as an attachment in ESAMS using the following outline: (1) Mishap summary description to include process, findings and outcomes; (2) Root Cause; (3) Direct Factors; (4) Indirect and Contributing Factors; (5) Corrective Actions; and (6) Recommendations. The Remedial Project Manager will provide copies of any required or special forms.

b. Near Misses: For Navy Projects, complete the applicable documentation in NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS). Near miss reports are considered positive and proactive Contractor safety management actions.

c. Conduct an accident investigation for any load handling equipment accident (including rigging accidents) to establish the root cause(s) of the accident. Complete the LHE Accident Report (Crane and Rigging Accident Report) form and provide the report to the Remedial Project Manager within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the Remedial Project Manager. The Remedial Project Manager will provide a blank copy of the accident report form.

1.13.3 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a FORM 16-1 Certificate of Compliance for LHE entering an activity under this contract and in accordance with EM 385-1-1. Post certifications on the crane.

Develop a Standard Lift Plan (SLP) in accordance with EM 385-1-1, Section 16.H.03 using Form 16-2 Standard Pre-Lift Crane Plan/Checklist for each lift planned. Submit SLP to the Remedial Project Manager for approval within 15 calendar days in advance of planned lift.

1.14 HOT WORK

1.14.1 Permit and Personnel Requirements

Submit and obtain a written permit prior to performing "Hot Work" (i.e. welding or cutting) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two 20 pound 4A:20 BC rated extinguishers for normal "Hot Work". The extinguishers must be current inspection tagged, and contain an approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch must be trained in accordance with NFPA 51B and remain on-site for a minimum of one hour after completion of the task.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. REPORT ANY FIRE, NO MATTER HOW SMALL, TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

1.14.2 Work Around Flammable Materials

Obtain permit approval from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems or welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, or vaults) that have the potential for flammable or explosive atmospheres.

Whenever these materials, except beryllium and chromium (VI), are encountered in indoor operations, local mechanical exhaust ventilation systems that are sufficient to reduce and maintain personal exposures to within acceptable limits must be used and maintained in accordance with manufacturer's instruction and supplemented by exceptions noted in EM 385-1-1, Section 06.H

1.15 CONFINED SPACE ENTRY REQUIREMENTS

Confined space entry must comply with Section 34 of EM 385-1-1, OSHA 29 CFR 1926, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, and OSHA Directive CPL 2.100. Any potential for a hazard in the confined space requires a permit system to be used.

1.15.1 Entry Procedures

Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. Comply with EM 385-1-1, Section 34 for entry procedures. Hazards pertaining to the space must be reviewed with each employee during review of the AHA.

1.15.2 Rescue Procedures and Coordination with Local Emergency Responders

Develop and implement an on-site rescue and recovery plan and procedures. The rescue plan must not rely on local emergency responders for rescue

from a confined space.

1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs for confined spaces must comply with NEMA Z535.2. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" must be red and readable from 5 feet.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

a. Hard Hat

b. Long Pants

c. Appropriate Safety Shoes

d. Appropriate Class Reflective Vests

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. An employee check-in/check-out communication procedure must be developed to ensure employee safety.

3.1.2 Hazardous Material Use

Each hazardous material must receive approval from the Contracting Office or their designated representative prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.3 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The Remedial Project Manager, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Remedial Project Manager approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.4 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, stop that portion of work and notify the Remedial Project Manager immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to FAR 52.243-4 Changes and FAR 52.236-2 Differing Site Conditions.

3.2 UTILITY OUTAGE REQUIREMENTS

Apply for utility outages at least 7 days in advance. At a minimum, the written request must include the location of the outage, utilities being affected, duration of outage, any necessary sketches, and a description of the means to fulfill energy isolation requirements in accordance with EM 385-1-1, Section 11.A.02 (Isolation). Some examples of energy isolation devices and procedures are highlighted in EM 385-1-1, Section 12.D. In accordance with EM 385-1-1, Section 12.A.01, where outages involve Government or Utility personnel, coordinate with the Government on all activities involving the control of hazardous energy.

These activities include, but are not limited to, a review of HECP and HEC procedures, as well as applicable Activity Hazard Analyses (AHAs). In accordance with EM 385-1-1, Section 11.A.02 and NFPA 70E, work on energized electrical circuits must not be performed without prior government authorization. Government permission is considered through the permit process and submission of a detailed AHA. Energized work permits are considered only when de-energizing introduces additional or increased

hazard or when de-energizing is infeasible.

3.3 OUTAGE COORDINATION MEETING

After the utility outage request is approved and prior to beginning work on the utility system requiring shut-down, conduct a pre-outage coordination meeting in accordance with EM 385-1-1, Section 12.A. This meeting must include the Prime Contractor, the Prime and subcontractors performing the work, the Remedial Project Manager, and the Installation representative. All parties must fully coordinate HEC activities with one another. During the coordination meeting, all parties must discuss and coordinate on the scope of work, HEC procedures (specifically, the lock-out/tag-out procedures for worker and utility protection), the AHA, assurance of trade personnel qualifications, identification of competent persons, and compliance with HECP training in accordance with EM 385-1-1, Section 12.C. Clarify when personal protective equipment is required during switching operations, inspection, and verification.

3.4 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSP Z359.2 and EM 385-1-1, Sections 21.A and 21.D.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Protection Program, provide training for each employee who might be exposed to fall hazards and using personal fall protection equipment. Provide training by a competent person for fall protection in accordance with EM 385-1-1, Section 21.C. Document training and practical application of the competent person in accordance with EM 385-1-1, Section 21.C.04 and ASSP Z359.2 in the AHA.

3.4.2 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21.

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 Section 21.I, 29 CFR 1926.500 Subpart M,ASSP Z359.0, ASSP Z359.1, ASSP Z359.2, ASSP Z359.3, ASSP Z359.4, ASSP Z359.6, ASSP Z359.7, ASSP Z359.11, ASSP Z359.12, ASSP Z359.13, ASSP Z359.14, ASSP Z359.15, ASSP Z359.16 and ASSP Z359.18.

3.4.2.1 Additional Personal Fall Protection Measures

In addition to the required fall protection systems, other protective measures such as safety skiffs, personal floatation devices, and life rings, are required when working above or next to water in accordance with EM 385-1-1, Sections 21.O through 21.O.06. Personal fall protection systems and equipment are required when working from an articulating or

extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

3.4.2.2 Personal Fall Protection Equipment

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabineers must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. All full body harnesses must be equipped with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with EM 385-1-1, Section 21.I.06.

3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet from unprotected edge of a roof having a slope less than or equal to 4:12 (vertical to horizontal), protect personnel from falling by the use of conventional fall protection systems (personal fall arrest/restraint systems, guardrails, or safety nets) in accordance with EM 385-1-1, Section 21 and 29 CFR 1926.500. A safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 6 feet from the unprotected roof edge, addition to the use of conventional fall protection systems the use of a warning line system is also permitted, in accordance with 29 CFR 1926.500 and EM 385-1-1, Section 21.L.

b. Steep-Sloped Roofs: Work on a roof having a slope greater than 4:12 (vertical to horizontal) requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also applies to residential or housing type construction.

3.4.4 Horizontal Lifelines (HLL)

Provide HLL in accordance with EM 385-1-1, Section 21.I.08.d.2. Commercially manufactured horizontal lifelines (HLL) must be designed, installed, certified and used, under the supervision of a qualified person, for fall protection as part of a complete fall arrest system which

maintains a safety factor of 2 (29 CFR 1926.500). The competent person for fall protection may (if deemed appropriate by the qualified person) supervise the assembly, disassembly, use and inspection of the HLL system under the direction of the qualified person. Locally manufactured HLLs are not acceptable unless they are custom designed for limited or site specific applications by a Registered Professional Engineer who is qualified in designing HLL systems.

3.4.5 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must comply with the requirements of EM 385-1-1, ASSP Z359.2, and ASSP Z359.4.

3.5 WORK PLATFORMS

3.5.1 Scaffolding

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Comply with the following requirements:

a. Scaffold platforms greater than 20 feet in height must be accessed by use of a scaffold stair system.

b. Ladders commonly provided by scaffold system manufacturers are prohibited for accessing scaffold platforms greater than 20 feet maximum in height.

c. An adequate gate is required.

d. Employees performing scaffold erection and dismantling must be qualified.

e. Scaffold must be capable of supporting at least four times the maximum intended load, and provide appropriate fall protection as delineated in the accepted fall protection and prevention plan.

f. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.

g. Special care must be given to ensure scaffold systems are not overloaded.

h. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited. The first tie-in must be at the height equal to 4 times the width of the smallest dimension of the scaffold base.

i. Scaffolding other than suspended types must bear on base plates upon wood mudsills (2 in x 10 in x 8 in minimum) or other adequate firm

foundation.

j. Scaffold or work platform erectors must have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 6 feet.

k. Delineate fall protection requirements when working above 6 feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6 EQUIPMENT

3.6.1 Material Handling Equipment (MHE)

a. Material handling equipment such as forklifts must not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions. Material handling equipment fitted with personnel work platform attachments are prohibited from traveling or positioning while personnel are working on the platform.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions. Material Handling Equipment Operators must be trained in accordance with OSHA 29 CFR 1910, Subpart N.

c. Operators of forklifts or power industrial trucks must be licensed in accordance with OSHA.

3.6.2 Load Handling Equipment (LHE)

The following requirements apply. In exception, these requirements do not apply to commercial truck mounted and articulating boom cranes used solely to deliver material and supplies (not prefabricated components, structural steel, or components of a systems-engineered metal building) where the lift consists of moving materials and supplies from a truck or trailer to the ground; to cranes installed on mechanics trucks that are used solely in the repair of shore-based equipment; to crane that enter the activity but are not used for lifting; nor to other machines not used to lift loads suspended by rigging equipment. However, LHE accidents occurring during such operations must be reported.

a. Equip cranes and derricks as specified in EM 385-1-1, Section 16.

b. Notify the Remedial Project Manager 15 working days in advance of any LHE entering the activity, in accordance with EM 385-1-1, Section 16.A.02, so that necessary quality assurance spot checks can be coordinated. Contractor's operator must remain with the crane during the spot check. Rigging gear must comply with OSHA, ASME B30.9 Standards safety standards.

c. Comply with the LHE manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower

cranes, ASME B30.8 for floating cranes and floating derricks, ASME B30.9 for slings, ASME B30.20 for below the hook lifting devices and ASME B30.26 for rigging hardware.

e. When operating in the vicinity of overhead transmission lines, operators and riggers must be alert to this special hazard and follow the requirements of EM 385-1-1 Section 11, and ASME B30.5 or ASME B30.22 as applicable.

f. Do not use crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane. Additionally, submit a specific AHA for this work to the Remedial Project Manager. Ensure the activity and AHA are thoroughly reviewed by all involved personnel.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads, except for employees required to handle the load.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel access where accessible areas of the LHE's rotating superstructure poses a risk of striking, pinching or crushing personnel.

l. Maintain inspection records in accordance by EM 385-1-1, Section 16.D, including shift, monthly, and annual inspections, the signature of the person performing the inspection, and the serial number or other identifier of the LHE that was inspected. Records must be available for review by the Remedial Project Manager.

m. Maintain written reports of operational and load testing in accordance with EM 385-1-1, Section 16.F, listing the load test procedures used along with any repairs or alterations performed on the LHE. Reports must be available for review by the Remedial Project Manager.

n. Certify that all LHE operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. At wind speeds greater than 20 mph, the operator, rigger and lift supervisor must cease all crane operations, evaluate conditions and determine if the lift may proceed. Base the determination to proceed or not on wind calculations per the manufacturer and a reduction in LHE rated capacity if applicable. Include this maximum wind speed determination as part of the activity hazard analysis plan for that operation.

p. On mobile cranes, lifts where the load weight is greater than 90 percent of the equipment's capacity are prohibited.

3.6.3 Machinery and Mechanized Equipment

a. Proof of qualifications for operator must be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment must be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.

3.7 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.7.1 Utility Locations

Provide a third party, independent, private utility locating company to positively identify underground utilities in the work area in addition to any station locating service and coordinated with the station utility department.

3.7.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within 3 feet of the underground system.

3.7.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company must locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the Contractor from meeting this requirement.

3.8 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1, Appendix A, Sections 11 and 12.

3.8.1 Conduct of Electrical Work

As delineated in EM 385-1-1, electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be

positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147.

3.8.2 Qualifications

Electrical work must be performed by QP personnel with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with State, Local requirements applicable to where work is being performed.

3.8.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and circuit parts. Training must be administered by an electrically qualified source and documented.

3.8.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground unless otherwise noted by EM 385-1-1.

Check grounding circuits to ensure that the circuit between the ground and a grounded power conductor has a resistance low enough to permit sufficient current flow to allow the fuse or circuit breaker to interrupt the current.

3.8.5 Testing

Temporary electrical distribution systems and devices must be inspected,

tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

-- End of Section --

SECTION 01 35 29.13

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	(2014) American National Standard for Emergency Eyewash and Shower Equipment

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 85-115	(1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response

1.2 PRECONSTRUCTION SAFETY CONFERENCE

Conduct a preconstruction safety conference prior to the start of site activities and after submission of the Accident Prevention Plan/Site Safety And Health Plan (APP/SSHP). The objective of the meeting is to discuss health and safety concerns related to the impending work, discuss project health and safety organization and expectations, review and answer comments and concerns regarding the APP/SSHP or other health and safety concerns . Ensure that those individuals responsible for health and safety at the project level are available and attend this meeting.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Work Zones

SD-03 Product Data

Amendments to the APP/SSHP

Site Control Log

SSHO's Daily Inspection Logs

SD-07 Certificates

Certificate Of Worker/Visitor Acknowledgement

SD-11 Closeout Submittals

Safety And Health Phase-Out Report

1.4 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)

Develop and implement a Site Safety and Health Plan in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and attach to the Accident Prevention Plan (APP) as an appendix (APP/SSHP). Address all occupational safety and health hazards (traditional construction as well as contaminant-related hazards) associated with cleanup operations within the APP/SSHP. Cover each SSHP element in sections 28.A.01 and 33.B of EM 385-1-1 and each APP element in Appendix A of EM 385-1-1. There are overlapping elements in Section 28.A.01 and Appendix A of EM 385-1-1. SSHP appendix elements that overlap with APP elements need not be duplicated in the APP/SSHP provided each safety and occupational health (SOH) issue receives adequate attention and is documented in the APP/SSHP. The APP/SSHP is a dynamic document, subject to change as project operations/execution change. Modify the APP/SSHP to address changing and previously unidentified health and safety conditions. Ensure that the APP/SSHP is updated accordingly. Submit amendments to the APP/SSHP to the Remedial Project Manager as the APP/SSHP is updated. For long duration projects resubmit the APP/SSHP to the Remedial Project Manager annually for review. The APP/SSHP must contain all updates.

1.4.1 Acceptance and Modifications

Prior to submittal, the APP/SSHP must be signed and dated by the Safety and Health Manager and the Site Superintendent. Submit for review 10 days prior to the Preconstruction Safety Conference. Deficiencies in the APP/SSHP will be discussed at the preconstruction safety conference, and must be revised to correct the deficiencies and resubmitted for acceptance. Onsite work must not begin until the plan has been accepted. Maintain a copy of the written APP/SSHP onsite. Changes and modifications to the APP/SSHP must be made with the knowledge and concurrence of the

Safety and Health Manager, the Site Superintendent, and the Remedial Project Manager. Bring to the attention of the Safety and Health Manager, the Site Superintendent, and the Remedial Project Manager any unforeseen hazard that becomes evident during the performance of the work, through the Site Safety and Health Officer (SSHO) for resolution as soon as possible. In the interim, take necessary action to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP/SSHP is cause for stopping work until the matter has been rectified.

1.4.2 Availability

Make available the APP/SSHP in accordance with 29 CFR 1910.120, (b)(1)(v) and 29 CFR 1926.65, (b)(1)(v).

1.5 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES

Provide hazardous waste operations and emergency response organization in accordance with EM 385-1-1, Section 33.

1.5.1 Safety and Health Manager

Safety and Health Manager must be a safety professional certified by the Board of Certified Safety Professionals.

Apply the following in conjunction with the required qualifications and responsibilities stated in EM 385-1-1, Section 33.C.01.

1.5.1.1 Additional Qualifications

The Safety and Health Manager must have the following qualifications:

a. A minimum of 3 years experience in developing and implementing safety and occupational health programs at HTRW sites.

b. Documented experience in supervising professional and technician level personnel.

c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.

d. Documented experience in managing personal protective equipment (PPE) programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.

e. Working knowledge of state and Federal occupational safety and health regulations.

1.5.1.2 Responsibilities and Duties

a. Development, implementation, oversight, and enforcement of the APP/SSHP.

b. Provide onsite consultation as needed to ensure the APP/SSHP is fully implemented.

c. Conduct initial site-specific training.

d. Be present onsite during the first 3 days of remedial activities and at the startup of each new major phase of work.

e. Visit the site as needed and at least once per week for the duration of activities, to audit the effectiveness of the APP/SSHP.

f. Be available for emergencies.

g. Coordinate any modifications to the APP/SSHP with the Site Superintendent, the SSHO, and the Remedial Project Manager.

h. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.

i. Provide continued support for upgrading/downgrading of the level of personal protection.

j. Serve as a member of the quality control staff.

k. Review accident reports and results of daily inspections.

l. Sign and date the APP/SSHP prior to submittal.

1.5.2 Site Safety and Health Officer

Designate an individual and one alternateas the Site Safety and Health Officer (SSHO). Include the name, qualifications (education and training summary and documentation), and work experience of the Site Safety and Health Officer and alternate in the APP/SSHP.

The Apply the following in conjunction with the required qualifications and responsibilities stated in EM 385-1-1, Section 33.C.02.

1.5.2.1 Qualifications

The following requirements are in addition to those in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

a. A minimum of 1 year experience in implementing SOH programs at HTRW sites.

b. Meet 29 CFR 1910.120/29 CFR 1926.65 requirements for 40-hour initial and 8-hour supervisor training and, maintain 8-hour refresher training requirements.

c. Specific training in personal and respiratory protective equipment, confined space entry and in the proper use of air monitoring instruments and air sampling methods including monitoring for ionizing radiation.

d. Documented experience in construction techniques and construction safety procedures.

e. Working knowledge of Federal and state occupational SOH regulations.

1.5.2.2 Responsibilities and Duties

The following requirements are in addition to those in Section 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS.

a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the accepted APP/SSHP.

b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO can have collateral duties in addition to SOH related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer must be present for each shift and when applicable, act as the radiation safety officer (RSO) as defined in paragraph 06.F.02 of EM 385-1-1 on radioactive waste cleanup projects.

c. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

d. Have authority to ensure site compliance with specified SOH requirements, Federal, state and OSHA regulations and all aspects of the APP/SSHP including, but not limited to, activity hazard analyses, air monitoring, monitoring for ionizing radiation, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily SOH inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.

e. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

f. Consult with and coordinate any modifications to the APP/SSHP with the Safety and Health Manager, the Site Superintendent, and the Remedial Project Manager.

g. Conduct daily safety inspection and document SOH findings into the Daily Safety Inspection Log. Track noted SOH deficiencies to ensure that they are corrected.

h. Conduct accident investigations and prepare accident reports.

i. Serve as a member of the quality control staff on matters relating to SOH.

1.5.3 Additional Certified Health and Safety Support Personnel

Retain health physics support from a health physicist certified by the American Board of Health Physics to develop radiation protection requirements of the APP/SSHP and, when necessary, visit the site to help implement ionizing radiation protection requirements of the APP/SSHP.

1.5.4 Persons Certified in First Aid and CPR

At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency must be onsite at all times during site operations. They must be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens

Standard of 29 CFR 1910, Section .1030. These persons may perform other duties but must be immediately available to render first aid when needed.

1.5.5 Safety and Health Technicians

For each work crew in the exclusion zone, one person, designated as a Safety and Health technician, must perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO. They must have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and report to and be under the supervision of the SSHO.

1.6 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

Develop and implement an Emergency Response Plan, that meets the requirements of EM 385-1-1 Section 33.G, 29 CFR 1910.120 (l) and 29 CFR 1926.65 (l), as a section of the APP/SSHP. In the event of any emergency associated with remedial action, without delay, alert all onsite employees and as necessary offsite emergency responders that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the Remedial Project Manager; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Train employees that are required to respond to hazardous emergency situations to their level of responsibility according to 29 CFR 1910.120 (q) and 29 CFR 1926.65 (q) requirements. Rehearse the plan regularly as part of the overall training program for site operations. Review the plan periodically and revised as necessary to reflect new or changing site conditions or information. Provide copies of the Emergency Response Portion of the accepted APP/SSHP to the affected local emergency response agencies. Address, as a minimum, the following elements in the plan:

a. Pre-emergency planning. Coordinate with local emergency response providers during preparation of the Emergency Response Plan. At a minimum, coordinate with local fire, rescue, hazardous materials response teams, police and emergency medical providers to assure all organizations are capable and willing to respond to and provide services for on-site emergencies. Ensure the Emergency Response Plan for the site is compatible and integrated with the local fire, rescue, medical and police security services available from local emergency response planning agencies.

b. Personnel roles, lines of authority, communications for emergencies.

c. Emergency recognition and prevention.

d. Site topography, layout, and prevailing weather conditions.

e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).

f. Route maps to nearest prenotified medical facility. Site-support vehicles must be equipped with maps. At the beginning of project operations, drivers of the support vehicles must become familiar with the emergency route and the travel time required.

g. Specific procedures for decontamination and medical treatment of

injured personnel.

h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the Remedial Project Manager and their alternates).

i. Criteria for initiating community alert program, contacts, and responsibilities.

j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies must be immediately notified. In addition, verbally notify the Remedial Project Manager and the local district safety office immediately and submit a written notification within 24 hours. Include within the report the following items:

(1) Name, organization, telephone number, and location of the Contractor.

(2) Name and title of the person(s) reporting.

(3) Date and time of the incident.

(4) Location of the incident, i.e., site location, facility name.

(5) Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.

(6) Cause of the incident, if known.

(7) Casualties (fatalities, disabling injuries).

(8) Details of any existing chemical hazard or contamination.

(9) Estimated property damage, if applicable.

(10) Nature of damage, effect on contract schedule.

(11) Action taken to ensure safety and security.

(12) Other damage or injuries sustained, public or private.

k. Procedures for critique of emergency responses and follow-up.

1.7 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A copy of a certificate of worker/visitor acknowledgement must be completed and submitted for each visitor allowed to enter contamination reduction or exclusion zones, and for each employee, following the Example Certificate Of Worker/Visitor Acknowledgement at the end of this section.

1.8 INSPECTIONS

Attach to and submit with the Daily Quality Control reports the SSHO's

Daily Inspection Logs. Include with each entry the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special SOH issues and notes, and signature of preparer.

1.9 SAFETY AND HEALTH PHASE-OUT REPORT

Submit a Safety and Health Phase-Out Report in conjunction with the project close out report, prior to final acceptance of the work. Include the following minimum information :

a. Summary of the overall performance of SOH (e.g., accidents or incidents including near misses, unusual events, lessons learned).

b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities.

c. Signatures of Safety and Health Manager and SSHO.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

Comply with EM 385-1-1, 29 CFR 1926.65, 29 CFR 1910.120, OSHA requirements in 29 CFR 1910 and 29 CFR 1926 with work performed under this contract, and state specific OSHA requirements where applicable. Submit to the Remedial Project Manager for resolution matters of interpretation of standards before starting work. The most stringent requirements apply where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary.

2.2 PERSONAL PROTECTIVE EQUIPMENT

2.2.1 Site Specific PPE Program

Provide onsite personnel exposed to contaminants with appropriate personal protective equipment. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Use only respirators approved by NIOSH.

Keep protective equipment and clothing clean and well maintained. Include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, cartridge change out, and storage of PPE within the PPE section of the APP/SSHP.

2.2.2 Levels of Protection

The Safety and Health Manager must establish and evaluate as the work progresses the levels of protection for each work activity. Also establish action levels for upgrade or downgrade in levels of PPE. Describe in the SSHP the protocols and the communication network for changing the level of protection. Address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, and individual medical considerations within the PPE evaluation protocol.

2.2.3 PPE for Government Personnel

Three clean sets of personal protective equipment must be available for use by the Remedial Project Manager or official visitors. The items must be cleaned, maintained and stored and clearly marked: "FOR USE BY GOVERNMENT ONLY." Provide basic training in the use and limitations of the PPE provided.

2.3 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Maintain, as a minimum, the following items onsite and available for immediate use:

a. First aid equipment and supplies approved by the consulting physician.

b. Emergency eyewashes and showers that comply with ANSI/ISEA Z358.1.

C. Provide fire extinguishers of sufficient size and type at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.

PART 3 EXECUTION

3.1 TRAINING

In conjunction with EM 385-1-1, Section 33D, meet the training program requirements for workers performing cleanup operations and who will be exposed to contaminants.

3.1.1 General HTRW Operations Training

All Personnel performing duties with potential for exposure to onsite contaminants must meet and maintain the following 29 CFR 1910.120/ 29 CFR 1926.65 (e) training requirements:

a. 40 hours of off site HTRW instruction.

b. 3 days actual on-the-job field experience under the direct supervision of a trained, experienced supervisor.

c. 8 hours refresher training annually.

Onsite supervisors must have an additional 8 hours management and supervisor training specified in 29 CFR 1910.120/29 CFR 1926.65 (e) (4).

3.1.2 Pre-Entry Briefing

Prior to commencement of onsite field activities, all site employees must attend a site-specific SOH training session. This session will be conducted by the Safety and Health Manager and the Site Safety and Health Officer to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Thoroughly discuss procedures and contents of the accepted APP/SSHP and Sections 01.B.02 and 28.D.03 of EM 385-1-1 . Each employee must sign a training log to acknowledge attendance and understanding of the training. Notify the Remedial Project Manager at least 5 days prior to the initial site-specific training session so government personnel involved in the

project may attend.

3.1.3 Periodic Sessions

Conduct periodic onsite training by the SSHO at least weekly for personnel assigned to work at the site during the following week. Address SOH procedures, work practices, any changes in the APP/SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Convene a meeting prior to implementation of the change should an operational change affecting onsite field work be made, to explain SOH procedures. Conduct a site-specific training sessions for new personnel, visitors, and suppliers by the SSHO using the training curriculum outlines developed by the Safety and Health Manager. Each employee must sign a training log to acknowledge attendance and understanding of the training.

3.2 MEDICAL SURVEILLANCE PROGRAM

Meet all requirements of 29 CFR 1910.120/29 CFR 1926.65 medical surveillance program and EM 385-1-1, Section 33.G for workers performing cleanup operations and who will be exposed to contaminants. Ensure the Occupational Physician or the physician's designee performs the physical examinations and reviews examination results. Participation in the medical surveillance program is without cost to the employee, without loss of pay and at a reasonable time and place.

3.3 SPILL AND DISCHARGE CONTROL

Develop and implement written spill and discharge containment/control procedures. Address radioactive wastes, shock sensitive wastes, laboratory waste packs, material handling equipment, as well as drum and container handling, opening, sampling, shipping and transport. Describe prevention measures, such as building berms or dikes; spill control measures and material to be used (e.g. booms, vermiculite); location of the spill control material; personal protective equipment required to cleanup spills; disposal of contaminated material; and who is responsible to report the spill. Storage of contaminated material or hazardous materials must be appropriately bermed, diked and contained to prevent any spillage of material on uncontaminated soil. If the spill or discharge is reportable, or human health or the environment are threatened, notify the National Response Center, the state, and the Remedial Project Manager as soon as possible. Provide control as required by Section 01 57 19 TEMPORARY ENVIRONMENT CONTROLS.

3.4 SITE CONTROL MEASURES

Coordinate site control measures with Section 01 57 19 TEMPORARY ENVIRONMENT CONTROLS.

3.4.1 Work Zones

Initial anticipated work zone boundaries (exclusion zone, contamination reduction zone, support zone, all access points and decontamination areas) are to be clearly delineated on the site drawings. Delineation of work zone boundaries on the contamination characterization data and the hazard/risk analysis to be performed as described in EM 385-1-1 06.A.02. As work progresses and field conditions are monitored, work zone boundaries may be modified (and site drawings modified) with approval of the Remedial Project Manager. Clearly identify work zones and mark in the

field (using fences, tape, or signs). Submit and post a site map, showing work zone boundaries and locations of decontamination facilities in the onsite office. Work zones must consist of the following:

3.4.2 Site Control Log

A log of personnel visiting, entering, or working on the site must be maintained. Include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable). Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they must show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and fill out a Certificate of Worker or Visitor Acknowledgment. Record this visitor information, including date, in the log.

3.4.3 Communication

Provide and install an employee alarm system that has adequate means of on and off site communication in accordance with 29 CFR 1910 Section .165. The means of communication must be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace. The signals must be distinctive and recognizable as messages to evacuate or to perform critical operations.

3.4.4 Site Security

Provide the following site security: Print signs in bold large letters on contrasting backgrounds. Signs must be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

3.5 PERSONAL HYGIENE AND DECONTAMINATION

Personnel entering the Exclusion or Contamination Reduction Zones or otherwise exposed to hazardous chemical vapors, gases, liquids, or contaminated solids must decontaminate themselves and their equipment prior to exiting the contamination reduction zone (CRZ) and entering the support zone. Consult Chapter 10.0 of NIOSH 85-115 when preparing decontamination procedures. Submit a detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers as part of the APP/SSHP. Train employees in the procedures and enforce the procedures throughout site operations.

3.5.1 Personnel Decontamination

Initially set up a decontamination line in the CRZ. Employees must exit the exclusion zone through the CRZ and implement the following decontamination procedures and techniques: Scrub and rinse water proof outer garments, hand and face wash

-- End of Section --

SECTION 01 45 00.00 20

QUALITY CONTROL
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-01 Preconstruction Submittals

Construction Quality Control (QC) Plan; G

Submit a Construction QC Plan prior to start of construction.

1.3 INFORMATION FOR THE REMEDIAL PROJECT MANAGER

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Remedial Project Manager (RPM). The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control (CQC) Report, CQC Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log.

Deliver the following to the RPM during Construction:

a. CQC Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.

b. Contractor Production Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.

c. Preparatory Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Preparatory Phase held.

d. Initial Phase Checklist: Submit the report electronically in the same

manner as the CQC Report for each Initial Phase held.

e. QC Specialist Reports: Submit the report electronically by 10:00 AM the next working day after each day that work is performed.

f. Field Test Reports: Within two working days after the test is performed, submit the report as an electronic attachment to the CQC Report.

g. Monthly Summary Report of Tests: Submit the report as an electronic attachment to the CQC Report at the end of each month.

h. Testing Plan and Log: Submit the report as an electronic attachment to the CQC Report, at the end of each month. Provide a copy of the final Testing Plan and Log to the preparer of the Operation & Maintenance (O&M) documentation.

i. Rework Items List: Submit lists containing new entries daily, in the same manner as the CQC Report.

j. CQC Meeting Minutes: Within two working days after the meeting is held, submit the report as an electronic attachment to the CQC Report.

k. QC Certifications: As required by the paragraph entitled "QC Certifications."

l. Special Inspection Report: Submit the Special Inspection reports, in the same manner as the CQC Report.

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. This QC program is a key element in meeting the objectives of NAVFAC Commissioning. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, QC certifications, independent Special Inspections in accordance with Section 01 45 35 SPECIAL INSPECTIONS, and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

1.4.1 Commissioning

Commissioning (Cx) is a systematic process of ensuring that all building systems meet the requirements and perform interactively according to the Contract. The QC Program is a key to this process by coordinating, verifying and documenting measures to achieve the following objectives:

a. Verify and document that the applicable equipment and systems are installed in accordance with the design intent as expressed through

the Contract and according to the manufacturer's recommendations and industry accepted minimum standards.

b. Verify and document that equipment and systems receive complete operational checkout by the installing contractors.

c. Verify and document proper performance of equipment and systems.

d. Verify that Operation and Maintenance (O&M) documentation is complete.

e. Verify the Training Plan and training materials are accurate and provide correct instruction and documentation on the critical elements of the products, materials, and systems in the constructed facility. Verify that all identified Government operating personnel are trained.

1.4.2 Acceptance of the Construction Quality Control (QC) Plan

Acceptance of the QC Plan is required prior to the start of construction. The RPM reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The RPM reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the RPM. The RPM may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

1.4.3 Preliminary Construction Work Authorized Prior to Acceptance

The only construction work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.4 Notification of Changes

Notify the RPM, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the RPM.

1.4.5 Special Inspections

Perform all required Special Inspections per Section 01 45 35 SPECIAL INSPECTIONS, the statement of Special Inspections and the Schedule of Special Inspections.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program, and to serve as the Site Safety and Health Officer (SSHO) as detailed in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. In addition to implementing and managing the QC program, the QC Manager may perform the duties of Project Superintendent. The QC Manager is required to attend the partnering meetings, QC Plan Meetings, Coordination and

Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities. The QC manager is responsible for notifying the Special Inspector of activities which require their review. The QC manager is responsible for coordinating the Special Inspection activities, see paragraph QUALITY CONTROL MANAGER, in Section 01 45 35 SPECIAL INSPECTIONS.

1.5.1.2 Qualifications

An individual with a minimum of 10 years combined experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must have at least two years experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1, and have experience in the areas of hazard identification, safety compliance, and sustainability.

1.5.2 Commissioning Authority

1.5.2.1 Duties

Provide a Commissioning Authority (CA) as key person for the Cx and documentation thereof, who is subordinate to the QC Manager. The CA directs and coordinates Cx activities and submits Cx reports to the RPM to meet the submittal and reporting requirements of Commissioning and develops the commissioning plan. The CA coordinates the actions of the QC Specialists, Testing Laboratory personnel, and other inspection and testing personnel required by this Contract for building Cx.

1.5.2.2 Qualifications

The CA must be certified as a commissioning professional by the Associated Air Balance Council (AABC) Commissioning Group (ACG), the Association of Energy Engineers (AEE), the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), the Commissioning Process Management Professional (CPMP), the Building Commissioning Association (BCA), the National Environmental Balancing Bureau (NEBB), or the University of Wisconsin - Madison (UWM). The CA may not have been involved with the project design, construction management, or supervision, and must be with a third-party firm that is not on the design team.

1.5.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager must have completed the course entitled "Construction Quality Management (CQM) for Contractors." If the QC Manager does not have a current certification, they must obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the RPM for information on the next scheduled class.

1.5.4 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager must be the same as for the QC Manager.

1.5.5 Special Inspector

The Special Inspector (SI) must be an independent third party hired directly by the Prime Contractor. The SI must not be a company employee of the Contractor or any Sub-Contractor performing the work to be inspected. The qualifications of the SI are defined in Section 01 45 35 SPECIAL INSPECTION.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Construction Quality Control (QC) Plan

1.6.1.1 Requirements

Provide, for acceptance by the RPM, a Construction QC Plan submitted in a three-ring binder that includes a table of contents, with major sections identified with tabs, with pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing quality control commissioning activities during the construction of the project:

a. QC ORGANIZATION: A chart showing the QC organizational structure.

b. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, for each person in the QC organization. Include the CQM for Contractors course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs entitled "Construction Quality Management Training" and "Alternate QC Manager Duties and Qualifications".

c. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.

d. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.

e. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work which is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.

f. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving, and managing submittals. Provide the name(s) of

the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.

g. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs entitled "Accreditation Requirements", as applicable.

h. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

i. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track, and complete rework items.

j. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the construction schedule. Include in the list of DFOWs, but not be limited to, all critical path activities on the NAS. Include all activities for which this specification requires QC Specialists or specialty inspection personnel. Provide separate DFOWs in the Network Analysis Schedule for each submittal package.

k. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each DFOW, a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.

l. PERSONNEL MATRIX: Not Applicable

m. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.

n. TRAINING PROCEDURES AND TRAINING LOG: Procedures for coordinating and documenting the training of personnel required by the Contract.

o. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for coordinating, tracking and documenting all certifications on subcontractors, testing laboratories, suppliers, personnel, etc. QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the contract that the work is being performed.

1.7 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to Government approval and the start of construction, the QC Manager will meet with the RPM to present the QC program required by this Contract. When a new QC Manager is appointed, the coordination and mutual understanding meeting must be repeated.

1.7.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, Cx, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

a. Waste Management Plan.

b. IAQ Management Plan.

c. Procedures for noise and acoustics management.

d. Environmental Protection Plan.

e. Environmental regulatory requirements.

f. Cx Plan.

g. Special Inspections.

1.7.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Coordinate prefunctional tests and startup testing with Cx.

1.7.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager,, CA, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities must have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor, the A/E and the RPM. Provide a copy of the signed minutes to all attendees and include in the QC Plan.

1.8 QC MEETINGS

After the start of construction, conduct QC meetings once every two weeks by the QC Manager at the work site with the Project Superintendent. the QC Specialists, the Special Inspector, the CA, and the foremen who are performing the work of the DFOWs. The QC Manager is to prepare the minutes of the meeting and provide a copy to the RPM within two working days after the meeting. The RPM may attend these meetings. As a minimum, accomplish the following at each meeting:

a. Review the minutes of the previous meeting.

b. Review the schedule and the status of work and rework.

c. Review the status of submittals.

d. Review the work to be accomplished in the next two weeks and documentation required.

e. Resolve QC and production problems (RFI, etc.).

f. Address items that may require revising the QC Plan.

g. Review Accident Prevention Plan (APP).

h. Review environmental requirements and procedures.

i. Review Waste Management Plan.

j. Review IAQ Management Plan.

k. Review Environmental Management Plan.

l. Review the status of training completion.

m. Review Cx Plan and progress.

1.9 THREE PHASES OF CONTROL

Adequately cover both on-site and off-site work with the Three Phases of Control and include the following for each DFOW.

1.9.1 Preparatory Phase

Notify the RPM at least two work days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the QC Specialists, the Project Superintendent, the CA, the Special Inspector, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a subcontractor, that subcontractor's foreman must attend the preparatory phase meeting. Document the results of the preparatory phase actions in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFOW:

a. Review each paragraph of the applicable specification sections.

b. Review the Contract drawings.

c. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.

d. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.

e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.

f. Review special inspections required by Section 01 45 35 SPECIAL INSPECTION, the statement of special inspections and the schedule of special inspections.

g. Examine the work area to ensure that the required preliminary work has been completed.

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

i. Arrange for the return of shipping/packaging materials, such as wood pallets, where economically feasible.

j. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data and are properly stored.

k. Discuss specific controls used and construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.

l. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Safety Data Sheets (SDS) are submitted.

m. Review the Cx Plan and ensure all preliminary work items have been completed and documented.

1.9.2 Initial Phase

Notify the RPM at least two work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the QC Specialists, the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each DFOW:

a. Establish level of workmanship and verify that it meets the minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

b. Resolve any workmanship issues.

c. Ensure that testing is performed by the approved laboratory.

d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

e. Review project specific work plans (i.e. Cx, HAZMAT Abatement, Stormwater Management) to ensure all preparatory work items have been completed and documented.

f. Coordinate scheduled work with special inspections required by Section 01 45 35 SPECIAL INSPECTIONS, the statement of special inspections and the schedule of special inspections.

1.9.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC

Report:

a. Ensure the work is in compliance with Contract requirements.

b. Maintain the quality of workmanship required.

c. Ensure that testing is performed by the approved laboratory.

d. Ensure that rework items are being corrected.

e. Assure manufacturers representatives have performed necessary inspections if required and perform safety inspections.

f. Review the Cx Plan and ensure all work items, testing, and documentation has been completed.

g. Coordinate scheduled work with special inspections required by Section 01 45 35 SPECIAL INSPECTIONS, the statement of special inspections and the schedule of special inspections.

1.9.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.9.5 Notification of Three Phases of Control for Off-Site Work

Notify the RPM at least two weeks prior to the start of the preparatory and initial phases.

1.10 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES.

1.11 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.11.1 Accreditation Requirements

Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (E 329, C 1077, D 3666, D 3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the Corporate Office.

1.11.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National

Institute of Standards and Technology at https://www.nist.gov/nvlap, the American Association of State Highway and Transportation Officials (AASHTO) Accredication Program at http://www.aashtoresource.org/aap/overview, International Accreditation Services, Inc. (IAS) at http://www.iasonline.org, U.S. Army Corps of Engineers Materials Testing Center (MTC) at http://www.erdc.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/9254/Article/476661/materials-testing-center.aspx, the American Association for Laboratory Accreditation (A2LA) program at http://www.a2la.org/, the Washington Association of Building Officials (WABO) at http://www.wabo.org/ (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) at https://www.wacel.org/lab-accreditation-and-insp ection-agency-audit-programs/laboratory-accreditation-program/(Approval authority by WACEL is limited to projects within Facilities Engineering Command (FEC) Washington geographical area).

1.11.3 Capability Check

The RPM retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.11.4 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the RPM immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results must be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the RPM via the QC Manager. Furnish a summary report of field tests at the end of each month, in accordance with paragraph INFORMATION FOR THE REMEDIAL PROJECT MANAGER.

1.11.5 Test Reports and Monthly Summary Report of Tests

Furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the RPM. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.12 QC CERTIFICATIONS

1.12.1 CQC Report Certification

Contain the following statement within the CQC Report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.12.2 Invoice Certification

Furnish a certificate to the RPM with each payment request, signed by the

QC Manager, attesting that as-built drawings are current, coordinated and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

1.12.3 Completion Certification

Upon completion of work under this Contract, the QC Manager must furnish a certificate to the RPM attesting that "the work has been completed, inspected, tested and is in compliance with the Contract." Provide a copy of this final QC Certification for completion to the preparer of the Operation & Maintenance (O&M) documentation.

1.13 COMPLETION INSPECTIONS

1.13.1 Punch-Out Inspection

Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager and the CA must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications and Contract. Include in the punch list any remaining items on the "Rework Items List", which were not corrected prior to the Punch-Out Inspection. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the RPM. The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government "Pre-Final Inspection".

1.13.2 Pre-Final Inspection

The Government and QC Manager will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the QC Manager as a result of this inspection. The QC Manager will ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the Client can be scheduled. Any items noted on the "Pre-Final" inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work,or any particular increment thereof, if the project is divided into increments by separate completion dates.

1.13.3 Final Acceptance Inspection

Notify the RPM at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, the CA, and others deemed necessary. Attendees for the Government will include the RPM, other FEAD/ROICC personnel, and personnel representing the Client. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the RPM to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.14 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.14.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE REMEDIAL PROJECT MANAGER" will be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work must be identified by terminology consistent with the construction schedule. In the "remarks" sections of the reports, enter pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

1.14.2 Quality Control Validation

Establish and maintain the following in a series of three ring binders. Binders must be divided and tabbed as shown below. These binders must be readily available to the RPM during all business hours.

a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.

b. All milestone inspections, arranged by Activity Number.

c. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.

d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.

e. An up-to-date copy of the Rework Items List.

f. Maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and Sub-Contractors and all punch lists issued by the Government.

g. Commissioning documentation including Cx checklists, schedules, tests, and reports.

h. Special inspection reports.

1.14.3 Testing Plan and Log

As tests are performed, the QC Manager will record on the "Testing Plan

and Log" the date the test was performed and the date the test results were forwarded to the RPM. Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month, per the paragraph "INFORMATION FOR THE REMEDIAL PROJECT MANAGER". Provide a copy of the final "Testing Plan and Log" to the preparer of the Operation & Maintenance (O&M) documentation.

1.14.4 Rework Items List

The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. The Contractor is responsible for including those items identified by the RPM.

1.14.5 As-Built Drawings

The QC Manager is required to ensure the as-built drawings, required by Section 01 78 00 CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.). The QC Manager must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the RPM.

1.15 NOTIFICATION ON NON-COMPLIANCE

The RPM will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, is deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the RPM may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time for excess costs or damages by the Contractor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

-- End of Section --

SECTION 01 45 35

SPECIAL INSPECTIONS
11/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2024) International Building Code

1.2 GENERAL REQUIREMENTS

Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the Prime Contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

1.3 DEFINITIONS

1.3.1 Continuous Special Inspections

Continuous Special Inspections is the constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

1.3.2 Perform

Perform these Special Inspections tasks for each welded joint or member.

1.3.3 Observe

Observe these Special Inspections items on a periodic daily basis. Operations need not be delayed pending these inspections.

1.3.4 Special Inspector (SI)

A qualified person retained by the Contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

1.3.5 Associate Special Inspector (ASI)

A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and

cannot perform inspections without the SI on site.

1.3.6 Third Party

A Special inspector must not be an employee of the Contractor or of any Sub-Contractor performing the work to be inspected.

1.3.7 Special Inspector of Record (SIOR)

A licensed engineer in responsible charge of supervision of all special inspectors for the project and approved by the Contracting Officer. The SIOR must be an independent third party entity hired directly by the Prime Contractor.

1.3.8 Contracting Officer

The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

1.3.9 Contractor's Quality Control (QC) Manager

An individual retained by the Prime Contractor and qualified in accordance with the Section 01 45 00 QUALITY CONTROL 01 45 00.00 40 QUALITY CONTROL having the overall responsibility for the Contractor's QC organization.

1.3.10 Structural Engineer of Record (SER)

A registered design professional contracted by the Government as an A/E responsible for the overall design and review of submittal documents prepared by others. The SER is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in the state in which the design professional works. The SER is also referred to as the Engineer of Record (EOR) in design code documents.

1.3.11 Statement of Special Inspections (SSI)

A document developed by the SER identifying the material, systems, components and work required to have Special Inspections. This statement is included at the end of this specification.

1.3.12 Schedule of Special Inspections (SSI)

A schedule which lists each of the required Special Inspections, the extent to which each Special Inspection is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. This schedule is included at the end of this specification.

1.3.13 Definable Feature of Work (DFOW)

An inspection group that is separate and distinct from other inspection groups, having inspection requirements or inspectors that are unique.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification

identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

SIOR Letter of Acceptance; G

Special Inspections Project Manual; G

Special Inspections Agency's Written NDT Practices with method and evidence of regular equipment calibration where applicable

SD-06 Test Reports

Special Inspections Daily Reports

Special Inspections Biweekly Reports

SD-07 Certificates

AISC Certified Steel Fabricator

AC472 Accreditation

Certificate of Compliance

Special Inspector of Record Qualifications; G

Special Inspector Qualifications; G

Qualification Records for NDT technicians

SD-11 Closeout Submittals

Comprehensive Final Report of Special Inspections; G

1.5 SPECIAL INSPECTOR QUALIFICATIONS

Submit qualifications for each special inspector and the special inspector of record.

1.5.1 Steel Construction and High Strength Bolting

1.5.1.1 Special Inspector

a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or

b. Registered Professional Engineer with three years of related experience

1.5.1.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.2 Welding Structural Steel

1.5.2.1 Special Inspector

a. ICC Structural Welding Special Inspector certificate with one year of related experience, or

b. AWS Certified Welding Inspector

1.5.2.2 Associate Special Inspector

AWS Certified Associate Welding Inspector

1.5.3 Nondestructive Testing of Welds

1.5.3.1 Special Inspector

NDT Level III Certificate

1.5.3.2 Associate Special Inspector

NDT Level II Certificate plus one year of related experience

1.5.4 Cold Formed Steel Framing

1.5.4.1 Special Inspector

a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or

b. ICC Commercial Building Inspector with one year of experience, or

c. Registered Professional Engineer with three years related experience

1.5.4.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.5 Concrete Construction

1.5.5.1 Special Inspector

a. ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or

b. ACI Concrete Construction Special Inspector, or

c. Registered Professional Engineer with three years of related experience

1.5.5.2 Associate Special Inspector

a. ACI Concrete Construction Special Inspector in Training, or

b. Engineer-In-Training with one year of related experience

1.5.6 Masonry Construction

1.5.6.1 Special Inspector

a. ICC Structural Masonry Special Inspector Certificate with one year of related experience, or

b. Registered Professional Engineer with three years of related experience

1.5.6.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.7 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements

1.5.7.1 Special Inspector

a. ICC Soils Special Inspector Certificate with one year of related experience, or

b. NICET Soils Technician Level II Certificate in Construction Material Testing, or

c. Geologist-In-Training with three years of related experience, or

d. Registered Professional Engineer with three years of related experience

1.5.7.2 Associate Special Inspector

a. NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or

b. Engineer-In-Training with one year of related experience

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the following certifications to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

AISC Certified Steel Fabricator.

International Accreditation Service, AC472 Accreditation

At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied and work performed by the fabricator are in accordance with the construction documents.

PART 3 EXECUTION

3.1 RESPONSIBILITIES

3.1.1 Special Inspector of Record

a. Supervise all Special Inspectors required by the Contract Documents and the IBC.

b. Submit a SIOR Letter of Acceptance to the Contracting Officer attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR.

c. Verify the qualifications of all of the Special Inspectors.

d. Verify the qualifications of fabricators.

e. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.

f. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.

g. Prepare a Special Inspections Project Manual, which must cover the following:

(1) Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, ASI, General Contractor's QC Manager and SER.

(2) Organizational chart or communication plan, indicating lines of communication.

(3) Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors.

(4) Indicate the Government reporting requirements.

(5) Propose forms or templates to be used by SI and SIOR to document inspections.

(6) Indicate procedures for tracking nonconforming work and verification that corrective work is complete.

(7) Indicate how the SIOR and SI will participate in weekly QC meetings.

(8) Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified in accordance with paragraph FABRICATOR SPECIAL INSPECTIONS.

(9) Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out for each item so that the

expectations are clear for the General Contractor and the Subcontractor performing the work.

Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval.

h. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party.

i. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the SER.

j. Submit a copy of the Special Inspector's daily reports to the QC Manager.

k. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.

l. Submit a biweekly Special Inspections report until all work requiring Special Inspections is complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:

(1) A brief summary of the work performed during the reporting time frame.

(2) Discrepancies which were resolved or corrected.

(3) A list of nonconforming items requiring resolution.

(4) All applicable test results including nondestructive testing reports.

3.1.2 Quality Control Manager

a. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.

3.1.3 Special Inspectors

a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.

b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.

c. Submit Special Inspections agency's written NDT practices for the monitoring and control of the agency's operations to include the

following:

(1) The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.

(2) The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.

d. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.

e. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.

f. Submit a copy of the daily reports to the QC Manager.

g. Report discrepancies that are observed during Special Inspections to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.

h. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:

(1) A brief summary of the work performed during the reporting time frame.

(2) Changes and discrepancies with the drawings, specifications that were observed during the reporting period.

(3) Discrepancies which were resolved or corrected.

(4) A list of nonconforming items requiring resolution.

(5) All applicable test result including nondestructive testing reports.

3.2 DEFECTIVE WORK

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Contracting Officer to accept such work.

-- End of Section --

SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

PERFORM: Perform these tasks for each weld, fastener or bolted connection, and noted verification.

OBSERVE: Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

The Seismic Design Category for this project is: ☐ A, ☒ B, ☐ C, ☐ D, ☐ E, ☐ F (check appropriate box)

DESIGNER NOTES (delete this box after reviewing):

1. This schedule contains minimum requirements. Do not delete applicable inspection tasks unless notes in blue indicate it is acceptable to do so.
2. Blue text = designers notes. The designer must review and edit all blue text in this schedule prior to inserting this schedule into the special inspections spec (UFGS 01 45 35).
3. Check section boxes with ANY inspection tasks applicable to your project. You may choose to delete unchecked sections or leave them in the schedule unchecked.
4. Individual rows/tasks that that are not applicable to the project may be left in the section, as the inspector can determine whether they occur/apply (e.g. metal trusses in the light gauge framing section for example).
5. Design discipline sections are color coded for easier reference by designers. This schedule does NOT need to be printed in color.
6. When finished editing, delete this note box and save this schedule as a PDF and insert into the project specifications (special inspections section).

STRUCTURAL - STEEL – WELDING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

STEEL INSPECTION PRIOR TO WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	**PERFORM**	
2. Verify manufacturer certifications for welding consumables are available	**PERFORM**	
3. Verify material identification	**PERFORM**	Type and grade.
4. Welder Identification System	**PERFORM**	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	✓ Joint preparation ✓ Dimensions (alignment, root opening, root face, bevel) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location) ✓ Backing type and fit (if applicable)
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	✓ Dimensions (alignment, gaps at root) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location)
STEEL INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	**PERFORM**	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	✓ Packaging ✓ Electrode atmospheric exposure control
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	✓ Wind speed within limits ✓ Precipitation and temperature
12. Welding Procedures Specification followed	OBSERVE	✓ Settings on welding equipment ✓ Travel speed ✓ Selected welding materials ✓ Shielding gas type/flow rate ✓ Preheat applied ✓ Interpass temperature maintained (min./max.) ✓ Proper position (F, V, H, OH) ✓ Intermix of filler metals avoided
13. Welding techniques	OBSERVE	✓ Interpass and final cleaning ✓ Each pass within profile limitations ✓ Each pass meets quality requirements

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	**PERFORM**	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	**PERFORM AND DOCUMENT**	✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	**PERFORM**	
18. k-area	**PERFORM**	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	**PERFORM**	
20. Repair activities	**PERFORM AND DOCUMENT**	
21. Document acceptance or rejection of welded joint or member	**PERFORM**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL – BOLTING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Manufacture's certifications available for fastener materials	**PERFORM**	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified nondestructive testing personnel	**PERFORM**	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. CJP groove welds	OBSERVE	**[NOTE: DOR must delete this row if section D (SEISMIC PROVISIONS SECTION) is checked]** Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 5/16" (8mm) thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.
3. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
4. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Section J6.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: DOR may uncheck this section for projects NOT designed in accordance with AISC 341 (Seismic Provisions) or for projects designed according to AISC 341, but using an R value equal to 3]		
5. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
6. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
7. K-area NDT (AISC 341)	**PERFORM**	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
8. Placement of reinforcing or contouring fillet welds	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION [1]

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table N6.1, AISC 341-16: Table J9.1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Placement and installation of steel headed stud anchors	**PERFORM**	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has not been re-bent in the field	OBSERVE	
6. Reinforcing clearances have been provided	OBSERVE	
7. Reinforcing steel has been tied and supported as required	OBSERVE	
8. Composite member has required size	OBSERVE	

END SECTION

STRUCTURAL - STEEL - OTHER INSPECTIONS

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	**PERFORM**	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	**DOCUMENT**	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	**DOCUMENT**	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	**DOCUMENT**	No holes or unapproved attachments made by the responsible contractor

END SECTION

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[1] See Concrete Construction Section for all concrete related inspection of composite steel construction.

[2] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

METAL DECK INSPECTION PRIOR TO DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.1		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	**PERFORM**	
2. Document acceptance or rejection of deck and deck accessories	**DOCUMENT**	
METAL DECK INSPECTION DURING DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
3. Verify compliance of deck and all deck accessories installation with construction documents	**PERFORM**	
4. Verify deck materials are represented by the mill certifications that comply with the construction documents	**PERFORM**	
5. Document acceptance or rejection of installation of deck and deck accessories	**DOCUMENT**	
METAL DECK INSPECTION AFTER DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
6. Welding procedure specification (WPS) available	**PERFORM**	
7. Manufactures certifications for welding consumables available	OBSERVE	
8. Material identification (type/grade)	OBSERVE	
9. Check welding equipment	OBSERVE	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

METAL DECK INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.4		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified welders	OBSERVE	
2. Control and handling of welding consumables	OBSERVE	
3. Environmental conditions (wind speed, moisture, temperature)	OBSERVE	
4. WPS followed	OBSERVE	
METAL DECK INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. Verify size and location of welds, including support, sidelap, and perimeter welds.	**PERFORM**	
6. Welds meet visual acceptance criteria	**PERFORM**	
7. Verify repair activities	**PERFORM**	
8. Document acceptance or rejection of welds	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

METAL DECK INSPECTION BEFORE MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Manufacturer installation instructions available for mechanical fasteners	OBSERVE	
2. Proper tools available for fastener installation	OBSERVE	
METAL DECK INSPECTION DURING MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
3. Fasteners are positioned as required	OBSERVE	
4. Fasteners are installed in accordance with manufacturer's instructions	OBSERVE	
METAL DECK INSPECTION AFTER MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. Check spacing, type, and installation of support fasteners	**PERFORM**	
6. Check spacing, type, and installation of sidelap fasteners	**PERFORM**	
7. Check spacing, type, and installation of perimeter fasteners	**PERFORM**	
8. Verify repair activities	**PERFORM**	
9. Document acceptance or rejection of mechanical fasteners	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

LIGHT GAUGE STEEL CONSTRUCTION AND CONNECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.2, 1705.11.2, 1705.11.3, UFC 4 023 03		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Trusses spanning 60-feet or greater where/if applies	**PERFORM**	Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.
2. Welded connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs. **[NOTE: DOR must identify critical wind and/or seismic force resisting welds in the contract drawings so that the special inspector can confirm compliance.]**
3. Connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all screw attachment, bolting, anchoring and other fastening of components within the main wind or seismic force resisting system, including roof deck, roof framing, exterior wall covering, wall to roof/floor connections, braces, collectors (drag struts) and hold-downs. **[NOTE: DOR must identify critical wind and/or seismic force resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]**
4. Cold-formed steel (progressive collapse resisting system where/if applies)	OBSERVE	Verify proper welding operations, screw attachment, bolting, anchoring and other fastening of components within the progressive collapse resisting system, including horizontal tie force elements, vertical tie force elements and bridging elements (UFC 4 023 03). **[NOTE: DOR must identify critical progressive collapse resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]**

END SECTION

STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

OPEN-WEB STEEL JOISTS AND JOIST GIRDERS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Installation of open-web steel joists and joist girders	OBSERVE	✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - CONCRETE CONSTRUCTION SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Reinforcing bar welding	OBSERVE	✓ Verify weldability of reinforcing bars other than ASTM A 706 ✓ Inspect single-pass fillet welds, maximum 5/16" in accordance with AWS D1.4
3. All other welding	**CONTINUOUS**	Visually inspect all welds in accordance with AWS D1.4
4. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
5. Post-installed adhesive anchors in horizontal or upward inclined orientations	**CONTINUOUS AND DOCUMENT**	✓ Inspect as required per approved ICC-ES report ✓ Verify that installer is certified for installation of horizontal and overhead installation applications ✓ Inspect proof loading as required by the contract documents
6. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
7. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	**CONTINUOUS**	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
8. Inspect concrete and/or shotcrete placement for proper application techniques	**CONTINUOUS**	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
9. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
10. Pre-stressed concrete	**CONTINUOUS**	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Inspect erection of precast concrete members	OBSERVE	
12. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OBSERVE	
13. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE AT START OF CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Compliance with approved submittals prior to start	OBSERVE	
2. Proportions of site-mixed mortar.	OBSERVE	
3. Grade and type of reinforcement, anchor bolts, and prestressing tendons and anchorages	OBSERVE	
4. Prestressing technique	OBSERVE	
5. Properties of thin bed mortar for AAC masonry	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE PRIOR TO GROUTING IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
6. Grout space	OBSERVE **CONTINUOUS**	**[NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/ III]**
7. Proportions of site-prepared grout and prestressing grout for bonded tendons	OBSERVE	
8. Proportions of site-mixed grout and prestressing grout for bonded tendons	OBSERVE	
9. Placement of masonry units and mortar joints	OBSERVE	
10. Welding of reinforcement	**CONTINUOUS**	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE DURING CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Size and location of structural elements is in compliance	OBSERVE	
12. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F (4.4°c) or hot weather (temp above 90°F (32.2°C))	OBSERVE	
13. Application and measurement of prestressing force	**CONTINUOUS**	
14. Placement of grout and prestressing grout for bonded tendons	**CONTINUOUS**	
15. Placement of AAC masonry units and construction of thin bed mortar joints	**CONTINUOUS**	Continuous for first 5000 square feet only (465 square meters).
16. Observe preparation of grout specimens, mortar specimens, and/or prisms	OBSERVE	
17. Type, size and placement of reinforcement, connectors, anchor bolts and prestressing tendons and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE **CONTINUOUS**	**[NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/III]**

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

WOOD CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. High-load diaphragms where applicable	OBSERVE	Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.
2. Metal-plate connected wood trusses spanning 60 feet or greater	OBSERVE	Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package

END SECTION

STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION

THIS SECTION IS APPLICABLE IF BOX IS CHECKED: ☐

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.11 & 1705.12.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: DOR may uncheck this section where sheathing nailing/fasteners (both shearwall and roof) are consistently greater than 4" on center, or if the design wind speed (ASD) is less than 110 mph (49 meters/sec) AND the seismic design category is A or B]		
1. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system	OBSERVE (CONTINUOUS FOR GLUING)	Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors (double top plates), braces, hold downs, roof connections to exterior walls.

END SECTION

STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

ISOLATION AND ENERGY DISSIPATION SYSTEMS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC TABLE 1705.12.8		
[NOTE: This section is not applicable to Seismic Design Category A. Uncheck this section if this category applies]		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Fabrication and installation	OBSERVE	Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer's recommendations and approved construction documents
2. Testing of seismic isolation Systems in seismically isolated structures		Seismic Isolation Systems in seismically isolated structures shall be tested accordance with ASCE 7, Section 17.8

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

GEOTECHNICAL - SOILS INSPECTION SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

SOILS INSPECTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	OBSERVE	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	**OBSERVE**	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	**CONTINUOUS**	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

END SECTION

GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	**CONTINUOUS**	
2. Inspect driving operations and maintain complete and accurate records for each element	**CONTINUOUS**	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achiever design capacity, record tip and butt elevations and document any damage to foundation element	**CONTINUOUS**	
4. Determine capacities of test elements and conduct additional load tests if required.	**CONTINUOUS**	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

HELICAL PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.9		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required. The approved geotechnical report and the contract documents shall be used to determine compliance	**CONTINUOUS**	

END SECTION

GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element.	**CONTINUOUS**	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	**CONTINUOUS**	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

END SECTION

[1] **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.14		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

END SECTION

FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.15		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

END SECTION

FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.17		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	**[NOTE: This section applies to Risk Category III, IV, & V only. DOR may choose to uncheck this section where project is assigned to Risk Category I or II. Confirm Risk Category with Structural Engineer]**
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

FIRE PROTECTION – SMOKE CONTROL SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.18		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.16		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570. **[NOTE: not applicable to masonry or concrete wall applications. Uncheck this section in those cases]**

END SECTION

ARCHITECTURAL – ARCHITECTURAL COMPONENTS

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.12.5, 1705.12.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: This section is not applicable to Seismic Design Categories A, B, & C. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with the structural engineer]		
1. Erection and fastening of exterior cladding and interior and exterior veneer.	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if height is less than 30 feet or weight is less than 5psf**
2. Interior and exterior non-load bearing walls	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if interior non-load bearing walls weigh less than 15psf**
3. Access floors	OBSERVE	Verify that anchorage complies with approved construction documents.
4. Storage racks	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report. **Inspector Note: Not required for racks less than 8 feet in height**

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
[NOTE: This section is not applicable to Seismic Design Categories A or B. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with structural engineer]		
1. Anchorage of electrical equipment for emergency and standby power systems	OBSERVE	✓ Check for general conformance
2. Anchorage of all other electrical equipment in Seismic Design Categories E and F only (See first page of this schedule for Seismic Design Category)	OBSERVE	✓ Check for general conformance
3. Installation and anchorage of piping designed to carry hazardous materials and their associated mechanical units.	OBSERVE	✓ Check for general conformance
4. Installation and anchorage of vibration isolation systems where the construction documents require a nominal clearance of ¼" or less between support framing and restraint.	OBSERVE	✓ Check for general conformance
5. Verification of clearance between fire sprinkler piping and surrounding mechanical and electrical equipment, including ductwork, piping and their structural supports.	OBSERVE	✓ Check for minimum clearances noted in ASCE7 13.2.3 or a nominal clearance of not less than 3 inches

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

Project: PHASE III GROUNDWATER TREATMENT PLANT
Location: Bethpage, NY
Project #: N62472-99-D-0032
Date: 3/6/2024

STATEMENT OF SPECIAL INSPECTIONS

Project Seismic Design Category: B
Project Risk Category: III
Project Design Wind Speed (mph): 129
Number of Stories: 1
Structure Height Above Grade (ft): 25
Hazardous Occupancy or attached to such? No Group H Occupancies

Special Inspector of Record (SIOR)

A Special Inspector of Record (SIOR) **IS** required (per UFGS 01 45 35, Section 1.3.8)

SIOR Name (Registered Professional):
Professional Registration Number:
Consulting Firm Name (if any):
SIOR Office AND Mobile Phone Number:

Lateral Force Resisting System (LFRS)

2018 IBC 1704.3.2 and 1704.3.3

Following is a listing of critical main wind/seismic force resisting systems for this structure. Carefully inspect these elements as part of the roles and responsiblities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

Vertical LFRS Elements	Notes
Ordinary Reinforced Masonry Shear Walls	

Horizontal LFRS Elements	Notes
Ordinary Reinforced Masonry Shear Walls	

Project: PHASE III GROUNDWATER TREATMENT PLANT
Location: Bethpage, NY
Project #: N62472-99-D-0032
Date: 3/6/2024

Designated Seismic Systems (DSS)

(2018 IBC 1705.13.3) (ASCE 7-16, 13.2.2, C13.2.2) (UFC 3-301-1, 2-5.3)

DESIGNATED SEISMIC SYSTEMS DO NOT APPLY TO THIS PROJECT, due to the Seismic Design Category being less than C.

ELECTRICAL Designated Seismic Systems (DSS) Requiring a Certificate of Compliance
N/A
N/A
N/A
N/A
N/A

If additional space is required, append an additional sheet listing the remaining DSS

MECHANICAL/PLUMBING Designated Seismic Systems (DSS) Requiring a Certificate of Compliance
N/A
N/A
N/A
N/A
N/A
N/A

If additional space is required, append an additional sheet listing the remaining DSS

OTHER Designated Seismic Systems (DSS) Requiring a Certificate of Compliance
N/A
N/A
N/A
N/A
N/A
N/A

Final Walk Down Inspection and Report

(UFC 3 301 01 SECTION 2-5.4)

Final Walk Down Inspection of non-structural Designated Seismic Systems does not apply to this project (no Designated Seismic Systems)

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.1053	Respirable Crystalline Silica
29 CFR 1926.1153	Respirable Crystalline Silica
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 64	Compliance Assurance Monitoring
40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 262.31	Standards Applicable to Generators of Hazardous Waste-Labeling
40 CFR 262.34	Standards Applicable to Generators of Hazardous Waste-Accumulation Time
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities

40 CFR 268	Land Disposal Restrictions
40 CFR 273	Standards for Universal Waste Management
40 CFR 273.2	Standards for Universal Waste Management - Batteries
40 CFR 273.4	Standards for Universal Waste Management - Mercury Containing Equipment
40 CFR 273.5	Standards for Universal Waste Management - Lamps
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 300.125	National Oil and Hazardous Substances Pollution Contingency Plan - Notification and Communications
40 CFR 355	Emergency Planning and Notification
40 CFR 403	General Pretreatment Regulations for Existing and New Sources of Pollution
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 172.101	Hazardous Material Regulation-Purpose and Use of Hazardous Material Table
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Class I and II Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act. A list of Class I ODS can be found on the EPA website at the following weblink. https://www.epa.gov/ozone-layer-protection/ozone-depleting-substances.

Class II ODS is defined in Section 602(s) of The Clean Air Act. A list of Class II ODS can be found on the EPA website at the following weblink. https://www.epa.gov/ozone-layer-protection/ozone-depleting-substances.

1.2.2 Contractor Generated Hazardous Waste

Contractor generated hazardous waste is materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the

Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene), waste thinners, excess paints, excess solvents, waste solvents, excess pesticides, and contaminated pesticide equipment rinse water.

1.2.3 Electronics Waste

Electronics waste is discarded electronic devices intended for salvage, recycling, or disposal.

1.2.4 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally or historically.

1.2.5 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.6 Hazardous Debris

As defined in paragraph SOLID WASTE, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) in accordance with 40 CFR 261. Hazardous debris also includes debris that exhibits a characteristic of hazardous waste in accordance with 40 CFR 261.

1.2.7 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172.

Hazardous material is any material that: Is regulated as a hazardous material in accordance with 49 CFR 173; or requires a Safety Data Sheet (SDS) in accordance with 29 CFR 1910.120; or during end use, treatment, handling, packaging, storage, transportation, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D. Designation of a material by this definition, when separately regulated or controlled by other sections or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this section for "control" purposes. Such material includes ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials, and other materials such as asbestos, mercury, and polychlorinated biphenyls (PCBs).

1.2.8 Hazardous Waste

Hazardous Waste is any material that meets the definition of a solid waste and exhibit a hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity) as specified in 40 CFR 261, Subpart C, or contains a listed hazardous waste as identified in 40 CFR 261, Subpart D.

1.2.9 Land Application

Land Application means spreading or spraying discharge water at a rate that allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Comply with federal, state, and local laws and regulations.

1.2.10 Municipal Separate Storm Sewer System (MS4) Permit

MS4 permits are those held by installations to obtain NPDES permit coverage for their stormwater discharges.

1.2.11 National Pollutant Discharge Elimination System (NPDES)

The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

1.2.12 Oily Waste

Oily waste are those materials that are, or were, mixed with Petroleum, Oils, and Lubricants (POLs) and have become separated from that POLs. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, POLs and may be appropriately tested and discarded in a manner which is in compliance with other state and local requirements.

This definition includes materials such as oily rags, "kitty litter" sorbent clay and organic sorbent material. These materials may be land filled provided that: It is not prohibited in other state regulations or local ordinances; the amount generated is "de minimus" (a small amount); it is the result of minor leaks or spills resulting from normal process operations; and free-flowing oil has been removed to the practicable extent possible. Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, perform a hazardous waste determination prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

1.2.13 Regulated Waste

Regulated waste are solid wastes that have specific additional federal, state, or local controls for handling, storage, or disposal.

1.2.14 Sediment

Sediment is soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.15 Solid Waste

Solid waste is a solid, liquid, semi-solid or contained gaseous waste. A solid waste can be a hazardous waste, non-hazardous waste, or non-Resource Conservation and Recovery Act (RCRA) regulated waste. Types of solid waste typically generated at construction sites may include:

1.2.15.1 Debris

Debris is non-hazardous solid material generated during the construction, demolition, or renovation of a structure that exceeds 2.5-inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (for example, cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

1.2.15.2 Green Waste

Green waste is the vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

1.2.15.3 Material not regulated as solid waste

Material not regulated as solid waste is nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1.2.15.4 Non-Hazardous Waste

Non-hazardous waste is waste that is excluded from, or does not meet, hazardous waste criteria in accordance with 40 CFR 263.

1.2.15.5 Surplus Soil

Surplus soil is existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars, and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included and must be managed in accordance with paragraph HAZARDOUS MATERIAL MANAGEMENT.

1.2.15.6 Scrap Metal

This includes scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe, and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

1.2.15.7 Wood

Wood is dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included. Treated wood includes, but is not limited to, lumber, utility poles, crossties, and other wood products with chemical treatment.

1.2.16 Surface Discharge

Surface discharge means discharge of water into drainage ditches, storm sewers, creeks or "waters of the United States". Surface discharges are discrete, identifiable sources and require a permit from the governing agency. Comply with federal, state, and local laws and regulations.

1.2.17 Wastewater

Wastewater is the used water and solids from a community that flow to a treatment plant.

1.2.17.1 Stormwater

Stormwater is any precipitation in an urban or suburban area that does not evaporate or soak into the ground, but instead collects and flows into storm drains, rivers, and streams.

1.2.18 Waters of the United States

Waters of the United States means Federally jurisdictional waters, including wetlands, that are subject to regulation under Section 404 of the Clean Water Act or navigable waters, as defined under the Rivers and Harbors Act.

1.2.19 Wetlands

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

1.2.20 Universal Waste

The universal waste regulations streamline collection requirements for certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (for example, thermostats), and lamps (for example, fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Regulatory Notifications; G

Stormwater Pollution Prevention Plan (SWPPP)

SD-06 Test Reports

Inspection Reports

SD-11 Closeout Submittals

Stormwater Pollution Prevention Plan Compliance Notebook; G

Disposal Documentation for Hazardous and Regulated Waste; G

Contractor Hazardous Material Inventory Log; G

Hazardous Waste/Debris Management; G

Regulatory Notifications; G

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this Contract. Comply with federal, state, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Tests and procedures assessing whether construction operations comply with Applicable Environmental Laws may be required. Analytical work must be performed by qualified laboratories; and where required by law, the laboratories must be certified.

1.4.1 Conformance with the Environmental Management System

Perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). Perform work in a manner that conforms to objectives and targets of the environmental programs and operational controls identified by the EMS. Support Government personnel when environmental compliance and EMS audits are conducted by escorting auditors at the Project site, answering questions, and providing proof of records being maintained. Provide monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, take corrective and preventative actions. In addition, employees must be aware of their roles and responsibilities under the installation EMS and of how these EMS roles and responsibilities affect work performed under the contract.

Coordinate with the installation's EMS coordinator to identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. Provide training documentation to the Remedial Project Manager. The Installation Environmental Office will retain associated environmental compliance records.

1.5 SPECIAL ENVIRONMENTAL REQUIREMENTS

Comply with the special environmental requirements attached at the end of this section.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Notifications

Provide regulatory notification requirements in accordance with federal, state and local regulations. In cases where the Government will also provide public notification (such as stormwater permitting), coordinate with the Remedial Project Manager. Submit copies of regulatory notifications to the Remedial Project Manager at least 30 days prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all-inclusive): demolition, renovation, NPDES defined site work, construction, removal or use of a permitted air emissions source, and remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.6.2 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the installation; and types and quantities of wastes/wastewater that may be generated during the Contract.

1.6.3 Non-Compliance Notifications

The Remedial Project Manager will notify the Contractor in writing of any observed noncompliance with federal, state or local environmental laws or regulations, permits, and other elements of the Contractor's EPP. After receipt of such notice, inform the Remedial Project Manager of the proposed corrective action and take such action when approved by the Remedial Project Manager. The Remedial Project Manager may issue an order stopping all or part of the work until satisfactory corrective action has been taken. FAR 52.242-14 Suspension of Work provides that a suspension, delay, or interruption of work due to the fault or negligence of the Contractor allows for no adjustments to the contract for time extensions or equitable adjustments. In addition to a suspension of work, the Remedial Project Manager may use additional authorities under the contract or law..

1.7 ENVIRONMENTAL RECORDS BINDER

Maintain on-site a separate three-ring Environmental Records Binder and submit at the completion of the project. Make separate parts within the binder that correspond to each submittal listed under paragraph CLOSEOUT SUBMITTALS in this section.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitats. Prior to the commencement of activities, consult with the Installation Environmental Office, regarding rare species or sensitive habitats that need to be protected. The protection of rare, threatened, and endangered animal and plant species identified, including their habitats, is the Contractor's responsibility.

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work that is consistent with the requirements of the Installation Environmental Office or as otherwise specified. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Flow Ways

Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as specified and permitted.

3.1.2 Vegetation

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Engineers's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages. Where such use of attached ropes, cables, or guys is authorized, the Contractor is responsible for any resultant damage.

Protect existing trees that are to remain to ensure they are not injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas.

3.2 STORMWATER

Do not discharge stormwater from construction sites to the sanitary sewer. If the water is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Obtain authorization in advance from the Installation Environmental Office for any release of contaminated water.

3.2.1 Construction General Permit

Provide a Construction General Permit as required by 40 CFR 122.26 or the State of New York General Permit. Under the terms and conditions of the permit, install, inspect, maintain BMPs, prepare stormwater erosion and sediment control inspection reports, and submit SWPPP inspection reports. Maintain construction operations and management in compliance with the terms and conditions of the general permit for stormwater discharges from construction activities.

3.2.1.1 Stormwater Pollution Prevention Plan

Submit a project-specific Stormwater Pollution Prevention Plan (SWPPP) to the Remedial Project Manager for approval, prior to the commencement of work. The SWPPP must meet the requirements of 40 CFR 122.26 and the New York State General Permit for stormwater discharges from construction sites.

Include the following:

a. Comply with terms of the state general permit for stormwater discharges from construction activities. Prepare SWPPP in accordance with state requirements.

b. Select applicable BMPs from EPA Fact Sheets located at https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater# or in accordance with applicable state or local requirements.

c. Include a completed copy of the BMP Inspection Report Template.

3.2.1.2 Inspection Reports

Submit "Inspection Reports" to the Remedial Project Manager in accordance with the State of New York Construction General Permit.

3.2.1.3 Stormwater Pollution Prevention Plan Compliance Notebook

Create and maintain a three ring binder of documents that demonstrate compliance with the Construction General Permit. Include a copy of the permit Notice of Intent, proof of permit fee payment, SWPPP and SWPPP update amendments, inspection reports and related corrective action records, and copies of correspondence with the New York State Permitting Agency.At project completion, the notebook becomes property of the Government. Provide the compliance notebook to the Remedial Project Manager.

3.2.2 Erosion and Sediment Control Measures

Provide erosion and sediment control measures in accordance with state and local laws and regulations. Preserve vegetation to the maximum extent practicable.

Erosion control inspection reports may be compiled as part of a stormwater pollution prevention plan inspection reports.

3.2.2.1 Erosion Control

Prevent erosion by mulching or temporary seeding. Stabilize slopes by sodding, seeding, or such combination of these methods necessary for effective erosion control. Use of hay bales is prohibited.

Provide seeding in accordance with Section 32 92 19 SEEDING.

3.2.2.2 Sediment Control Practices

Implement sediment control practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement sediment control practices prior to soil disturbance and prior to creating areas with

concentrated flow, during the construction process to minimize erosion and sediment laden runoff. Include the following devices: silt fence, storm drain inlet protection. Location and details of installation and construction are indicated on the drawings.

3.2.3 Work Area Limits

Mark the areas that need not be disturbed under this Contract prior to commencing construction activities. Mark or fence isolated areas within the general work area that are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. Personnel must be knowledgeable of the purpose for marking and protecting particular objects.

3.2.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Remedial Project Manager. Move or relocate the Contractor facilities only when approved by the Government. Provide erosion and sediment controls for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant or work areas to protect adjacent areas.

3.2.5 Municipal Separate Storm Sewer System (MS4) Management

Comply with the Installation's MS4 permit requirements.

3.3 SURFACE AND GROUNDWATER

3.3.1 Cofferdams, Diversions, and Dewatering

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure must be constantly controlled to maintain compliance with existing state water quality standards and designated uses of the surface water body. Comply with the State of New York water quality standards and anti-degradation provisions. Do not discharge excavation ground water to the sanitary sewer, storm drains, or to surface waters without prior specific authorization in writing from the Installation Environmental Office. Discharge of hazardous substances will not be permitted under any circumstances. Use sediment control BMPs to prevent construction site runoff from directly entering any storm drain or surface waters.

If the construction dewatering is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Obtain authorization for any contaminated groundwater release in advance from the Installation Environmental Officer and the federal or state authority, as applicable. Discharge of hazardous substances will not be permitted under any circumstances.

3.3.2 Waters of the United States

Do not enter, disturb, destroy, or allow discharge of contaminants into waters of the United States.

3.4 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with 40 CFR 64 and state air emission and performance laws and standards.

3.4.1 Preconstruction Air Permits

Notify the Air Program Manager, through the Remedial Project Manager, at least 6 months prior to bringing equipment, assembled or unassembled, onto the Installation, so that air permits can be secured. Necessary permitting time must be considered in regard to construction activities. Clean Air Act (CAA) permits must be obtained prior to bringing equipment, assembled or unassembled, onto the Installation.

3.4.2 Oil or Dual-fuel Boilers and Furnaces

Provide product data and details for new, replacement, or relocated fuel fired boilers, heaters, or furnaces to the Installation Environmental Office (Air Program Manager) through the Remedial Project Manager. Data to be reported include: equipment purpose (water heater, building heat, process), manufacturer, model number, serial number, fuel type (oil type, gas type) size (MMBTU heat input). Provide in accordance with paragraph PRECONSTRUCTION AIR PERMITS.

3.4.3 Burning

Under no circumstances shall the burning or debris of waste materials be conducted at the site.

3.4.4 Accidental Venting of Refrigerant

Accidental venting of a refrigerant is a release and must be reported immediately to the Remedial Project Manager.

3.4.5 EPA Certification Requirements

Heating and air conditioning technicians must be certified through an EPA-approved program. Maintain copies of certifications at the employees' places of business; technicians must carry certification wallet cards, as provided by environmental law.

3.4.6 Dust Control

Keep dust down at all times, including during nonworking periods. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster. Since these products contain Crystalline Silica, comply with the applicable OSHA standard, 29 CFR 1910.1053 or 29 CFR 1926.1153 for controlling exposure to Crystalline Silica Dust.

3.4.6.1 Particulates

Dust particles, aerosols and gaseous by-products from construction activities, and processing and preparation of materials (such as from asphaltic batch plants) must be controlled at all times, including

weekends, holidays, and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates that would exceed 40 CFR 50, state, and local air pollution standards or that would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators, or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with state and local visibility regulations.

3.4.6.2 Abrasive Blasting

Blasting operations cannot be performed without prior approval of the Installation Air Program Manager. The use of silica sand is prohibited in sandblasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive agent, paint chips, and other debris.

3.4.7 Odors

Control odors from construction activities. The odors must be in compliance with state regulations and local ordinances and may not constitute a health hazard.

3.5 WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the EPP. Obtain a copy of the installation's Pollution Prevention/Hazardous Waste Minimization Plan for reference material when preparing this part of the EPP. If no written plan exists, obtain information by contacting the Remedial Project Manager. Describe the anticipated types of the hazardous materials to be used in the construction when requesting information.

3.5.1 Salvage, Reuse and Recycle

Identify anticipated materials and waste for salvage, reuse, and recycling. Describe actions to promote material reuse, resale or recycling. To the extent practicable, all scrap metal must be sent for reuse or recycling and will not be disposed of in a landfill.

Include the name, physical address, and telephone number of the hauler, if transported by a franchised solid waste hauler. Include the destination and, unless exempted, provide a copy of the state or local permit (cover) or license for recycling.

3.6 WASTE MANAGEMENT AND DISPOSAL

3.6.1 Control and Management of Hazardous Waste

Do not dispose of hazardous waste on Government property. Do not discharge any waste to a sanitary sewer, storm drain, or to surface waters

or conduct waste treatment or disposal on Government property without written approval of the Remedial Project Manager.

3.6.1.1 Hazardous Waste/Debris Management

Identify construction activities that will generate hazardous waste or debris. Provide a documented waste determination for resultant waste streams. Identify, label, handle, store, and dispose of hazardous waste or debris in accordance with federal, state, and local regulations, including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Manage hazardous waste in accordance with the approved Hazardous Waste Management Section of the EPP. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities is identified as being generated by the Government. Prior to removal of any hazardous waste from Government property, hazardous waste manifests must be signed by personnel from the Installation Environmental Office. Do not bring hazardous waste onto Government property.

3.6.1.2 Waste Storage/Satellite Accumulation/90 Day Storage Areas

Accumulate hazardous waste at satellite accumulation points and in compliance with 40 CFR 262.34 and applicable state or local regulations. Individual waste streams will be limited to 55 gallons of accumulation (or 1 quart for acutely hazardous wastes). If the Contractor expects to generate hazardous waste at a rate and quantity that makes satellite accumulation impractical, the Contractor may request a temporary 90 day accumulation point be established. Submit a request in writing to the Remedial Project Manager and provide the following information (Attach Site Plan to the Request):

Contract Number	(_____)
Contractor	(_____)
Haz/Waste or Regulated Waste POC	(_____)
Phone Number	(_____)
Type of Waste	(_____)
Source of Waste	(_____)
Emergency POC	(_____)
Phone Number	(_____)
Location of the Site	(_____)

Attach a Waste Determination form for the expected waste streams. Allow 10 working days for processing this request. Additional compliance requirements (e.g. training and contingency planning) that may be required are the responsibility of the Contractor. Barricade the designated area where waste is being stored and post a sign identifying as follows:

"DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

3.6.1.3 Hazardous Waste Disposal

3.6.1.3.1 Responsibilities for Contractor's Disposal

Provide hazardous waste manifest to the Installations Environmental Office for review, approval, and signature prior to shipping waste off Government property.

3.6.1.3.1.1 Services

Provide service necessary for the final treatment or disposal of the hazardous material or waste in accordance with 40 CFR 260, local, and state, laws and regulations, and the terms and conditions of the Contract within 60 days after the materials have been generated. These services include necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal or transportation, include manifesting or complete waste profile sheets, equipment, and compile documentation).

3.6.1.3.1.2 Samples

Obtain a representative sample of the material generated for each job done to provide waste stream determination.

3.6.1.3.1.3 Analysis

Analyze each sample taken and provide analytical results to the Remedial Project Manager. .

3.6.1.3.1.4 Labeling

Determine the Department of Transportation's (DOT's) proper shipping names for waste (each container requiring disposal) and demonstrate to the Remedial Project Manager how this determination is developed and supported by the sampling and analysis requirements contained herein. Label all containers of hazardous waste with the words "Hazardous Waste" or other words to describe the contents of the container in accordance with 40 CFR 262.31 and applicable state or local regulations.

3.6.1.3.2 Contractor Disposal Turn-In Requirements

Hazardous waste generated must be disposed of in accordance with the following conditions to meet installation requirements:

a. Drums must be compatible with waste contents and drums must meet DOT requirements for 49 CFR 173 for transportation of materials.

b. Band drums to wooden pallets.

c. No more than three 55 gallon drums or two 85 gallon over packs are to be banded to a pallet.

d. Band using 1-1/4 inch minimum band on upper third of drum.

e. Provide label in accordance with 49 CFR 172.101.

f. Leave 3 to 5 inches of empty space above volume of material.

3.6.1.4 Universal Waste Management

Manage the following categories of universal waste in accordance with federal, state, and local requirements and installation instructions:

a. Batteries as described in 40 CFR 273.2

b. Lamps as described in 40 CFR 273.5

c. Mercury-containing equipment as described in 40 CFR 273.4

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed.

3.6.1.5 Electronics End-of-Life Management

Recycle or dispose of electronics waste, including, but not limited to, used electronic devices such computers, monitors, hard-copy devices, televisions, mobile devices, in accordance with 40 CFR 260-262, state, and local requirements, and installation instructions.

3.6.1.6 Disposal Documentation for Hazardous and Regulated Waste

Contact the Remedial Project Manager for the facility RCRA identification number that is to be used on each manifest.

3.6.2 Releases/Spills of Oil and Hazardous Substances

3.6.2.1 Response and Notifications

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated in accordance with 40 CFR 300. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the state or local authority.

Submit verbal and written notifications as required by the federal (40 CFR 300.125 and 40 CFR 355), state, local regulations and instructions. Provide copies of the written notification and documentation that a verbal notification was made within 20 days. Spill response must be in accordance with 40 CFR 300 and applicable state and local regulations. Contain and clean up these spills without cost to the Government.

3.6.2.2 Clean Up

Clean up hazardous and non-hazardous waste spills. Reimburse the Government for costs incurred including sample analysis materials, clothing, equipment, and labor if the Government will initiate its own spill cleanup procedures, for Contractor- responsible spills, when: Spill

cleanup procedures have not begun within one hour of spill discovery/occurrence; or, in the Government's judgment, spill cleanup is inadequate and the spill remains a threat to human health or the environment.

3.6.3 Mercury Materials

Immediately report to the Environmental Office and the Remedial Project Manager instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the Remedial Project Manager.

Do not recycle a mercury spill cleanup; manage it as a hazardous waste for disposal.

3.6.4 Wastewater

3.6.4.1 Disposal of wastewater must be as specified below.

3.6.4.1.1 Treatment

Do not allow wastewater from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, and forms to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction- related waste water from the project in accordance with 40 CFR 403, state, regional, and local laws and regulations.

3.6.4.1.2 Surface Discharge

For discharge of ground water, surface discharge in accordance with federal, state, and local laws and regulations.

3.6.4.1.3 Land Application

Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing must be discharged into the sanitary sewer with prior approval and notification to the Wastewater Treatment Plant's Operator.

3.7 HAZARDOUS MATERIAL MANAGEMENT

Include hazardous material control procedures in the Safety Plan, in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Do not bring hazardous material onto Government property that does not directly relate to requirements for the performance of this contract. Submit an SDS and estimated quantities to be used for each hazardous material to the Remedial Project Manager prior to bringing the material on the installation. Typical materials requiring SDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. Use hazardous materials in a manner that minimizes the amount of hazardous waste generated. Containers of hazardous materials must have National Fire Protection Association labels or their equivalent. Certify that hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste, in accordance with 40 CFR 261.

3.7.1 Contractor Hazardous Material Inventory Log

Submit the "Contractor Hazardous Material Inventory Log"(found at: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic), which provides information required by (EPCRA Sections 312 and 313) along with corresponding SDS, to the Remedial Project Manager at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Keep copies of the SDSs for hazardous materials onsite. At the end of the project, provide the Remedial Project Manager with copies of the SDSs, and the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used.

The Remedial Project Manager may request documentation for any spills or releases, environmental reports, or off-site transfers.

3.8 PREVIOUSLY USED EQUIPMENT

Clean previously used construction equipment prior to bringing it onto the project site. Equipment must be free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the U.S. Department of Agriculture jurisdictional office for additional cleaning requirements.

3.9 INADVERTENT DISCOVERY OF PETROLEUM-CONTAMINATED SOIL OR HAZARDOUS WASTES

If petroleum-contaminated soil, or suspected hazardous waste is found during construction that was not identified in the Contract documents, immediately notify the Remedial Project Manager. Do not disturb this material until authorized by the Remedial Project Manager.

3.10 CHLORDANE

Evaluate excess soils and concrete foundation debris generated during the demolition of housing units or other wooden structures for the presence of chlordane or other pesticides prior to reuse or final disposal.

3.11 SOUND INTRUSION

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives are not permitted without written permission from the Remedial Project Manager, and then only during the designated times. Confine pile-driving operations to the period between 8 a.m. and 4 p.m. Monday through Friday, exclusive of holidays, unless otherwise specified.

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the State of New York rules.

3.12 POST CONSTRUCTION CLEANUP

Clean up areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Remedial Project Manager, remove traces of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures,

stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade parking area and similar temporarily used areas to conform with surrounding contours.

-- End of Section --

SECTION 01 58 00

PROJECT IDENTIFICATION
08/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Preliminary Drawing Indicating Layout And Text Content; G

1.3 PROJECT IDENTIFICATION SIGN

Prior to initiating any work on site, provide one project identification sign at the location designated. Construct the sign in accordance with project sign detail, which can be downloaded at: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site.

On the project sign, provide points of contact for the Design Safety Coordinator and the Construction Safety Officer in accordance with Italian Law as follows: "Design Safety Coordinator-_____, CEC, U.S. Navy, Commanding Officer, Engineering Field Activity Mediterranean" "Construction Safety Officer - _____, CEC, U.S. Navy, Resident Officer in Charge of Construction".

1.3.1 Project Identification Signboard

Provide a project identification signboard in accordance with attached Plates 1, 3, and 4. Provide a preliminary drawing indicating layout and text content. Erect a signboard at a conspicuous location on the job site where directed by the Remedial Project Manager.

a. The field of the sign consists of a 4 by 8 foot sheet of grade B-B medium density overlaid exterior plywood.

b. Lumber is B or better Southern pine, pressure-preservative treated in accordance with AWPA C1 and AWPA C2. Nails are aluminum or galvanized steel.

c. Give one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint to the entire signboard and supports. Perform the lettering and sign work by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles are as indicated. Where preservative-treated lumber is required, utilize only cured pressure-treated wood which has had the chemicals leached from the surface of the wood prior to painting.

d. Use spray applied automotive quality high gloss acrylic white enamel paint as background for the NAVFAC logo. NAVFAC logo is an applied 2 mil film sticker/decal with either transparent or white background or paint the logo by stencil onto the sign. The weather resistant sticker/decal film is rated for a minimum of 2-year exterior vertical exposure. Mount the self-adhering sticker to the sign with pressure sensitive, permanent acrylic adhesive. Shop cut sticker/decal to rectangular shape and provide pull-off backing sheet on adhesive side of design sticker for shipping.

e. Sign paint colors (manufacturer's numbers/types listed below for color identification only)

   (1) Blue = To match dark blue color in the NAVFAC logo.

   (2) White = To match Brilliant White color in the NAVFAC logo.

f. NAVFAC logo must retain proportions and design integrity. NAVFAC logos in electronic format may be obtained from the NAVFAC web portal via the following link: https://www.navfac.navy.mil/about_us/logos_and_seals.html. Use the following to choose color values for the paint to be used:

   (1) Dark Blue = equivalent to CMYK values 100, 72, 0, 8.

   (2) Light Blue = equivalent to CMYK values 69, 34, 0, 0.

   (3) Cyan = equivalent to CMYK values 100, 9, 0, 6.

   (4) Yellow = equivalent to CMYK values 0.9,94, 0.

g. Final signboard artwork (rendering) may be either mounted under plexiglass as indicated in attached Plates 2 and 5, or may be electrostatically printed on 4 mil self-adhering, weather resistant, glossy vinyl film and mounted to signboard. Provide film that is capable of full color reproduction of the building rendering and cover it with an ultra-violet protection film. Laminate the 2 mil satin gloss clear protection film to the white 4 mil vinyl image film. Utilize pressure sensitive "controltac" adhesive to attach rendering to signboard and smooth out surface with hand pressure tools in accordance with manufacturer's recommendations. Shop cut sticker to size required and provide pull-off backing sheet on adhesive side of film for shipping. Provide the rendering on film that is rated for a

minimum of 2-years exterior vertical exposure.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS
05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971	(2005; R 2011) Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings

GREEN SEAL (GS)

GS-37	(2017) Cleaning Products for Industrial and Institutional Use

U.S. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N	(2014; with Change 4, 2018) Navy and Marine Corps Design
UFC 1-300-08	(2009, with Change 2, 2011) Criteria for Transfer and Acceptance of DoD Real Property

1.2 DEFINITIONS

1.2.1 As-Built Drawings

As-built drawings are the marked-up drawings, maintained by the Contractor on-site, that depict actual conditions and deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to submitted Requests for Information (RFI's); direction from the Remedial Project Manager; design that is the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site. These files serve as the basis for the creation of the record drawings.

1.2.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings.

1.3 SOURCE DRAWING FILES

Request the full set of electronic drawings, in the source format, for Record Drawing preparation, after award and at least 30 days prior to required use.

1.3.1 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CAD drawing files are not construction documents. Differences may exist between the CAD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CAD files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished Source drawing files, the signed and sealed construction documents govern. The Contractor is responsible for determining if any conflict exists. Use of these Source Drawing files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indicia of ownership (seals, logos, signatures, initials and dates).

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Warranty Management Plan

Warranty Tags

Final Cleaning

Spare Parts Data

SD-08 Manufacturer's Instructions

Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

As-Built Drawings; G

Record Drawings; G

As-Built Record of Equipment and Materials

Final Approved Shop Drawings;

1.5 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, and stock level required for test and balance, pre-commissioning, maintenance and repair activities. List those items that may be standard to the normal maintenance of the system.

1.6 WARRANTY MANAGEMENT

1.6.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to FAR 52.246-21 Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit one set of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan narrative must contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Submit warranty information, made available during the construction phase, to the Remedial Project Manager for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period must begin on the date of project acceptance and continue for the full product warranty period. Conduct a joint 4 month and 9 month warranty inspection, measured from time of acceptance; with the Contractor, Remedial Project Manager and the Customer Representative. The warranty management plan must include, but is not limited to, the following:

a. Roles and responsibilities of personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. For each warranty, the name, address, telephone number, and e-mail of each of the guarantor's representatives nearest to the project location.

c. A list and status of delivery of Certificates of Warranty for extended warranty items, including roofs, HVAC balancing, pumps, motors, transformers, and for commissioned systems, such as fire protection and alarm systems, sprinkler systems, and lightning protection systems.

d. As-Built Record of Equipment and Materials list for each warranted equipment, item, feature of construction or system indicating:

(1) Name of item.
(2) Model and serial numbers.
(3) Location where installed.
(4) Name and phone numbers of manufacturers or suppliers.
(5) Names, addresses and telephone numbers of sources of spare parts.
(6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have warranties longer than one year must be indicated with separate warranty expiration dates.
(7) Cross-reference to warranty certificates as applicable.
(8) Starting point and duration of warranty period.
(9) Summary of maintenance procedures required to continue the warranty in force.
(10) Cross-reference to specific pertinent Operation and Maintenance manuals.
(11) Organization, names and phone numbers of persons to call for warranty service.
(12) Typical response time and repair time expected for various warranted equipment.

e. The plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

f. Procedure and status of tagging of equipment covered by warranties longer than one year.

g. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty or safety reasons.

1.6.2 Performance Bond

The Performance Bond must remain effective throughout the construction and warranty period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Remedial Project Manager will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Remedial Project Manager will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the Remedial Project Manager to proceed against the Contractor.

1.6.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Remedial Project Manager, meet with the Remedial Project Manager to develop a mutual understanding with respect to the requirements of this section. At this meeting, establish and review communication procedures for Contractor

notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Remedial Project Manager for the execution of the construction warranty In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact must be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.6.4 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Engineer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Type of product/material	
Model number	
Serial number	
Contract number	
Warranty period from/to	
Inspector's signature	
Construction Contractor	
Address	
Telephone number	
Warranty contact	
Address	
Telephone number	
Warranty response time priority code	

WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

PART 3 EXECUTION

2.1 AS-BUILT DRAWINGS

Provide and maintain two black line print copies of the PDF contract drawings for As-Built Drawings. Maintain the as-builts throughout construction as red-lined hard copies on site and/or red-lined PDF files. Submit As-Built Drawings 30 days prior to Beneficial Occupancy Date (BOD).

2.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the As-Built drawing. Show what was changed, how it was changed, where item(s) were relocated and change related details. These working as-built markup prints must be neat, legible and accurate as follows:

a. Use base colors of red, green, and blue. Color code for changes as follows:

   (1) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

   (2) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

   (3) Additions (Green) - Added items, lettering in notes and leaders.

b. Provide a legend if colors other than the "base" colors of red, green, and blue are used.

c. Add and denote any additional equipment or material facilities, service lines, incorporated under As-Built Revisions if not already shown in legend.

d. Use frequent written explanations on markup drawings to describe changes. Do not totally rely on graphic means to convey the revision.

e. Use legible lettering and precise and clear digital values when marking prints. Clarify ambiguities concerning the nature and application of change involved.

f. Wherever a revision is made, also make changes to related section views, details, legend, profiles, plans and elevation views, schedules, notes and call out designations, and mark accordingly to avoid conflicting data on all other sheets.

g. For deletions, cross out all features, data and captions that relate to that revision.

h. For changes on small-scale drawings and in restricted areas, provide large-scale inserts, with leaders to the applicable location.

i. Indicate one of the following when attaching a print or sketch to a markup print:

   1) Add an entire drawing to contract drawings

   2) Change the contract drawing to show

   3) Provided for reference only to further detail the initial design.

j. Incorporate all shop and fabrication drawings into the markup drawings.

2.1.2 As-Built Drawings Content

Show on the as-built drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Layout and schematic drawings of electrical circuits and piping.

d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

e. Changes in details of design or additional information obtained from working drawings specified to be prepared or furnished by the Contractor; including but not limited to shop drawings, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment, and foundations.

f. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

g. Changes or Revisions which result from the final inspection.

h. Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup drawings.

i. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

j. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

k. Changes in location of equipment and architectural features.

l. Modifications and compliance with FC 1-300-09N procedures.

m. Actual location of anchors, construction and control joints, etc., in concrete.

n. Unusual or uncharted obstructions that are encountered in the contract work area during construction.

o. Location, extent, thickness, and size of stone protection particularly where it will be normally submerged by water.

Provide Final Approved Shop Drawings upon completion of project.

2.2 RECORD DRAWINGS

Prepare and provide Record Drawings and Source Documents in accordance with FC 1-300-09N. Provide four copies of Record Drawings and Documents on separate CDs or DVDs 30 days after BOD.

2.3 OPERATION AND MAINTENANCE MANUALS

Provide project operation and maintenance manuals as specified in Section 01 78 23 OPERATION AND MAINTENANCE MANUALS DATA. Provide four electronic copies of the Operation and Maintenance Manual files. Submit to the Remedial Project Manager for approval within 90 calendar days of the Beneficial Occupancy Date (BOD). Update and resubmit files for final approval at BOD.

2.4 CLEANUP

Provide final cleaning in accordance with ASTM E1971 and submit two copies of the listing of completed final clean-up items. Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment and comply with the Indoor Air Quality (IAQ) Management Plan. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

2.5 REAL PROPERTY RECORD

Refer to UFC 1-300-08 for instruction on completing the DD FORM 1354. Contact the Remedial Project Manager for any project specific information necessary to complete the DD FORM 1354.

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
08/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971	(2005; R 2011) Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Training Plan ; G

Training Outline ; G

Training Content ; G

SD-11 Closeout Submittals

Training Video Recording ; G

Validation of Training Completion ; G

1.3 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.3.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.3.2 Package Content

Provide data package content in accordance with paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES. Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows.

1.3.3 Changes to Submittals

Provide manufacturer-originated changes or revisions to submitted data if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Remedial Project Manager for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.4 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete electronically linked operation and maintenance directory.

1.4.1 Organization

Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

1.4.2 CD or DVD Label and Disk Holder or Case

Provide the following information on the disk label and disk holder or case:

a. Building Number

b. Project Title

c. Activity and Location

d. Construction Contract Number

e. Prepared For: (Contracting Agency)

f. Prepared By: (Name, title, phone number and email address)

g. Include the disk content on the disk label

h. Date

i. Virus scanning program used

1.5 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are a detailed description of the data package items listed in paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES.

1.5.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.5.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.5.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.5.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.5.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.5.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.5.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.5.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.5.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary

operating records.

1.5.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.5.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.5.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

a. Define the anticipated time required to perform each of each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.5.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.5.3 Repair

Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.5.3.1 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.5.3.2 Wiring Diagrams and Control Diagrams

Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.5.3.3 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.5.3.4 Removal and Replacement Instructions

Provide step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Use a combination of text and illustrations.

1.5.3.5 Spare Parts and Supply Lists

Provide lists of spare parts and supplies required for repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.5.3.6 Repair Work-Hours

Provide manufacturer's projection of repair work-hours including requirements by type of craft. Identify, and tabulate separately, repair that requires the equipment manufacturer to complete or to participate.

1.5.4 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.5.4.1 Product Submittal Data

Provide a copy of SD-03 Product Data submittals documented with the

required approval.

1.5.4.2 Manufacturer's Instructions

Provide a copy of SD-08 Manufacturer's Instructions submittals documented with the required approval.

1.5.4.3 O&M Submittal Data

Provide a copy of SD-10 Operation and Maintenance Data submittals documented with the required approval.

1.5.4.4 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing must show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Group the parts shown in the listings by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.5.4.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components of the system. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.4.6 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference the specific operation and maintenance procedures that must be performed to keep the warranty valid. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.4.7 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.5.4.8 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

1.5.4.9 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.5.4.10 Field Test Reports

Provide a copy of Field Test Reports (SD-06) submittals documented with the required approval.

1.5.4.11 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Provide the O&M data packages specified in individual technical sections. The information required in each type of data package follows:

1.6.1 Data Package 1

a. Safety precautions and hazards

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Extended warranty information

f. Contractor information

g. Spare parts and supply list

1.6.2 Data Package 2

a. Safety precautions and hazards

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan, schedule, and procedures

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Extended warranty information

m. Contractor information

1.6.3 Data Package 3

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Operating log

h. Lubrication data

i. Preventive maintenance plan, schedule, and procedures

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Product submittal data

q. O&M submittal data

r. Parts identification

s. Warranty information

t. Extended warranty information

u. Testing equipment and special tool information

v. Testing and performance data

w. Contractor information

x. Field test reports

1.6.4 Data Package 4

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Operating log

i. Lubrication data

j. Preventive maintenance plan, schedule, and procedures

k. Cleaning recommendations

l. Troubleshooting guides and diagnostic techniques

m. Wiring diagrams and control diagrams

n. Repair procedures

o. Removal and replacement instructions

p. Spare parts and supply list

q. Repair work-hours

r. Product submittal data

s. O&M submittal data

t. Parts identification

u. Warranty information

v. Extended warranty information

w. Personnel training requirements

x. Testing equipment and special tool information

y. Testing and performance data

z. Contractor information

aa. Field test reports

1.6.5 Data Package 5

a. Safety precautions and hazards

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan, schedule, and procedures

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Extended warranty information

s. Testing and performance data

t. Contractor information

u. Field test reports

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TRAINING

Prior to acceptance of the facility by the Remedial Project Manager for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the Facilities Management Specialist, building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address aspects of the Operation and Maintenance Manual submitted in accordance

with Section 01 78 00 CLOSEOUT SUBMITTALS.eOMSI Manual, as submitted in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Training must include classroom or field lectures based on the system operating requirements. The location of classroom training requires approval by the Remedial Project Manager.

3.1.1 Training Plan

Submit a written training plan to the Remedial Project Manager for approval at least 60 calendar days prior to the scheduled training. Training plan must be approved by the Quality Control Manager (QC) prior to forwarding to the Remedial Project Manager. Also, coordinate the training schedule with the Remedial Project Manager and QC. Include within the plan the following elements:

a. Equipment included in training

b. Intended audience

c. Location of training

d. Dates of training

e. Objectives

f. Outline of the information to be presented and subjects covered including description

g. Start and finish times and duration of training on each subject

h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)

i. Instructor names and instructor qualifications for each subject

j. List of texts and other materials to be furnished by the Contractor that are required to support training

k. Description of proposed software to be used for video recording of training sessions.

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC is responsible for overseeing and approving the content and adequacy of the training. Spend 95 percent of the instruction time during the presentation on the OPERATION AND MAINTENANCE DATA. Include the following for each system training presentation:

a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.

b. Relevant health and safety issues.

c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.

d. Design intent.

e. Use of O&M Manual Files.

f. Review of control drawings and schematics.

g. Interactions with other systems.

h. Special maintenance and replacement sources.

i. Tenant interaction issues.

3.1.3 Training Outline

Provide the eOMSI Manual files as specified in Section 01 78 24.00 20, FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI), and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Training Video Recording

Record classroom training session(s) on video. Provide to the Remedial Project Manager two copies of the training session(s) in DVD video recording format. Capture within the recording, in video and audio, the instructors' training presentations including question and answer periods with the attendees. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.1.5 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees that remain unresolved, the instructor must send the answers, in writing, to the Remedial Project Manager for transmittal to the attendees, and the training video must be modified to include the appropriate clarifications.

3.1.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Remedial Project Manager, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.7 Quality Control Coordination

Coordinate this training with the QC in accordance with Section 01 45 00.0 0 20 QUALITY CONTROL.

-- End of Section --

SECTION 01 78 24.00 20

FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
02/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N	(2014; with Change 4, 2018) Navy and Marine Corps Design

1.2 DEFINITIONS AND ABBREVIATIONS

1.2.1 eOMSI Manual

Manual (PDF file) provided by the Contractor that includes, but is not limited to, product information, a facility description with photos, and a list of primary facility systems.

1.2.2 eOMSI Facility Data Workbook (FDW)

A Microsoft Excel file containing required facility information populated by the Contractor.

1.2.3 Systems

The words "system", "systems", and "equipment", when used in this document refer to as-built systems and equipment.

1.2.4 Computer Assisted Design and Drafting (CADD)

Electronic Computer Assisted Design and Drafting graphic software program that is used to create facility design contract documents and Record Drawings.

1.2.5 KTR

An abbreviation for "Contractor."

1.3 EOMSI MEETINGS

1.3.1 Pre-Construction Meeting

Be prepared to discuss the following during this meeting:

a. eOMSI Manual and eOMSI Facility Data Workbook Development Meetings

b. Processes and methods of gathering eOMSI Manual and eOMSI Facility Data Workbook information during construction.

1.3.2 eOMSI Manual and Facility Data Workbook Coordination Meeting

Facilitate a meeting after the Pre-Construction Meeting prior to the submission of the eOMSI Progress Submittal. Meeting attendance must include the Contractor's eOMSI Manual and Facility Data Workbook Preparer, and Quality Control Manager, Remedial Project Manager's Representative, and NAVFAC Public Works (PW) Facilities Management Division (FMD). Include any Mechanical, Electrical, and Fire Protection Sub-Contractors.

The purpose of this meeting is to reach a mutual understanding of the scope of work concerning the contract requirements for eOMSI and coordinate the efforts necessary by both the Government and Contractor to ensure an accurate collection, preparation and timely Government review of eOMSI.

1.4 SUBMITTAL SCHEDULING

1.4.1 eOMSI, Progress Submittal

Submit the Progress submittal when construction is approximately 50 percent complete, to the Remedial Project Manager for approval. Provide eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). Include the elements and portions of system construction completed up to this point.

The purpose of this submittal is to verify progress is in accordance with contract requirements as discussed during the eOMSI Coordination Meeting. Field verify a portion of the eOMSI information in accordance with paragraph FIELD VERIFICATION.

1.4.2 eOMSI, Prefinal Submittal

Submit the 100 percent submittal of the eOMSI Prefinal Submittal to the Remedial Project Manager for approval within 60 calendar days of the Beneficial Occupancy Date (BOD). This submittal must provide a complete, working document that can be used to operate and maintain the facility. Any portion of the submittal that is incomplete or inaccurate requires the entire submittal to be returned for correction. Any discrepancies discovered during the Government's review of eOMSI Progress submittal must be corrected prior to the Prefinal submission.

The eOMSI Prefinal Submittal must include eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel).

1.4.3 eOMSI, Final Submittal

Submit completed eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). The Final submittal is due at BOD. Any discrepancies discovered during the Government's review of the Prefinal eOMSI submittal, including the Field Verification, must be corrected prior to the Final eOMSI submission.

1.5 UNITS OF MEASURE

Provide eOMSI utilizing the units of measure used in the Government generated contract documents.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

eOMSI, Progress Submittal; G

eOMSI, Prefinal Submittal; G

eOMSI, Final Submittal; G

PART 2 PRODUCTS

2.1 eOMSI FILES FORMAT

Format eOMSI manuals and files in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include a complete electronically linked operation and maintenance directory. Provide four electronic copies of the eOMSI Manuals to the Remedial Project Manager for approval.

Provide eOMSI Facility Data Workbook on compact disks (CD) or data digital versatile disk (DVD) disks in (EXCEL) format. Scan eOMSI Manual Files and eOMSI Facility Data Workbook for viruses, malware, and spyware using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

2.1.1 eOMSI Manual Organization

Organize the eOMSI Manuals into two parts: 1) Product and Drawing Information, and 2) Facility Information. Bookmark the PDF files for easy access to the information.

a. Bookmark Product and Drawing Information documents in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

b. Bookmark Facility Information to at least one level lower than the major system.

2.1.2 eOMSI Manual CD or DVD Disk Label and Disk Holder or Case

Provide disks in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.2 eOMSI MANUAL

2.2.1 Product and Drawing Information

Provide an organized record of the facility products, materials, equipment, and minimum information necessary to operate the facility. Provide Product and Drawing Information for the systems in the final constructed facility.

2.2.1.1 O&M Data

As a minimum, provide the approved O&M Data, submitted in the technical

specification sections, in accordance with paragraph TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.2.1.2 Record Drawings

Provide an electronic, PDF copy of the Record Drawings, prepared in accordance with FC 1-300-09N and 01 78 00 CLOSEOUT SUBMITTALS. Bookmark drawings using the sheet title and sheet number.

2.2.1.3 Utility Record Drawings

Using Record Source Drawings, show and document details of the actual installation of the utility systems; annotate and highlight the eOMSI information. Provide Utility Record Drawings in PDF format. Provide the following drawings at a large enough scale to differentiate designated isolation units from surrounding valves and switches.

a. Utility Schematic Diagrams - Provide a one line schematic diagram for each utility system such as power, water, wastewater, and gas/fuel. Schematic diagram must show from the point where the utility line is connected to the mainline up to the five-foot connection point to the facility. Indicate location or area designation for route of transmission or distribution lines; locations of duct banks, manholes/ handholes or poles; isolation units such as valves and switches; and utility facilities such as pump stations, lift stations, and substations.

b. Enlarged Connection and Cutoff Plans - Provide enlarged floor plans that provide information between the five foot utility connection point and where utilities connect to facility distribution. Enlarge floor plans/ elevations of the rooms where the utility enters the building and indicate on these plans locations of the main interior and exterior connection and cutoff points for the utilities. Also enlarge floor plans / elevations of the rooms where equipment is located. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate designations such as room number, panel number, circuit breaker, or valve number, of each utility and equipment connection and cutoff point, and what that connection and cutoff point controls.

2.2.2 Facility Information

Provide the following in Facility Information:

2.2.2.1 General Facility and System Description

Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems and any special building features (for example, HVAC Controls, Sprinkler Systems, Cranes, Elevators, and Generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.

2.2.2.2 Floor Plans

Provide uncluttered, legible 11 by 17 inches floor plans. Include room

numbers, type or function of spaces, and overall facility dimensions on the floor plans. Do not include items such as construction instructions, references, or frame numbers.

2.2.2.3 Floor Coverings, Wall Surfaces, and Ceiling Surfaces

Provide a table that lists by room number (including hallways and common spaces), the type, and area of finish, manufacturer's product name, identifying number, and color. Include a facility summary of the total area for each type of space and floor, wall, or ceiling finish in the table.

2.2.2.4 Windows

Provide a table that lists by room number (including hallways and common spaces), the type of window, window size, number of each size and type, special features, manufacturer's product name, identifying number, and color. The table must include a facility summary of the total number for each type and size of window.

2.2.2.5 Roofing

Provide the total area of each type of roof surface and system. Provide the name of the roofing product and system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers; manufacturer's product name, identifying number, and color. For each type of roof, provide a recommended inspection, maintenance and repair schedule that details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

2.2.2.6 HVAC Filters

Provide a table that lists the quantity, type, size, and location of each HVAC filter, manufacturer's product name, and identifying number.

2.2.2.7 Plumbing Fixtures

Provide a table that lists by room number, the number and type of plumbing and bathroom plumbing fixtures (for example, sinks, water closets, urinals, showers and drinking fountains).

2.2.2.8 Lighting Fixtures

Provide a table that lists by room number (including hallways and common spaces), the type of lighting fixture, ballast, number of lighting fixtures, type of lamps and number of lamps, and the manufacturer's product name and the identifying number. The table must include a facility summary of the total number of fixtures of each type and number of lamps of each type.

2.2.2.9 Equipment Listing

Provide a table that lists the major equipment shown on the design equipment schedules. Show the item descriptions, locations, model numbers; and the names, addresses, and telephone numbers of the manufacturers, suppliers, contractors, and subcontractors.

2.2.2.10 System Flow Diagrams

Provide a flow diagram indicating system liquid, air or gas flow during normal operations. Integrate the system components into the diagram. A compilation of non-integrated, flow diagrams for the individual system components are not acceptable.

2.2.2.11 Valve List

Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

2.2.2.12 Riser Diagrams

Provide riser diagrams and settings of equipment.

2.3 eOMSI FACILITY DATA WORKBOOK

An initial, pre-edited draft of the Model & Facility Data Matrix tab within the eOMSI Facility Data Workbook is attached to this section. The Government will provide this eOMSI Facility Data Workbook electronically to the Contractor upon award. Add, delete, and update Mastersystems, Systems, and Subsystems that may have changed during construction, or any items that may have been omitted or missed during design, at no additional cost to the Government. Complete the KTR Facility Data File tab based on the selection of Mastersystems, Systems, and Subsystems installed. The following tabs are included in the eOMSI Facility Data File Workbook and serve the purpose stated:

a. Instructions Tab: Instructions for completing Model & Facility Data Matrix Tab and KTR Facility Data File Tab. If a discrepancy exists between what is required in this section and the Workbook, the instructions within the workbook take precedence.

b. Model & Facility Data Matrix Tab: - The Matrix lists Required Facility Asset Fields for each SYSTEM and SUBSYSTEM. The Designer of Record selects SYSTEMS and SUBSYSTEMS that are within the project scope, which the Contractor needs to include and populate in KTR Facility Data File tab. The "Required Facility Asset Field Position Numbers," one through seventeen, are pre-populated, and are not editable.

c. Required Facility Asset Fields Tab: Defines the 17 Required Facility Asset Field Position Numbers used in Model and Facility Data Matrix and KTR Facility Data File tabs.

d. KTR Sample Facility Data File Tab: Sample KTR eOMSI facility data file. This tab provides an example of the mandatory fields of equipment installed by the Contractor, and populated in the KTR eOMSI Facility Data File Tab, along with their descriptions.

e. KTR Facility Data File Tab: Required eOMSI facility data file deliverable provided to the Government. Provide a separate and unique new row for each facility component or piece of equipment installed.

PART 3 EXECUTION

3.1 FIELD VERIFICATION

Field verify eOMSI Facility Data Workbook information with Contractor and

Government personnel. Include the following personnel in this meeting: Contractor's eOMSI Manual and Facility Data Workbook Preparer and Quality Control Manager, and the Government's Remedial Project Manager's Representative and NAVFAC PW FMD. Request, and provide, an eOMSI Field Verification Meeting no sooner than 14 calendar days after submission of the Progress eOMSI submittal, and another, no sooner than 14 calendar days after submission of the Prefinal eOMSI submittal. During this meeting, the Government and Contractor will verify that the eOMSI Facility Data Workbook is complete and accurate.

Field verify that at least 5 Subsystems under each of the Mastersystems are accurate, for a total of 25 Subsystems. For each of these items, verify that the required facility asset field, as defined in the "Model & Facility Data Matrix" tab, contains the specified data and it is accurate (i.e. item description, manufacturer, model no., serial no.). 100 percent accuracy of eOMSI information is required for successful field verification. If data discrepancies are discovered amongst the 25 Subsystems verified, resubmit an updated eOMSI FDW, and request a make-up field verification meeting. At the make-up field verification meeting 25 new Subsystems and their associated required facility asset fields will be field verified; the 25 new Subsystems must be 100% accurate. Any discrepancies discovered must be corrected prior to next eOMSI Facility Data Workbook Submittal.

(1) D10 - CONVEYING
(2) D20 - PLUMBING
(3) D30 - HVAC
(4) D40 - FIRE PROTECTION
(5) D50 - ELECTRICAL

3.2 eOMSI TRAINING

Provide training on eOMSI Manuals and Facility Data Workbook in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

-- End of Section --

SECTION 01 79 00

FUNCTIONAL TESTING

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 Perform and verify various functional tests to demonstrate proper operation of mechanical, electrical, and control equipment in the presence of the Owner's Representative.

1.2 RELATED WORK

1.2.1 Operation & Maintenance Data is included in Section 01 78 23.

1.2.2 Process Control is included in 40 60 00.

1.2.3 Equipment Startup and testing requirements are included in Section 01 91 13.

1.3 SUBMITTALS

1.3.1 Submit in accordance with Section 01 33 00, the following:

1.3.1.1 System Functional Test Plan

1.3.1.2 Updated/Final Operation, Maintenance and Monitoring (OMM) Manual.

1.3.1.3 Functional test (s) log/reports.

1.4 FUNCTIONAL TEST PLAN

1.4.1 The functional test plan shall include, but not be limited to:

1.4.1.1 Description of functionality.
1.4.1.2 Operational conditions including normal, alarm, manual, auto, and off mode.
1.4.1.3 Test procedure to demonstrate all functionality and operational condition

1.5 OPERATION & MAINTENANCE AND MONITORING (OMM) MANUAL

1.5.1 A draft OMM plan has been prepared by Owner's representative and included with the bid documents. This document specifies various additional documents to be prepared by the Contractor.

1.5.2 The CONTRACTOR shall review the draft OMM plan and prepare a final OMM manual. The final OMM manual shall include routine and non-routine plant operations and maintenance requirements, detailed startup, testing and monitoring requirements, and documents and reports to be prepared during the O&M phase needed for this project. The plan shall include sampling and analysis procedures for groundwater monitoring and evaluation of the groundwater monitoring results with respect to impacts on groundwater quality. The Contractor shall also prepare Standard Operating Procedures (SOP) and detailed operating procedures (DOP) for this treatment facility. An example SOP indicating the required level of detail is also provided in the draft OMM plan. The final OMM manual shall be submitted as specified in Section 01 33 00.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PERFORMANCE

3.1.1 Prior to start of this functional test, make sure that an updated/finalized Operation Maintenance and Monitoring Manual (OMM) including all required attachments is in place and signed off by all operators.

3.1.2 At least ten (10) days prior to start of the functional test, notify Owner’s representative.

3.1.3 Conduct functional testing and operation demonstrations on all equipment, including (at a minimum) the following. Testing shall be conducted according to the test plan provided by the CONTRACTOR and approved by the Owner’s representative.

3.1.3.1 Verify as-built drawings have been prepared that match actual conditions.

3.1.3.2 Verify that instrument loop descriptions and up to date P&IDs are available.

3.1.3.3 Verify that all valves, instruments and equipment are numbered and match the P&IDs.

3.1.3.4 Verify all Critical Alarms have been set at proper alarm values and tested and documented as per detailed operating procedure (DOP) provided in the OMM Manual.

3.1.3.5 Verify all new piping has been successfully flushed and pressure tested to the required pressure as per Section 41 10 02.

3.1.3.6 Verify that all tanks have been leak tested as per technical specifications and there are no leaks. After the leak test,

all tank levels should be lowered to the middle of their operating range.

3.1.3.7 All chemical tanks shall be drained and cleaned of any foreign material in the bottom of the tank. Ensure all stainless steel piping that will come in contact with hydrogen peroxide has been passivated.

3.1.3.8 Verify all compressed air lines have been successfully flushed and tested to the required pressure per Section 41 10 02.

3.1.3.9 Verify all piping and electrical conduits are properly supported and restrained.

3.1.3.10 Check all bolts for proper tightness/torque on flanges and at connections.

3.1.3.11 Verify that all equipment is properly aligned per the manufacturers' recommendations. An alignment report shall be completed for all such equipment.

3.1.3.12 Verify that all protective guards are installed on all rotating equipment.

3.1.3.13 Verify all hot surfaces are protected from touching by guards.

3.1.3.14 Verify all chemical storage tanks have been labeled with the type and amount of chemical stored in each tank.

3.1.3.15 Verify that there are no tripping hazards at this facility (both inside and outside).

3.1.3.16 Verify all piping is properly labeled and have flow arrows.

3.1.3.17 Verify that all operators have OSHA HAZWOPER training, and submit copies of 40-hour and 8-hour refresher course certifications.

3.1.3.18 Verify chemical spill kits are in place.

3.1.3.19 Verify all operator PPE is available at this facility to respond to a chemical release and/or spill.

3.1.3.20 Verify that the operators know their chain of command and who to call in the event of an emergency.

3.1.3.21 Verify that there is a facility organization chart.

3.1.3.22 Verify that decontamination procedures are in place including decontamination fluids and equipment.

3.1.3.23 Verify that all operators know the location or locations of emergency shutoff for the system.

3.1.3.24 Verify there is a map to the closest hospital included in the site HASP.

3.1.3.25 Verify that laminated emergency procedures are posted in the facility.

3.1.3.26 Verify that the proper number of fire extinguishers are on site and have been tested/checked within the last month, and that the operators have been trained to properly use them.

3.1.3.27 Verify that all required maintenance tools are available at the facility and free from defects.

3.1.3.28 Verify that the most current revision of the SDS are available for the chemicals to be used onsite.

3.1.3.29 Verify that all required regulatory permits are available onsite.

3.1.3.30 Verify that there is an equipment maintenance schedule prepared and the operators trained on the use.

3.1.3.31 Verify that equipment maintenance log sheets are available.

3.1.3.32 Verify that all laboratory equipment, standards, etc. are onsite and within their expiration date.

3.1.3.33 Verify that there are operator round log sheets prepared and the operators trained on when, where and how often to perform these rounds.

3.1.3.34 Verify that the facility is in a neat condition and clear of unnecessary obstructions and debris (both inside and outside the treatment facility).

3.1.3.35 Verify that a joint Owner and Owner’s Representative have performed a safety walk-through of the entire system and approved it safe for operation.

3.1.3.36 Verify that Punchlist items required to be completed prior to startup have been satisfactorily completed.

3.1.3.37 Verify that Local County building and electrical inspectors inspected the facility and approved it for operation.

3.1.3.38 Verify that Owner’s process engineer has inspected the system equipment and is satisfied for system startup.

3.1.3.39 Verify that Owner’s electrical engineer inspected the system electrical equipment and is satisfied for system startup.

3.1.3.40 Verify that Owner’s instrumentation and controls engineer inspected the system equipment and is satisfied for system startup.

3.1.3.41 Verify that major process equipment manufacturer’s representatives have inspected and certified their equipment for proper installation and are ready for testing and startup

as specified in each process equipment specification section. A sample of such certificate is provided in this section.

3.1.3.42 Verify that a formal walk-through of the entire treatment facility by Owner and Owner's Representative has been conducted and that all parties are satisfied for the system startup.

3.1.3.43 Verify that all operators have received adequate training to operate the system. Train treatment plant operators including classroom review and field testing of SOPS and DOPs and the proper use and operation of the HMI control panel to confirm operators are knowledgeable on all aspects of the treatment system.

3.1.3.44 Check building utilities: electrical, communication, ventilation, lighting, compressed air, and potable water and sewer for proper operation. Check all office area HVAC for proper operation.

3.1.3.45 Check and test electrical equipment- transformers, switch gear, control panels, electrical panels, and motors.

3.1.3.46 Test building controls- heating, ventilation and lighting.

3.1.3.47 Confirm new media, cartridge, etc. are in associated vessels.

3.1.3.48 Confirm necessary spare parts are stocked at the Facility (a complete list of all spare parts must be provided in the final OMM manual).

3.1.3.49 Notify suppliers of carbon, acid, caustic and other chemical suppliers of system start and potential schedule for service chemical deliveries.

3.1.3.50 Notify the approved analytical laboratory services prior to startup and testing phase and schedule for required analyses. All samples shall be analyzed by a State of New York accredited laboratory. Only New York -approved and certified laboratories will be allowed to perform the analyses.

3.1.3.51 Verify that all potable water system is operational (safety showers, hose bibs, toilet facility, sanitary holding tank, etc.).

3.1.3.52 Verify that all code inspections have been performed and passed.

3.1.3.53 Verify that all electrical overloads at set to proper value.

3.1.3.54 Verify that the Arc Flash Study has been completed, including Short-Circuit Analysis, Protective Device Evaluation, and Coordination Study in compliance with applicable regulations and guidance, including the Occupational and Health Administration (OSHA) 29 CFR Subpart S, 1910 and the National Fire Protection Association (NFPA) 70E. The Arc Flash Study

shall include the main building electrical panel(s) as well as remote VFD panels. The scope of work includes costs for required Personal Protective Equipment (PPE), labelling and operator training for Arc Flash.

3.1.3.55 Verify that the Operational Readiness Test (ORT) has been completed in accordance with Section 40 60 00.

3.1.4 Coordination:

3.1.4.1 Designate a representative of the CONTRACTOR to be responsible for testing and operation demonstration of systems.

3.1.4.2 Notify Owner’s representative at least 10 days before tests and system operation demonstrations are to begin so Owner’s representative can make arrangements with OWNER to witness testing and demonstration.

3.1.4.3 Reschedule cancelled tests and operation demonstrations 5 days in advance.

3.1.5 Reports:

3.1.5.1 Prepare a report for each system on the results and activities encompassing testing as required by this section. Submit the report within 2 days of completion of each test.

3.1.5.2 At a minimum, reports shall describe findings of inspections; revisions, modifications or replacement of equipment; calibrations; test results; dates and names of persons involved and observing inspections, testing, and other activities pertaining to components and systems; and statement regarding operational condition of components and systems.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

OWNER _____

Project
_____

Contract No.
_____

EQUIPMENT SPECIFICATION SECTION NO.
_____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
___
(Print Manufacturer's Name)

hereby CERTIFY that
_____
(Print equipment name and model with serial no.)

_____

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date_____

Time_____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date:_____

-- END OF SECTION --

SECTION 01 91 00.15 10

TOTAL BUILDING COMMISSIONING
05/19

PART 1 GENERAL

1.1 SUMMARY

Commission the building systems listed herein. Employ the services of an independent Commissioning Firm. The Commissioning Firm must be a 1st tier subcontractor of the General or Prime Contractor and must be financially and corporately independent of all other subcontractors. The Commissioning Firm must employ a Lead Commissioning Specialist that coordinates all aspects of the commissioning process. Conform to the commissioning procedures outlined in this specification.

1.2 UNIFIED FACILTIES GUIDE SPECIFICATION REFERENCES

This specification section is intended to work in conjunction with the requirements included in the Unified Facilities Guide Specifications (UFGS) referenced within this specification section. Comply with the requirements of the referenced UFGS to the extent specified herein. UFGS can be found at on the Whole Building Design Guide website at: http://www.wbdg.org/

1.3 SYSTEMS TO BE COMMISSIONED

Commission the following systems:

Heating, Ventilating, Air Conditioning, and Refrigeration Systems (HVAC)
Building Automation System
Control System
Lighting Systems
Power Distribution Systems
Plumbing Systems
Natural Gas and Propane Systems
Water Pumping Systems

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 180	(2012) Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
ASHRAE 202	(2013; Addenda B 2018) Commissioning Process for Buildings and Systems

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline	(2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard	(2009) Procedural Standards for Whole Building Systems Commissioning of New Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

ANSI/SMACNA 014	(2013) HVAC Systems Commissioning Manual, 2nd Edition

1.5 COMMUNICATION WITH THE GOVERNMENT

The Lead Commissioning Specialist (CxC) must submit all plans, schedules, reports, and documentation directly to the Contracting Officer Representative concurrent with submission to the CQC System Manager. The Lead Commissioning Specialist must have direct communication with the Contracting Officer's Representative regarding all elements of the commissioning process; however, the Government has no direct contract authority with the Lead Commissioning Specialist.

1.6 SEQUENCING AND SCHEDULING

1.6.1 Sequencing

Complete the following prior to starting Functional Performance Tests of mechanical systems:

a. All equipment and systems have been completed, cleaned, flushed, disinfected, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications.

b. Performance Verification Tests of the controls systems have been completed and the Performance Verification Test Report has been submitted and approved in accordance with UFGS Section 23 09 00 Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

c. Testing, Adjusting, and Balancing has been completed and the Testing, Adjusting, and Balancing Report, has been submitted and approved in accordance with UFGS Section 23 05 93Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

d. The Pre-Functional Checklists have been submitted and approved.

e. The Certificate of Readiness for mechanical systems has been submitted and approved.

Complete the following prior to starting Functional Performance Tests of the electrical systems:

a. All electrical, power generation, and lighting equipment and systems have been completed, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications.

b. The building envelope is enclosed according to contract documents with final construction completed.

c. Ceiling tiles, floor coverings, and window coverings are in place.

d. The Certificate of Readiness for electrical systems has been submitted and approved.

e. Lamps have completed a minimum 100 hour burn-in period.

f. Furniture is in place.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Commissioning Firm; G, DO

Lead Commissioning Specialist; G, DO

Technical Commissioning Specialists; G, DO

Commissioning Firm's Contract; G, DO

SD-05 Design Data

Design Phase Commissioning Plan; G, DO

SD-06 Test Reports

Design Review Report; G, DO

Interim Construction Phase Commissioning Plan; G, DO

Final Construction Phase Commissioning Plan; G, DO

Template Building Envelope Inspection Checklists; G, DO

Building Envelope Inspection Checklists; G, DO

Pre-Functional Checklists; G, DO

Issues Log

Commissioning Report; G, DO

Post-Construction Trend Log Report; G, DO

SD-07 Certificates

Certificate of Readiness; G, DO

SD-10 Operation and Maintenance Data

Training Plan; G, RO

Training Attendance Rosters; G, RO

Systems Manual; G, DO

Systems Manual G, DO

Maintenance and Service Life Plans; G, DO

SD-11 Closeout Submittals

Final Commissioning Report; S, DO

Final Construction Phase Commissioning Plan; S

1.8 SUBMITTALS

In accordance with Section 01 33 00, submit name, address and resume of proposed field services technicians at least 30 days in advance of the need for such services.

This section provides general guidelines for various steps required for the equipment startup and testing phase. The Contractor shall prepare and, submit, a detailed Equipment Startup and Testing Plan for equipment testing and startup as specified in the various equipment sections. At a minimum, submittals shall include the following:

a. The Equipment Startup and Testing Plan shall be submitted at least 60 days in advance of the proposed test dates and shall include at least the following information:

(1) Name of equipment to be tested, including reference to specifications section number and title.

(2) Testing schedule of proposed dates and times for testing.

(3) Summary of power, lighting, chemical, water, etc., needs and identification of who will provide them and the quantity needed for testing.

(4) Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.

(5) Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, EPA Standard Methods, etc).

(6) Samples of forms to be used to collect and record test data and to present tabulated test results.

b. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect

actual conduct of the tests and the following additional information:

(1) Copy of all test data sheets and laboratory analytical reports.

(2) Summary comparison of specified test and performance requirements vs. actual test results.

(3) Should actual test results fail to meet specified test and performance requirements, describe action(s) to be taken prior to retest the equipment.

c. Copies of the field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, final setting for the equipment, a copy of all the manufacturer's startup checklists and other applicable paperwork.

1.9 COMMISSIONING FIRM

Provide a Commissioning Firm that is certified in commissioning by one of the following: the AABC Commissioning Group (ACG); the National Environmental Balancing Bureau (NEBB); the International Certification Board/Testing, Adjusting, and Balancing Bureau (ICB/TABB), the Building Commissioning Association (BCA); the Association of Energy Engineers (AEE). The Commissioning Firm must be certified in all systems to be commissioned to the extent such certifications are available from the certifying body. Describe any lapses in certification or disciplinary action taken by the certifying body against the proposed Commissioning Firm or Lead Commissioning Specialist in detail. Any firm or commissioning professional that has been the subject of disciplinary action by the certifying body within the five years preceding contract award is not eligible to perform any duties related to commissioning.

a. Submit the Commissioning Firm's certification of qualifications including the name of the firm and certifications no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

b. The Commissioning Firm's and Commissioning Specialists' certifications must be maintained for the entire duration of the duties specified herein. If, for any reason, the firm or a specialist loses a certification during this period, immediately notify the Contracting Officer's Representative and submit another Commissioning Firm or Commissioning Specialist for approval. All work specified in this specification section performed by the Commissioning Firm or associated Commissioning Specialists is invalid if the Commissioning Firm or Commissioning Specialist loses its certification prior to contract completion and must be performed by an approved successor.

c. The Commissioning Firm must oversee and assist the General or Prime Contractor with the work specified herein. Submit the Commissioning Firm's Contract including the Scope of Work associated with the paragraph POST-CONSTRUCTION SUPPORT no later than 30 calendar days after approval of the Commissioning Firm. Submit one hard copy and an electronic copy.

1.9.1 Lead Commissioning Specialist

The Commissioning Firm must provide a Lead Commissioning Specialist (CxC) that has a minimum of five years of commissioning experience, including two projects of similar size and complexity, and that is one of the following: a NEBB qualified Systems Commissioning Administrator (SCA); ACG Certified Commissioning Authority (CxA); ICB/TABB Certified Commissioning Supervisor; BCA Certified Commissioning Professional (CCP); AEE Certified Building Commissioning Professional (CBCP); University of Wisconsin-Madison Qualified Commissioning Process Provider (QCxP); ASHRAE Commissioning Process Management Professional (CPMP).

a. Submit the Lead Commissioning Specialist's certification of qualifications including the name of the specialist and firm; certifications; years of experience; and a listing of representative projects of similar size and complexity no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

b. The Lead Commissioning Specialists certifications must be maintained for the entire duration of the duties specified herein. If, for any reason, the specialist loses a certification during this period, immediately notify the Contracting Officer's Representative and submit another Lead Commissioning Specialist for approval. All work specified in this specification section to be performed by the Lead Commissioning Specialist is invalid if the Lead Commissioning Specialist loses its certification prior to contract completion and must be performed by an approved successor.

c. The Lead Commissioning Specialist must lead and oversee the commissioning work specified herein and be the primary point of contact for the Government regarding the commissioning work. One of the Technical Commissioning Specialists may be the Lead Commissioning Specialist provided that all of the qualification requirements are met.

1.9.2 Technical Commissioning Specialists

Technical Commissioning Specialists, employed by the Commissioning Firm and that have the following qualifications, must perform the technical work specified herein associated with each system to be commissioned:

a. Mechanical Technical Commissioning Specialist: The technical work associated with mechanical systems including Heating, Ventilating, Air Conditioning; Building Automation System; Control System; Service Water Heating Systems; Plumbing Systems; Water Pumping; ; ; Energy and Water Utility Metering Systems must be performed by a Commissioning Specialist certified by NEBB, ACG, ICB/TABB, or BCA in the commissioning of HVAC systems with five years of experience in the commissioning of HVAC systems.

b. Electrical Technical Commissioning Specialist: The technical work associated with electrical systems including Lighting Systems; Power Distribution Systems; Power Generation Systems; ; Electrical Utility Metering Systems must be performed by an engineering technician certified by the InterNational Electrical Testing Association (NETA) with five years of experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

c. Submit the Technical Commissioning Specialist's certification of qualifications including the name of the specialist and firm; certifications; years of experience; and a listing of representative projects of similar size and complexity no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

1.9.3 Commissioning Standard

Comply with the requirements of the commissioning standard under which the Commissioning Firm and Specialists qualifications are approved. When the firm and specialists are certified by BCA, AEE, ASHRAE, or the University of Wisconsin-Madison, comply with the requirements of one of the acceptable standards unless otherwise stated herein. The acceptable standards are ACG Commissioning Guideline, NEBB Commissioning Standard, ANSI/SMACNA 014, or ASHRAE 202. Comply with applicable NETA testing standards for electrical systems.

a. Implement all recommendations and suggested practices contained in the Commissioning Standard and electrical test standards.

b. Use the Commissioning Standard for all aspects of Commissioning, including calibration of instruments.

c. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, adhere to the manufacturer calibration recommendations.

d. All quality assurance provisions of the Commissioning Standard such as performance guarantees are part of this contract.

e. The Commissioning Specialists must develop commissioning procedures for any systems or system components not covered in the Commissioning Standard.

f. Use any new requirements, recommendations, and procedures published or adopted prior to contract solicitation by the body responsible for the Commissioning Standard.

1.10 ISSUES LOG

The Lead Commissioning Specialist must develop and maintain an Issues Log for tracking and resolution of all deficiencies discovered through submittal reviews, inspection, and testing. Include the date of final resolution of issues as confirmed by the Commissioning Specialist. Submit the Issues Log on a monthly basis at a minimum. At any point during construction, any commissioning team member finding deficiencies may communicate those deficiencies in writing to the Commissioning Specialist for inclusion into the Issues Log.

Track construction deficiencies identified in the Issues Log using QCS as specified in Specification Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM).

1.11 CERTIFICATE OF READINESS

Prior to scheduling Functional Performance Tests for each system, issue a Certificate of Readiness for the system certifying that the system is ready for Functional Performance Testing. The Certificate of Readiness must include, for each system to be commissioned, all equipment and system

start-up reports; Performance Verification Test Reports; completed Building Envelope Inspection Checklists; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; HVAC Controls Start-Up Reports; and the Air Leakage Test Reports and Diagnostic Test Reports to the extent applicable to the system. The Contractor; the Lead Commissioning Specialist; the Contractor's Quality Control Representative; the Mechanical, Electrical, Controls, and TAB subcontractor representatives must sign and date the Certificate of Readiness. Submit the Certificate of Readiness for each system no later than 14 calendar days prior to Functional Performance Tests of that system. Submit one hard copy and an electronic copy. Do not schedule Functional Performance Tests for a system until the Certificate of Readiness for that system receives approval by the Government.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 PRELIMINARY REQUIREMENTS

After installation of the equipment has been completed and the equipment is presumably ready for operation, complete functional test.Verify that the field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

a. Soundness (without cracks or otherwise damaged parts).

b. Correctness of setting, alignment and relative arrangement of various parts.

c. Check that all equipment, skids, and piping are properly fastened to a concrete foundation and that all bolts are completely tight.

d. Adequacy and correctness of packing, sealing and lubricants.

e. Check adequacy and tightness of all connections and verification that all power, compressed air, control cabling, communications, and other utilities are properly connected and functional.

The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

Upon completion of this work, the field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments and tests. The report shall contain copies of all of the field notes from the inspection.

3.2 STARTUP OF THE TREATMENT PLANT AND RELATED SYSTEMS

General Requirements

a. Successfully execute the step-by-step procedure of startup specified herein.

b. The startup shall be successfully executed prior to Substantial

Completion and acceptance by the OWNER.

Preparation for Startup

a. Upon completion of the treatment plant and all its related systems, all tanks, equipment and piping shall be flushed with potable water and hydraulically checked for leaks, cracks, and defects.

b. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the various pumps and other remaining equipment shall be made.

c. All systems shall be cleaned and purged as required Check that all valves shall be checked for proper operation and control, and there are no hindrances to valves fully opening and closing.

d. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made. All settings for all instrumentation shall be recorded and provided in separate cover.

e. No testing or equipment operation shall take place until it has been verified by the OWNER's representative that all specified safety equipment has been installed and is in good working order.

f. No testing or equipment operation shall take place until it has been verified by the OWNER's representative that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

Facilities Startup

a. Startup period shall not begin until all new treatment facilities and equipment have been tested as specified and are ready for operation. The OWNER shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup. All valve tagging shall also be complete prior to this startup.

b. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the OWNER and ENGINEER.

c. The CONTRACTOR shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc., and field service personnel on as need basis during the following three testing/startup phases.

d. Do not, at any time, during startup allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions and tolerances for which the equipment was designed.

3.3 CONSTRUCTION PHASE

3.3.1 Construction Commissioning Coordination Meeting

The Lead Commissioning Specialist must lead a Construction Commissioning Coordination Meeting no later than 14 days after approval of the Commissioning Firm and Commissioning Specialists30 days following construction notice to proceed to discuss the commissioning process including contract requirements, lines of communication, roles and responsibilities, schedules, documentation requirements, inspection and test procedures, and logistics as specified in this specification section. The Contractor's Superintendent or Project Manager, the Contractor's Quality Control Representative, and the Government must attend this meeting. Invite the User and a Reserve Support Command Representative, to attend this meeting.

3.3.2 Design Phase Commissioning Plan

The design phase commissioning plan does not form a part of this contract and is provided for commissioning review purposes only.

3.3.3 Construction Phase Commissioning Plan

3.3.3.1 Interim Construction Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Interim Construction Phase Commissioning Plan. Submit the Interim Construction Phase Commissioning Plan no later than 30 calendar days after the Construction Commissioning Coordination Meeting and no later than 14 days prior to the start of construction of the building envelope. Submit one hard copy and an electronic copy.

Identify the commissioning and testing standards and outline the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, lines of communication, documentation requirements for the construction phase of the project, and Template Building Envelope Inspection Checklists in the Interim Construction Phase Commissioning Plan.

3.3.3.1.1 Checklists

Download example Building Envelope Inspection Checklists, Pre-Functional Checklists, Integrated Systems Test Checklists, and Functional Performance Test Checklists for specification section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING at the following location:
http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic
The checklists submitted in the Interim and Final Construction Phase Commissioning Plans must contain the same level of detail shown in the examples. The submitted checklists are not required to match the format of the examples.

3.3.3.1.2 Template Building Envelope Inspection Checklists

The Building Envelope Technical Commissioning Specialist must develop the Template Building Envelope Inspection Checklists. Include all items that verify the building materials and construction maintain the required thermal and moisture integrity and air tightness of the building envelope system in the Building Envelope Inspection Checklists.

3.3.3.2 Final Construction Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Final Construction Phase Commissioning Plan. Submit the Final Construction Phase Commissioning Plan no later than 30 calendar days prior to the start of Pre-Functional Checks. Submit one hard copy and an electronic copy. Once approved, file the approved plan in the Sustainability eNotebook.

Include the information provided in the Interim Construction Phase Commissioning Plan. In addition, the Technical Commissioning Specialist must develop the Pre-Functional Checklists, Integrated Systems Test Checklists, and Functional Performance Test Checklists for each building, for each system required to be commissioned, and for each component for inclusion in the Final Construction Phase Commissioning Plan.

3.3.3.2.1 Pre-Functional Checklists

The Pre-Functional Checklists must include items for physical inspection or testing that demonstrate that installation and start-up of equipment and systems is complete. Refer to paragraph Pre-Functional Checks for more information.

3.3.3.2.2 Functional Performance Test Checklists

Functional Performance Test Checklists must include procedures that explain, step-by-step, the actions and expected results that will demonstrate that the system performs in accordance with the contract. Refer to paragraph Functional Performance and Integrated Systems Tests for more information. Include the following sections and details appropriate to the systems being tested in the Functional Performance Test Checklists:

a. Notable system features including information about controls to facilitate understanding of system operation

b. Conclusions and recommendations. Conclusions must clearly indicate if system does or does not perform in accordance with contract requirements. Recommendation must clearly indicate that the system should or should not be accepted by the Government.

c. Test conditions including date, beginning and ending time, and beginning and ending outdoor air conditions

d. Attendees

e. Identification of the equipment involved in the test

f. Control system feature identification

g. Point-to-point observations including demonstrating system flow meters and sensors have been calibrated and are correctly displayed on the Operator work station

h. Actuator operation observations demonstrating actuator responses to commands from the control system

i. As-found condition of the system operation

j. List of test items with step numbers along with the corresponding

feature or control operation, intended test procedure, expected system response, and pass/fail indication.

k. Space for comments for each test item.

3.3.3.2.3 Integrated Systems Test Checklists

Integrated Systems Test Checklists must include test procedures that explain, step-by-step, the actions and expected results that will demonstrate that the interactive operations between systems performs in accordance with the contract. Refer to paragraph Functional Performance and Integrated Systems Tests for more information. Include the following sections in the Integrated Systems Test Checklists:

a. Notable features of the interconnected systems organized by discipline including information to facilitate understanding of system operation

b. Conclusions and recommendations. Conclusions must clearly indicate if the systems do or do not perform in accordance with contract requirements. Recommendation must clearly indicate that the systems should or should not be accepted by the Government

c. Test conditions including date and beginning and ending time

d. Attendees

e. Identification of the equipment and systems involved in the test

f. List of test items with step numbers along with the corresponding feature or control operation, intended test procedure, expected system response, and pass/fail indication.

g. Space for comments for each test item.

3.3.4 Design Review

The Lead Commissioning Specialist and Technical Commissioning Specialists must review the construction contract plans and specifications.

a. Advise the Contracting Officer's Representative of any discrepancies between the Basis of Design and deficiencies of the design to comply with the Basis of Design, and deficiencies that would prevent the building systems and features from operating or performing effectively and from being adequately maintainable.

b. The Commissioning Specialists must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation or performance. Submit one hard copy and an electronic copy of the report to the Contracting Officer's Representative no later than 14 days after approval of the Commissioning Specialists.

c. The Lead Commissioning Specialist must participate in a meeting to discuss any items contained in the report no later than 14 calendar days after submission of the report.

3.3.5 Construction Submittals

Provide all submittals associated with the systems to be commissioned,

including shop drawings; equipment submittals; test plans, procedures, and reports; and resubmittal's to the Commissioning Specialists. The Technical Commissioning Specialist must review the submittals to the extent necessary verify that the equipment and system installation will comply with the contract requirements, the Unified Facilities Criteria (UFC) referenced by the design-build contract, and the requirements of the Basis of Design and the Owner's Project Requirements Document.

3.3.6 Inspection and Testing

Demonstrate that all system components have been installed, that each control device and item of equipment operates, and that the systems operate and perform, including interactive operation between systems, in accordance with contract documents and the Owner's Project Requirements. Requirements in related specification sections are independent from the requirements of this section and do not satisfy any of the requirements specified in this specification section. Provide all materials, services, and labor required to perform the Pre-Functional Checks, Building Envelope Inspection, Integrated Systems Tests, and Functional Performance Tests.

3.3.6.1 Commissioning Team

Provide a commissioning representative for each sub-contractor associated with the systems to be commissioned. Each commissioning representative is responsible for coordination of their respective sub-contractor's execution of the commissioning activities and participation in the inspection and testing required by this specification section. The designers listed below are the designers of record for their respective systems. Substitutes must be approved by the Contracting Officer's Representative.

3.3.6.1.1 Building Envelope Inspections Team

The following team members must participate in building envelope inspections:

Designation	Function
CxB	Building Envelope Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
BEC	Contractor's Building Envelope Commissioning Representative

3.3.6.1.2 Mechanical System Pre-Functional Checks Team

The following team members must participate in Pre-Functional checks of mechanical systems:

Designation	Function
CxM	Mechanical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
MC	Contractor's Mechanical Commissioning Representative
EC	Contractor's Electrical Commissioning Representative
CC	Contractor's Controls Commissioning Representative
TABC	Contractor's TAB Commissioning Representative
PC	Contractor's Plumbing Commissioning Representative
IC	Contractor's Irrigation Commissioning Representative

3.3.6.1.3 Electrical System Pre-Functional Checks Team

The following team members must participate in Pre-Functional checks of electrical systems:

Designation	Function
CxE	Electrical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
EC	Contractor's Electrical Commissioning Representative

3.3.6.1.4 Mechanical Systems Test Team

The following team members must participate in Functional Performance and Integrated Systems Testing of mechanical systems:

Designation	Function
CxM	Mechanical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
MC	Contractor's Mechanical Commissioning Representative
EC	Contractor's Electrical Commissioning Representative

Designation	Function
CC	Contractor's Controls Commissioning Representative
TABC	Contractor's TAB Commissioning Representative
PC	Contractor's Plumbing Commissioning Representative
IC	Contractor's Irrigation Commissioning Representative
MD	Mechanical Designer
PD	Plumbing Designer

3.3.6.1.5 Electrical Systems Test Team

The following team members must participate in Functional Performance and Integrated Systems Testing of electrical systems:

esgnation	Function
CxE	Electrical System Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
EC	Contractor's Electrical Commissioning Representative
ED	Electrical Designer

3.3.6.1.6 Other Pre-Functional and Functional Performance Participants

The following may participate as team members during Pre-Functional Checks and Functional Performance Testing:

Designation	Function
DPW	Directorate of Public Works Representative
BCE	Base Civil Engineer Office Representative
RSC	Reserve Support Command Representative
User	Using Agent's Representative

3.3.6.2 Building Envelope Inspection

Document building envelope inspection by the commissioning team using the approved Template Building Envelope Inspection Checklists. Indicate commissioning team member inspection and acceptance of each Building Envelope Inspection Checklist item by initials at the time they are inspected and found to be in conformance with contract requirements.

Inspect checklist items before they become hidden as construction progresses.

a. Submit the completed and initialed Building Envelope Inspection Checklists no later than 7 calendar days after completion of inspection of all checklists items. Submit one hard copy and an electronic copy.

b. The Building Envelope Technical Commissioning Specialist must make at least two site visits to the site to observe construction of the building envelope in-progress. On each visit, the Building Envelope Commissioning Specialist must review the Contractor's in-progress checklists to ensure that the commissioning team is inspecting the building envelope as required.

c. The Building Envelope Technical Commissioning Specialist must witness the building envelope pressure tests and diagnostic tests specified in UFGS Section 07 05 23Specification Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS. The Building Envelope Technical Commissioning Specialist must review the resulting reports and provide recommendations for correction of any deficiencies or further testing.

3.3.6.3 Pre-Functional Checks

Pre-Functional Checklists from the approved Final Construction Phase Commissioning Plan must be completed by the commissioning team. Complete one Pre-Functional Checklist for each individual item of equipment or system for each system required to be commissioned including, but not limited to, ductwork, piping, equipment, fixtures (lighting and plumbing), and controls. Indicate commissioning team member inspection and acceptance of each Pre-Functional Checklist item by initials. Acceptance of each Pre-Functional Checklist item by each team member indicates that item conforms to the construction contract and accepted design requirements in their area of responsibility. Technical Commissioning Specialist acceptance of each Pre-Functional Checklist item indicates that each item has been installed correctly and in accordance with contract documents and the Owner's Project Requirements. Submit the completed and initialed Pre-Functional Checklists no later than 7 calendar days after completion of inspection of all checklists items for each system. Submit one hard copy and an electronic copy. Include manufacturer start-up checklists associated with equipment with the submission of the Pre-Functional Checklists.

3.3.6.4 Testing, Adjusting, and Balancing (TAB) Report and Field Acceptance Testing

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by UFGS Section 23 05 93Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. Resolve all deficiencies prior to TAB Field Acceptance Testing.

The Mechanical System Technical Commissioning Specialist must witness the TAB Field Acceptance Testing specified by UFGS Section 23 05 93 Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Include a certification by the Mechanical Technical Specialist that no outstanding deficiencies exist in the systems relative to Testing,

Adjusting, and Balancing with the final TAB Report submittal.

3.3.6.5 HVAC Controls Test Reports

The Mechanical System Technical Commissioning Specialist must review the Start-Up Testing Report and the PVT Procedures and Reports required by UFGS Section 23 09 00Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC . Include a certification by the Mechanical System Technical Commissioning Specialist that the submittals contain no deficiencies or that the submittals do not indicate any deficiencies in the HVAC systems or HVAC control systems with each of these submittals.

3.3.6.6 Tests

3.3.6.6.1 Functional Performance and Integrated Systems Tests

Schedule Functional Performance Tests for each system only after the Certificate of Readiness has been approved by the Government for the system. Correct all deficiencies identified through any prior review, inspection, or test activity before the start of Functional Performance Tests. Perform Integrated Systems Tests only after the Functional Performance Tests for each associated system are completed with all deficiencies resolved and after the related Functional Performance Test Checklists have been signed by each commissioning team member.

a. Functional Performance Tests and Integrated Systems Tests must be performed with the Contracting Officer's Quality Assurance Representative present.

b. Abort Functional Performance Tests or Integrated Systems Tests when any system deficiency prevents the successful completion of the test.

c. Technical Commissioning Specialists must lead and document all Functional Performance Tests and Integrated Systems Tests for the systems to be commissioned with the Contractor and appropriate sub-contractors performing the Functional Performance Tests and Integrated Systems Tests. The representatives listed in the paragraph Commissioning Team must attend the tests. Abort Functional Performance Tests or Integrated Systems Tests when any required commissioning team member is not present for the test.

3.3.6.6.1.1 Checklist

Use the Functional Performance Test and Integrated Systems Test Checklists from the approved Final Construction Phase Commissioning Plan to guide the Functional Performance Tests and Integrated Systems Tests. Functional Performance Tests must be performed for each item of equipment and each system required to be commissioned and verify all sensor calibrations, control responses, safeties, interlocks, operating modes, sequences of operation, capacities, lighting levels, and all other performance requirements comply with construction contract and accepted design requirements regardless of the specific items listed within the Functional Performance Test and Integrated Systems Test Checklists provided. Testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. Integrated Systems Tests must be performed for the interactive operation between systems such as HVAC systems, fire protection systems, back-up electrical supply, energy generation systems, and other systems, and verify correct interactive operation, acceptable speed of response, and other contract requirements

for both normal and failure modes. Examples of Integrated Systems Tests include the correct operation of HVAC systems during emergency system activation, correct operation of uninterruptible power supplies or energy generators and connected systems, or lighting system operation during power outage or emergency system activation. The order of components and systems to be tested must be determined by the Technical Commissioning Specialists.

3.3.6.6.1.2 Acceptance

Indicate acceptance of each item of equipment and systems tested by signature of each commissioning team member for each Functional Performance Test or Integrated Systems Test Checklist. The Contractor's Quality Control Representative and the Technical Commissioning Specialists must indicate acceptance after the equipment and systems are free of deficiencies.

3.3.6.6.2 HVAC Test Methods

Perform Functional Performance Tests in accordance with the following:

3.3.6.6.2.1 Prior to Testing

Prior to testing operating modes, sequences of operation, interlocks, and safeties, complete control point-to-point observations, test sensor calibrations, and test actuator commands.

3.3.6.6.2.2 Simulating Conditions

Over-writing control input values through the controls system is not acceptable, unless approved by the Contracting Officer's Representative. Identify proposed exceptions in a protocol submitted to the Contracting Officer's Representative for approval. Before simulating conditions, overwriting values (if approved), or changing set-points, calibrate all sensors, transducers and devices. Below are several examples of exceptions that would be considered acceptable:

a. When varying static pressures inside ductwork can not be simulated within the duct, and where a sensor signals the controls system to initiate sequences at various duct static pressures, it is acceptable to simulate the various pressures with a Pneumatic Squeeze-Bulb Type Signaling Device with gauge temporarily attached to the sensing tube leading to the transmitter. It is not acceptable to reset the various set-points, nor to simulate an electric analog signal (unless approved as noted above).

b. Dirty filter pressure drops can be simulated using sheets of cardboard at filter face.

c. Freeze-stat safeties can be simulated by packing portion of sensor with ice.

d. High outside air temperatures can be simulated with a hair blower.

e. High entering cooling coil temperatures can be used to simulate entering cooling coil conditions.

f. Do not use signal generators to simulate sensor signals unless approved by the Contracting Officer's Representative, as noted above,

for special cases.

g. Control set points can be altered. For example, to see the air conditioning compressor lockout work at an outside air temperature below 55 degrees F, when the outside air temperature is above 55 degrees F, temporarily change the lockout set point to be 0 degrees F above the current outside air temperature. Caution: Set points are not to be raised or lowered to a point such that damage to the components, systems, or the building structure and/or contents will occur.

h. Test duct mounted smoke detectors in accordance with the manufacturer's recommendations. Perform the tests with air system at minimum airflow condition in ductwork.

i. Test current sensing relays used for fan and pump status signals to control system to indicate unit failure and run status by resetting the set point on the relay to simulate a lost belt or unit failure while the unit is running. Confirm that the failure alarm was generated and received at the control system. After the test is conducted, return the set point to its original set-point or a set-point as indicated by the Contracting Officer's Representative.

3.3.6.6.2.3 Setup

Perform each test under conditions that simulate actual conditions as close as is practically possible. Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion of the test, return the affected building equipment and systems to their pre-test condition.

3.3.6.6.3 Sample Strategy

Perform Functional Performance Tests using the following sample strategy. Prepare and complete a Functional Performance Test Checklist for each item of equipment or system to be tested. For sample sizes less than 100 percent for all similar equipment, the Government will select the specific equipment or system to be tested during testing. Equipment Identifiers are as indicated on the design drawings:

Equipment Identifier	Sample Size (Percent)
AHU	
VAV	
CUH	
CWP	
DWH	
Lighting Controls	
Renewable Energy Systems/Equipment	

Perform Integrated Systems Tests for all systems and equipment having

interactive operation.

Perform Functional Performance Tests and Integrated Systems Tests for all equipment and systems. Prepare and complete a Functional Performance Test Checklist for each item of equipment or system. Prepare and complete an Integrated Systems Test Checklist for each item of equipment or system.

3.3.6.6.4 Seasonal Tests

3.3.6.6.4.1 Initial Functional Performance Tests

Perform Initial Functional Performance Tests as soon as all contract work is completed, regardless of the season. Develop and implement means of artificial loading to demonstrate, to a reasonable level of confidence, the ability of the HVAC systems to handle peak seasonal loads.

3.3.6.6.4.2 Full-Load Conditions

In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems under full-load conditions during peak heating and cooling seasons during outdoor air condition design extremes.

Schedule Seasonal Functional Performance Tests in coordination with the Government.

3.3.6.6.4.3 System Acceptance

Systems may be partially accepted by the Government prior to seasonal testing if they comply with all construction contract and accepted design requirements that can be tested during initial Functional Performance Tests. All Functional Performance Test procedures must be completed prior to full systems acceptance.

3.3.6.6.5 Aborted Tests and Re-Testing

Abort Functional Performance Tests, Integrated Systems Tests, or Seasonal Tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Reimburse the Government for all costs associated with effort lost due to re-testing due to test failures and aborted tests. These costs must include salary, travel costs, and per diem for Government commissioning team members. Re-test only after all deficiencies identified during the original tests have been corrected.

3.3.6.6.5.1 100 Percent Sample

Systems or equipment for which 100 percent sample size are tested fail if one or more of the test procedures results in discovery of a deficiency and the deficiency cannot be resolved within 5 minutes during the test.

Re-test to the extent necessary to confirm that the deficiencies have been corrected without negatively impacting the performance of the rest of the system.

3.3.6.6.5.2 Less than 100 Percent Sample

For systems tests with a sample size less than 100 percent, if one or more of the test procedures for an item of equipment or a system results

in discovery of a deficiency, regardless of whether the deficiency is corrected during the sample tests, the item of equipment or system fails the test.

a. If the system failure rate is 5 percent or less, meaning that 5 percent or less of the equipment or systems had at least one deficiency, re-test only on the items which experienced the initial failures.

b. If the system failure rate is higher than 5 percent, meaning that more than 5 percent of equipment or systems tested had at least one deficiency, re-test the items which experienced the initial failures to the extent necessary to confirm that the deficiencies have been corrected . In addition, test another random sample of the same size as the initial sample for the first time. If the second random sample set has any failures, re-test those failed items and all remaining equipment and systems to complete 100 percent testing of that system type.

3.3.7 Training Plan

Develop a training plan which identifies all training required by specification sections associated with commissioned systems. Include a matrix listing each training requirement, content of the training, the trainer name, trainer contact information, and schedule and location of training. Submit one hard copy and an electronic copy of the Training Plan to the Commissioning Specialists and the Government no later than 30 calendar days prior to the associated training.

Document training attendance using training attendance rosters and provide completed attendance rosters to the Commissioning Specialists and the Government no later than 7 calendar days following the completion of training for each system to be commissioned. Submit one hard copy and an electronic copy..

3.3.8 Systems Manual

Prepare and submit a Systems Manual including a signed certification or letter from the Technical Commissioning Specalists and the Lead Commissioning Specialist stating that the Systems Manual is complete, clear, and accurate.

Submit Systems Manual no later than 30 calendar days following completion of Functional Performance Tests and Integrated Systems Tests. Submit three hard copies and an electronic copy.

3.3.9 Maintenance and Service Life Plans

3.3.9.1 Maintenance Plan

Prepare and submit a Maintenance Plan for the project mechanical, electrical, plumbing, and fire protection systems. Prepare the HVAC and refrigeration sections of the Maintenance Plan in accordance with ASHRAE 180. Develop required inspection and maintenance tasks similar to Section 5 of ASHRAE 180 for the other commissioned systems and fire protection systems.

Submit the Maintenance Plan no later than 30 calendar days following the completion of Functional Performance Tests and Integrated Systems Tests.

Submit three hard copies and an electronic copy.

3.3.9.2 Service Life Plan

Prepare and submit a Service Life Plan for the building envelope, structural systems, and site hardscape that includes the following for each assembly or component:

a. A description of each including the materials or products.

b. The estimated service life, in years.

c. The estimated maintenance frequency and description of maintenance tasks.

d. The point of maintenance access for the components with estimated service life less than service life of the building.

Submit the Service Life Plan no later than 30 calendar days following the completion of Functional Performance Tests and Integrated Systems Tests. Submit three hard copies and an electronic copy.

3.4 COMMISSIONING REPORT

Following the completion of Functional Performance Tests and Integrated Systems Tests, with the exception of Seasonal Tests, the Lead Commissioning Specialist must prepare a Commissioning Report.

a. Include an executive summary describing the overall commissioning process, the results of the commissioning process, any outstanding deficiencies and recommended resolutions, and any seasonal testing that must be scheduled for a later date. Indicate, in the executive summary, whether the systems meet the requirements of the construction contract and accepted design and the Owner's Project Requirements.

b. Detail any deficiencies discovered during the commissioning process and the corrective actions taken in the report. Include the completed Building Envelope Inspection Checklists, Pre-Functional Checklists, Functional Performance Test Checklists, Integrated Systems Test Checklists,the Commissioning Plans, the Issues Log, Performance Verification Test Reports, Training Attendance Rosters, the Design Review Report, the final TAB Report.

c. Submit the Commissioning Report no later than 14 calendar days following commissioning team acceptance of all Functional Performance Tests and Integrated Systems Tests with the exception of Seasonal Tests. Submit three hard copies and an electronic copy.

d. Following any Seasonal Tests or Post-Construction Activities, update the Final Commissioning Report to reflect any changes and resubmit. File the approved, updated, Final Commissioning Report in the Sustainability eNotebook.

3.5 POST-CONSTRUCTION SUPPORT

3.5.1 Post-Construction Endurance Test

Perform an Endurance Test in accordance with the paragraph Endurance Test in UFGS Section 23 09 00Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC once during the peak heating season and once during the peak cooling season during outdoor air condition extremes with the exception that network bandwidth usage measurement and recording is not required. Use the Temporary Trending Hardware, if necessary, in accordance with UFGS Section 23 09 00Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

The Mechanical System Commissioning Specialists must review the trend logs from the Endurance Tests to ensure that the systems have stable operation and operate as required by the construction contract, the accepted design, and the Owner's Project Requirements Document. The Commissioning Specialists must provide a Post-Construction Trend Log Report that identifies any deficiencies noted in operation, recommendations for correction, and includes a graphical representation of the trends. Provide one Trend Log Report for the peak cooling season and one Trend Log Report for the peak heating season. Submit one hard copy and one electronic copy of the Post-Construction Trend Log Reports no later than 14 calendar days following receipt of the trend log data by the Commissioning Specialist.

3.5.2 Post-Construction Site Visit

The Commissioning Specialists must visit the building site concurrent with the 9 month warranty inspection to inspect building system equipment and review building operation with the building operating/maintenance staff. The Commissioning Specialists must identify any deficiency of the building systems to operate in accordance with the contract and accepted design requirements and the Owner's Project Requirements. The Commissioning Specialists must advise the Contracting Officer's Representative of any identified deficiencies and the proposed corrective action. Submit an updated commissioning report and systems manual documenting the results of the post-construction inspection.

-- End of Section --

SECTION 01 91 13

EQUIPMENT TESTING AND STARTUP

PART 1 - GENERAL

1.1 SCOPE OF WORK

1.1.1 Provide competent field services technicians of all equipment furnished to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.

1.1.2 Provide services of major process equipment manufacturer's representatives (Advance Oxidation Process (AOP) system, ozone and oxygen generation system, multimedia filters, horizontal cartridge filters, liquid phase granular activated carbon vessels, process pumps, process tanks) as per Technical Specifications.

1.1.3 Perform specified equipment field performance tests, final acceptance tests and startup services.

1.1.4 Duration of equipment manufacturer's representatives at the facility shall be as long as necessary to demonstrate the equipment meets all requirements of the equipment/system specification including flow rate and constituent removal performance.

1.2 RELATED SECTIONS

1.2.1 The related sections are as follows:

1.2.1.1 01 33 00 Submittal Procedures

1.2.1.2 01 78 23 Operation and Maintenance Data

1.2.1.3 01 79 00 Functional Testing

1.2.1.4 01 91 00.15 10 Total Building Commissioning

1.3 SUBMITTALS

1.3.1 Government approval is required for submittals with a "G" designation; Submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Groundwater Treatment Equipment Startup and Testing Plan
Recovery Wells Startup and Testing Plan
Final Groundwater Treatment System Startup and Testing Plan

SD-06 Test Reports

Test Reports
Field Service Technician Report

1.3.2 In accordance with Section 01 33 00, submit name, address and resume of proposed field services technicians at least 30 days in advance of the need for such services.

1.3.3 This section provides general guidelines for various steps required for the equipment startup and testing phase. The Contractor shall prepare and, submit, a detailed Equipment Startup and Testing Plan for equipment testing and startup as specified in the various equipment sections. At a minimum, submittals shall include the following:

1.3.3.1 The Equipment Startup and Testing Plan shall be submitted at least 60 days in advance of the proposed test dates and shall include at least the following information:

1.3.3.1.1 Name of equipment to be tested, including reference to specifications section number and title.
1.3.3.1.2 Testing schedule of proposed dates and times for testing.
1.3.3.1.3 Summary of power, lighting, chemical, water, etc., needs and identification of who will provide them and the quantity needed for testing.
1.3.3.1.4 Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
1.3.3.1.5 Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, EPA Standard Methods, etc).
1.3.3.1.6 Samples of forms to be used to collect and record test data and to present tabulated test results.

1.3.3.2 Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect actual conduct of the tests and the following additional information:

1.3.3.2.1 Copy of all test data sheets and laboratory analytical reports.
1.3.3.2.2 Summary comparison of specified test and performance requirements vs. actual test results.
1.3.3.2.3 Should actual test results fail to meet specified test and performance requirements, describe action(s) to be taken prior to retest the equipment.

1.3.3.3 Copies of the field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, final

setting for the equipment, a copy of all the manufacturer's startup checklists and other applicable paperwork.

1.4 QUALITY ASSURANCE

1.4.1 Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.

1.4.2 Manufacturers' sales and marketing personnel will not be accepted as field service technicians.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PRELIMINARY REQUIREMENTS

3.1.1 After installation of the equipment has been completed and the equipment is presumably ready for operation, complete functional test.Verify that the field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

3.1.1.1 Soundness (without cracks or otherwise damaged parts).
3.1.1.2 Correctness of setting, alignment and relative arrangement of various parts.
3.1.1.3 Check that all equipment, skids, and piping are properly fastened to a concrete foundation and that all bolts are completely tight.
3.1.1.4 Adequacy and correctness of packing, sealing and lubricants.
3.1.1.5 Check adequacy and tightness of all connections and verification that all power, compressed air, control cabling, communications, and other utilities are properly connected and functional.

3.1.2 The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

3.1.3 Upon completion of this work, the field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments and tests. The report shall contain copies of all of the field notes from the inspection.

3.2 STARTUP OF THE TREATMENT PLANT AND RELATED SYSTEMS

3.2.1 General Requirements

3.2.1.1 Successfully execute the step-by-step procedure of startup specified herein. The startup of the treatment plant and

related systems shall meet the requirements of 01 79 00 Function Testing.

3.2.1.2 The startup shall be successfully executed prior to Substantial Completion and acceptance by the OWNER.

3.2.2 Preparation for Startup

3.2.2.1 Upon completion of the treatment plant and all its related systems, all tanks, equipment and piping shall be flushed with potable water and hydraulically checked for leaks, cracks, and defects.

3.2.2.2 All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the various pumps and other remaining equipment shall be made.

3.2.2.3 All systems shall be cleaned and purged as required Check that all valves shall be checked for proper operation and control, and there are no hindrances to valves fully opening and closing.

3.2.2.4 All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made. All settings for all instrumentation shall be recorded and provided in separate cover.

3.2.2.5 No testing or equipment operation shall take place until it has been verified by the OWNER’s representative that all specified safety equipment has been installed and is in good working order.

3.2.2.6 No testing or equipment operation shall take place until it has been verified by the OWNER’s representative that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

3.2.3 Facilities Startup

3.2.3.1 Startup period shall not begin until all new treatment facilities and equipment have been tested as specified and are ready for operation. The OWNER shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup. All valve tagging shall also be complete prior to this startup.

3.2.3.2 In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the OWNER and ENGINEER.

3.2.3.3 The CONTRACTOR shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc., and field service personnel on as need basis during the following three testing/startup phases.

3.2.3.4 Do not, at any time, during startup allow the facility to be operated in a manner which subjects equipment to conditions that are more severe than the maximum allowable operating conditions and tolerances for which the equipment was designed.

3.3 PERFORMANCE TEST WITH POTABLE WATER

3.3.1 During this test phase, entire treatment system will be tested with potable water as follows:

3.3.1.1 Verify programming and testing of PLC and HMI (including vendor supplied systems) is complete.

3.3.1.2 Contractor shall perform a system function test including all pumps and equipment with potable water for 30 minutes at the design capacity of 1500 gpm on a continuous basis. For the system performance testing procedure, the Contractor shall pump flow at design capacity using the pumps from influent header through entire treatment train. Contractor shall provide a temporary loop connection to send flow back from effluent end of the Liquid phase activated granular carbon vessels to the Equalization tank and then pump back through entire treatment train. This full system testing shall be on a continuous basis for 30 minutes. Full system shall be checked for any leaks during this operation.

3.3.1.3 Once testing is confirmed, drain out all tanks, pipes and discharge the water to final treatment plant effluent discharge pipes to storm water basins.

3.4 PERFORMANCE TEST WITH GROUNDWATER

3.4.1 Upon successful completion of water test as per Para 3.3 above, entire treatment system shall be tested with ground water as follows:

3.4.1.1 This test will be similar to system function test. This step will require pumping of groundwater from each of the three (3) sets of recovery wells. This set of recovery wells will pump at a maximum flow rate of 1800 gpm through the entire treatment train. Perform this test for 2 hours, on a continuous basis.

3.4.1.2 During the test collect two rounds of samples during 30 minutes of operation and analyze them for various parameters as per attached table.

3.4.1.3 Discharge effluent water to temporary storage tanks with total holding capacity of 54,000 gallon. Discharge to final plant effluent pipes upon demonstration that water meets NPDES discharge criteria.

3.4.1.4 Once the sampling analysis data for both rounds is available, provide it to the Owner’s representative.

3.4.1.5 If any process treatment system does not meet performance requirements as specified in the Technical Specifications, the Contractor shall make necessary modifications to the satisfaction of the Owner’s representative and above tests shall be repeated. A sample of final inspection certificate for major process equipment is attached.

-- END OF SECTION --

EQUIPMENT SUPPLIER'S CERTIFICATE OF OPERATION

OWNER _____

Project _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION NO. _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

_____

installed for the subject project has (have) been tested, operated and adjusted, and is (are) ready for place in operation for its intended use.

Date_____

Time_____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date:_____

Process Sampling								
Sampling Location	**Volatile organic compounds**	**1,4-Dioxane**	**Target analyte list metals, total**	**Target analyte list metals, dissolved**	**Total suspended solids**	**Ozone**	**Hydrogen Peroxide**	**TO-14 (air/vapor)**
Recovery Wells (3)	X	X	X	X	X			
Before Multimedia Filters	X	X	X	X				
After Multimedia Filters	X	X	X	X				
After AOP reactor	X	X	X	X		X	X	
After Ozone Destruct						X	X	X
Before LGAC	X	X				X		
After LGAC	X	X				X	X	
Carbon Cannister vent system (24-hr composite)	X					X	X	X
Duplicate and other QA/QC samples						X		
National Pollutant and Discharge Elimination System permit sampling								
Final effluent (regulatory) discharge	X	X	X	X	X			

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE
02/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 301	(2016) Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI SP-2	(2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,

	Welded and Seamless
ASTM A184/A184M	(2019) Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A970/A970M	(2018) Standard Specification for Headed Steel Bars for Concrete Reinforcement
ASTM A1044/A1044M	(2016a) Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2019a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2020) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2018a) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	(2018) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2018) Standard Specification for Ready-Mixed Concrete
ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2018) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C311/C311M	(2018) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C552	(2017; E 2018) Standard Specification for Cellular Glass Thermal Insulation
ASTM C578	(2018) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2019a) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C595/C595M	(2018) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C803/C803M	(2018) Standard Test Method for Penetration Resistance of Hardened Concrete
ASTM C845/C845M	(2018) Standard Specification for Expansive Hydraulic Cement
ASTM C873/C873M	(2015) Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
ASTM C900	(2015) Standard Test Method for Pullout Strength of Hardened Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1012/C1012M	(2018b) Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution

ASTM C1017/C1017M	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1074	(2011) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107/C1107M	(2017) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	(2010a; R 2015) Standard Specification for Fiber-Reinforced Concrete
ASTM C1157/C1157M	(2017) Standard Performance Specification for Hydraulic Cement
ASTM C1218/C1218M	(2017) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	(2008; R 2015) Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C1778	(2016) Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete

	Paving and Structural Construction
ASTM D2628	(1991; R 2016) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D5759	(2012) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D6690	(2015) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E329	(2020) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E1155	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1643	(2018a) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor barriers Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2017) Standard Specification for Water Vapor barriers Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E1993/E1993M	(1998; R 2013; E 2013) Standard Specification for Bituminous Water Vapor barriers Used in Contact with Soil or Granular Fill Under Concrete Slabs

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2018) Manual of Standard Practice
CRSI RB4.1	(2016) Supports for Reinforcement Used in Concrete

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland

cement, pozzolan, fly ash, slag cement, and .

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Supplementary cementing materials" (SCM) include coal fly ash, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.

e. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.

f. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.

g. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.

h. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

i. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Concrete Curing Plan

Quality Control Plan; G

Quality Control Personnel Certifications; G

Quality Control Organizational Chart

Laboratory Accreditation; G

Form Removal Schedule; G

Maturity Method Data

SD-02 Shop Drawings

Formwork

Reinforcing Steel; G, AE

SD-03 Product Data

Joint Sealants

Joint Filler

Formwork Materials

Cementitious Materials

Vapor Barrier; AE

Concrete Curing Materials; AE

Reinforcement

Liquid Chemical Floor Hardeners and Sealers

Admixtures; AE

Reinforcing Fibers; AE

Mechanical Reinforcing Bar Connectors

Waterstops; AE

Biodegradable Form Release Agent

Pumping Concrete

Finishing Plan

Nonshrink Grout; AE

SD-04 Samples

Slab Finish Sample

SD-05 Design Data

Concrete Mix Design; G, AE

Formwork Calculations

SD-06 Test Reports

Concrete Mix Design; G, AE

Fly Ash; AE

Pozzolan; AE

Slag Cement; AE

Aggregates; AE

Fiber-Reinforced Concrete; G, AE

Tolerance Report

Compressive Strength Tests; G, AE

Chloride Ion Concentration

Air Content; AE

Slump Tests

Water

SD-07 Certificates

Reinforcing Bars; AE

Welder Qualifications

VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers

Safety Data Sheets

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Liquid Chemical Floor Hardeners and Sealers

Joint Sealants

Curing Compound

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," and the "Structural Engineer," to mean the RPM, FEAD CM or Engineer .

1.5 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor barrier, vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in

place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, supplementary cementitious materials, fibers, and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, supplementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable. Submit form removal schedule indicating element and minimum length of time for form removal.

Design, fabricate, erect, support, brace, and maintain formwork so that it is able to support, without failure, all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

1.6.2.2 Reinforcing Steel

Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

1.6.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI 308.1.

1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.3.3 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish for the floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

1.6.3.4 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.5 Safety Data Sheets

Submit Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.4.2 Slag Cement

Submit test results in accordance with ASTM C989/C989M for slag cement. Submit test results performed within 6 months of submittal date.

1.6.4.3 Aggregates

Submit test results in accordance with ASTM C33/C33M, ASTM C1293 or ASTM C1567 as required in the paragraph titled ALKALI-AGGREGATE REACTION.

1.6.4.4 Fiber-Reinforced Concrete

Test to determine flexural toughness index I5 in accordance with ASTM C1116/C1116M.

1.6.5 Field Samples

1.6.5.1 Slab Finish Sample

Install minimum of 10 foot by 10 foot slab. Slab finish sample must not be part of the final project. Finish as required by specification.

1.6.6 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier. Maintain a copy of ACI SP-15 and CRSI 10MSP at project site.

1.6.7 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit American Concrete Institute certification for the following:

a. CQC personnel responsible for inspection of concrete operations.

b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.

c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

1.6.7.1 Quality Manager Qualifications

The quality manager must hold a current license as a professional engineer in a U.S. state or territory with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.6.7.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.

b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.

c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

1.6.8 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.6.9 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a registered professional engineer in a U.S. state or territory competent in concrete materials and must sign all reports and designs.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.

c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to material manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

a. Provide data indication the percentage of post-industrial pozzolan (fly

ash, slag cement) cement substitution as a percentage of the full product composite by weight.

b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.

c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.

d. Provide product data stating the location where all products were manufactured

e. For projects using reusable formwork, provide data showing how formwork is reused.

f. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.

g. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M for welding of reinforcement or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

a. Form-facing material in contact with concrete must be lumber, plywood, tempered concrete-form-grade hardboard, metal, or plastic. Submit product information on proposed form-facing materials if different from that specified herein.

b. Design formwork, shores, reshores, and backshores to support loads transmitted to them and to comply with applicable building code requirements.

c. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

d. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.

e. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.

f. Design formwork joints to inhibit leakage of mortar.

g. Limit deflection of facing materials for concrete surfaces exposed to

view to 1/240 of center-to-center spacing of facing supports.

h. Do not use earth cuts as forms for vertical or sloping surfaces.

i. Submit product information on proposed form-facing materials if different from that specified herein.

j. Submit procedure for reshoring and backshoring, including drawings signed and sealed by a licensed design engineer. Include on shop drawings the formwork removal procedure and magnitude of construction loads used for design of reshoring or backshoring system. Indicate in procedure the magnitude of live and dead loads assumed for required capacity of the structure at time of reshoring or backshoring.

n. Submit manufacturer's product data on form liner proposed for use with each formed surface.

2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY.

2.1.3 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

a. Use commercially manufactured formwork accessories, including ties and hangers.

b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

a. Use form ties with ends or end fasteners that can be removed without damage to concrete.

b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in

walls.

c. The breakback distance for ferrous ties must be at least 2 in. for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.

d. If the breakback distance is less than 3/4 in., use coated or corrosion-resistant ties.

e. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

2.2.2.2 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to the following requirements when tested in accordance to ASTM D412: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.2.3 Biodegradable Form Release Agent

a. Provide form release agent that is colorless, biodegradable, and water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content.

b. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

c. Provide form release agent that reduces formwork moisture absorption, and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

d. Submit manufacturer's product data on formwork release agent for use on each form-facing material.

2.2.4 Chamfer Materials

Use lumber materials with dimensions of 3/4 x 3/4 in.

2.2.5 Construction and movement joints

a. Submit details and locations of construction joints in accordance with the requirements herein.

b. Locate construction joints within middle one-third of spans of slabs.

c. Locate construction joints in walls and columns at underside of slabs,

beams, or girders and at tops of footings or slabs.

d. Make construction joints perpendicular to main reinforcement.

e. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.

f. Submit location and detail of movement joints if different from those indicated in Contract Documents.

g. Submit manufacturer's data sheet on expansion joint materials.

h. Provide keyways where indicated in Contract Documents. Longitudinal keyways indicated in Contract Documents must be at least 1-1/2 in. deep, measured perpendicular to the plane of the joint.

2.2.6 Perimeter Insulation

Perimeter insulation must be polystyrene conforming to ASTM C578, Type II; polyurethane conforming to ASTM C591, Type II; or cellular glass conforming to ASTM C552, Type I or IV. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

2.2.7 Other Embedded items

Use sleeves, inserts, anchors, and other embedded items of material and design indicated in Contract Documents.

2.3 CONCRETE MATERIALS

2.3.1 Cementitious Materials

2.3.1.1 Portland Cement

a. Unless otherwise specified, provide cement that conforms to ASTM C150/C150M Type I and II

b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

c. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.

d. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.1.2 Blended Cements

a. Blended cements must conform to ASTM C595/C595M Type IP and IS or ASTM C1157/C1157M Type GU .

b. Slag cement added to the Type IS blend must meet ASTM C989/C989M.

c. The pozzolan added to the Type IP blend must be ASTM C618 Class F fly ash and must be interground with the cement clinker. The manufacturer

must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of pozzolan used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

2.3.1.3 Fly Ash

a. ASTM C618, Class F , except that the maximum allowable loss on ignition must not exceed 3 percent.

b. Fly ash content must be a minimum of 30 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.3.1.4 Slag cement

ASTM C989/C989M, Grade 120. When used, slag content must be a minimum of 25 percent by weight of cementitious material.

2.3.1.5 Other Supplementary Cementitious Materials

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling ASR and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating ASR must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.

b. The average particle size must not exceed 6 microns.

c. The sum of SiO_2 + Al_2O_3 + Fe_2O_3 must be greater than 77 percent.

2.3.2 Water

a. Water or ice must comply with the requirements of ASTM C1602/C1602M.

b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.

c. Water must be potable ; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

d. Protect mixing water and ice from contamination during storage and delivery.

e. Submit test report showing water complies with ASTM C1602/C1602M.

2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

a. Aggregates must conform to ASTM C33/C33M .

b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.

c. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.

d. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with ASTM C33/C33M, and ASTM C1293 expansion data not more than 18 months old.

2.3.4 Admixtures

a. Chemical admixtures must conform to ASTM C494/C494M.

b. Air-entraining admixtures must conform to ASTM C260/C260M.

c. Chemical admixtures for use in producing flowing concrete must conform to ASTM C1017/C1017M.

d. Do not use calcium chloride admixtures.

e. Use a corrosion-inhibiting admixture for concrete.

f. Admixtures used in concrete must be the same as those used in the concrete represented by submitted field test records or used in trial mixtures.

g. Protect stored admixtures against contamination, evaporation, or damage.

h. To ensure uniform distribution of constituents, provide agitating equipment for admixtures used in the form of suspensions or unstable solutions. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.

i. Submit types, brand names, producers' names, manufacturer's technical data sheets, and certificates showing compliance with standards required herein.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

2.4.2 Nonshrink Grout

Nonshrink grout in accordance with ASTM C1107/C1107M.

2.4.3 Floor Finish Materials

2.4.3.1 Liquid Chemical Floor Hardeners and Sealers

a. Hardener must be a colorless aqueous solution containing a blend of inorganic silicate or siliconate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.

b. Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content. Submit manufactures instructions for placement of sealers.

2.4.4 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752 Type I or Type II. Material must be 1/2 inch thick, unless otherwise indicated.

2.4.5 Joint Sealants

Submit manufacturer's product data.

2.4.5.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

2.4.5.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T.

2.4.5.3 Preformed Polychloroprene Elastomeric Type

ASTM D2628.

2.4.6 Vapor Barrier

ASTM E1745 Class B polyethylene sheeting, minimum 15 milthickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.

Consider plastic vapor barriers and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

a. Use materials and material combinations listed in this section and the contract documents.

b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents.

The minimum cementitious material content for concrete used in floors must meet the following requirements:

Nominal maximum size of aggregate, in.	**Minimum cementitious material content, pounds per cubic yard**
1-1/2	470
1	520
3/4	540
3/8	610

c. Selected target slump must meet the requirements this section, the contract documents, and must not exceed 9 in. Concrete must not show visible signs of segregation.

d. The target slump must be enforced for the duration of the project. Determine the slump by ASTM C143/C143M. Slump tolerances must meet the requirements of ACI 117.

e. The nominal maximum size of coarse aggregate for a mixture must not exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

f. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must be in accordance with the requirements of the paragraph titled DURABILITY.

g. Measure air content at the point of delivery in accordance with ASTM C173/C173M or ASTM C231/C231M.

h. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total air content greater than 3 percent.

i. Concrete properties and requirements for each portion of the structure are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

	Minimum *f'c* psi	Exposure ategories	Miscellaneous Requirements
Footings	5000 at 28 days	S1 ; C1 ; W1; F3	Max. slump: 6 in. Nominal maximum aggregate size must be 1 in.
Piers and Foundation Walls	5000 at 28 days	S1 ; C2; W1; F3	Nominal maximum aggregate size must be 1 in.
Beams and elevated slabs	4000 at 28 days	S1 ; C1 ; W1; F0	Nominal maximum aggregate size must be 1 in. Min. dosage of 1.5 pounds per cubic yard for synthetic micro-fiber. Coordination with product manufacturer for recommended dosage rates.
Slabs-on-ground	5000 at 28 days	S1 ; C2; W1; F0	Min. dosage of 4.0 (pounds per cubic yard) for synthetic macro-fiber Coordination with product manufacturer for recommended dosage rates. Nominal maximum aggregate size must be 1 1/2 in.

2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR). Use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction (ASR):

a. For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 must not exceed 0.04 percent at one year.

b. For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 must not exceed 0.10 percent at an age of 16 days.

c. Alkali content in concrete (LBA) must not exceed 4 pounds per cubic yard for moderately reactive aggregate or 3 pounds per cubic yard for highly reactive aggregate. Reactivity must be determined by testing in accordance with ASTM C1293 and categorized in accordance with ASTM C1778. Alkali content is calculated as follows:
LBA = (cement content, pounds per cubic yard) × (equivalent alkali content of portland cement in percent/100 percent)

2.5.2.2 Freezing and Thawing Resistance

a. Provide concrete meeting the following requirements based on exposure class assigned to members for freezing-and-thawing exposure in Contract Documents:

Exposure class	**Maximum *w/cm****	**Minimum *f'c*, psi**	**Air content**	**Additional Requirements**
F0	N/A	2500	N/A	
F1	0.55	3500	Depends on aggregate size	N/A
F2	0.45	4500	Depends on aggregate size	See limits on maximum cementitious material by mass
F3	0.40	5000	Depends on aggregate size	See limits on maximum cementitious material by mass
F3 plain concrete	0.45	4500	Depends on aggregate size	See limits on maximum cementitious material by mass

*The maximum *w/cm* limits do not apply to lightweight concrete.

b. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must meet the requirements of the following table:

Nominal maximum aggregate size, in.	Total air content, percent*^	
	Exposure Class F2 and F3	Exposure Class F1
3/8	7.5	6.0
1/2	7.0	5.5
3/4	6.0	5.0
1	6.0	4.5
1-1/2	5.5	4.5
2	5.0	4.0
3	5.5	3.5

*Tolerance on air content as delivered must be plus/minus 1.5 percent.
^For f'c greater than 5000 psi, reducing air content by 1.0 percentage point is acceptable.

c. Submit documentation verifying compliance with specified requirements.

d. For sections of the structure that are assigned Exposure Class F3, submit certification on cement composition verifying that concrete mixture meets the requirements of the following table:

Cementitious material	Maximum percent of total cementitious material by mass*
Fly ash or other pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989/C989M	50
Total of fly ash or other pozzolans, slag cement	50^
Total of fly ash or other pozzolans	35^

*Total cementitious material also includes ASTM C150/C150M, ASTM C595/C595M, ASTM C845/C845M, and ASTM C1157/C1157M cement. The maximum percentages above must include:
i. Fly ash or other pozzolans present in ASTM C1157/C1157M or ASTM C595/C595M Type IP blended cement.
ii. Slag cement present in ASTM C1157/C1157M or ASTM C595/C595M Type IS blended cement.

^Fly ash or other pozzolans and silica fume must constitute no more than 25 percent and 10 percent, respectively, of the total mass of the cementitious materials.

2.5.2.3 Corrosion and Chloride Content

a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members requiring protection against reinforcement corrosion in Contract Documents.

b. Submit documentation verifying compliance with specified requirements.

c. Water-soluble chloride ion content contributed from constituents including water, aggregates, cementitious materials, and admixtures must be determined for the concrete mixture by ASTM C1218/C1218M at age between 28 and 42 days.

d. The maximum water-soluble chloride ion (Cl-) content in concrete, percent by mass of cement is as follows:

Exposure class	**Maximum *w/cm****	**Minimum f'c, psi**	**Maximum water-soluble chloride ion (CL-) content in concrete, percent by mass of cement**
Reinforced concrete			
C0	N/A	2500	1.00
C1	N/A	2500	0.30
C2	0.4	5000	0.15
Prestressed concrete			
C0	N/A	2500	0.06
C1	N/A	2500	0.06
C2	0.4	5000	0.06

*The maximum w/cm limits do not apply to lightweight concrete.

2.5.2.4 Sulfate Resistance

a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members for sulfate exposure.

Exposure class	**Maximum w/cm**	**Minimum f'c, psi**	**Required cementitious materials-types**			**Calcium chloride admixture**
			ASTM C150/C150M	**ASTM C595/C595M**	**ASTM C1157/C1157M**	
S0	N/A	2500	N/A	N/A	N/A	No restrictions
S1	0.50	4000	II*^	IP(MS); IS(<70)(MS); IT(MS)	MS	No restrictions

Exposure class	Maximum w/cm	Minimum f'c, psi	Required cementitious materials-types			Calcium chloride admixture
			ASTM C150/C150M	ASTM C595/C595M	ASTM C1157/C1157M	
S2	0.45	4500	IV^	IP(HS); IS(<70)(HS); IT(HS)	HS	Not permitted
S3	0.45	4500	V + pozzolan or slag cement**	IP(HS)+ pozzolan or slag cement^; IS (<70)(HS) + pozzolan or slag cement^; IT (HS) + pozzolan or slag cement**	HS + pozzolan or slag cement**	Not permitted

* For seawater exposure, other types of portland cements with tricalcium aluminate (C3A) contents up to 10 percent are acceptable if the w/cm does not exceed 0.40.
** The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag used shall not be less than the amount tested in accordance with ASTM C1012/C1012M and meeting the requirements maximum expansion requirements listed herein.
^ Other available types of cement, such as Type III or Type I, are acceptable in exposure classes S1 or S2 if the C3A contents are less than 8 or 5 percent, respectively.

b. The maximum w/cm limits for sulfate exposure do not apply to lightweight concrete.

c. Alternative combinations of cementitious materials of those listed in this paragraph are acceptable if they meet the maximum expansion requirements listed in the following table:

Exposure class	Maximum expansion when tested using ASTM C1012/C1012M		
	At 6 months	At 6 months	At 18 months
S1	0.10 percent	N/A	N/A
S2	0.05 percent	0.10 percent^	N/A
S3	N/A	N/A	0.10 percent

^The 12-month expansion limit applies only when the measured expansion exceeds the 6-month maximum expansion limit.

2.5.2.5 Concrete Temperature

The temperature of concrete as delivered must not exceed 95°F .

2.5.2.6 Concrete permeability

a. Provide concrete meeting the requirements of the following table based on exposure class assigned to members requiring low permeability in the Contract Documents.

Exposure class	**Maximum *w/cm****	**Minimum f'c, psi**	**Additional minimum requirements**
W0	N/A	2500	None
W1	0.5	4000	None

*The maximum w/cm limits do not apply to lightweight concrete.

b. Submit documentation verifying compliance with specified requirements.

2.5.3 Trial Mixtures

Trial mixtures must be in accordance to ACI 301.

2.5.4 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

a. Type and brand cement

b. Cement and supplementary cementitious materials content in 94-pound bags per cubic yard of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixtures

e. Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

a. Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.

b. Submit manufacturer's certified test report for reinforcement.

c. Submit placing drawings showing fabrication dimensions and placement

locations of reinforcement and reinforcement supports. Placing drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.

d. Submit request with locations and details of splices not indicated in Contract Documents.

e. Submit request to place column dowels without using templates.

f. Submit request for field cutting, including location and type of bar to be cut and reason field cutting is required.

2.6.1 Reinforcing Bars

a. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.

b. ASTM A615/A615M with the bars marked A, Grade 60 Cold drawn wire used for spiral reinforcement must conform to ASTM A1064/A1064M.

c. Submit mill certificates for reinforcing bars.

2.6.1.1 Headed Reinforcing Bars

Headed reinforcing bars must conform to ASTM A970/A970M including Annex A1, and other specified requirements.

2.6.1.2 Bar Mats

a. Bar mats must conform to ASTM A184/A184M.

2.6.1.3 Headed Shear Stud Reinforcement

Headed studs and headed stud assemblies must conform to ASTM A1044/A1044M.

2.6.2 Mechanical Reinforcing Bar Connectors

a. Provide 125 percent minimum yield strength of the reinforcement bar.

b. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Wire

a. Provide flat sheets of welded wire reinforcement for slabs and toppings, unless noted otherwise.

b. Plain or deformed steel wire must conform to ASTM A1064/A1064M.

2.6.4 Welded wire reinforcement

a. Use welded wire reinforcement specified in Contract Documents and conforming to one or more of the specifications given herein.

b. Plain welded wire reinforcement must conform to ASTM A1064/A1064M, with

welded intersections spaced no greater than 12 in. apart in direction of principal reinforcement.

c. Deformed welded wire reinforcement must conform to ASTM A1064/A1064M, with welded intersections spaced no greater than 16 in. apart in direction of principal reinforcement.

2.6.5 Reinforcing Bar Supports

a. Provide reinforcement support types within structure as required by Contract Documents. Reinforcement supports must conform to CRSI RB4.1. Submit description of reinforcement supports and materials for fastening coated reinforcement if not in conformance with CRSI RB4.1.

b. Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6.6 Reinforcing Fibers

2.6.6.1 Synthetic Fibers

In addition to the requirements specified above, provide fiber reinforced concrete in accordance with ASTM C1116/C1116M Type III, synthetic fiber reinforced concrete, and as follows. Synthetic reinforcing fibers must be 100 percent virgin monofilament polypropylene fibers.

Provide fibers that have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Add fibers at the batch plant. Provide the services of a qualified technical representative to instruct the concrete supplier in proper batching and mixing of materials to be provided.

2.6.7 Dowels for Load Transfer in Floors

Provide greased dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to ASTM A615/A615M, Grade 40. Provide dowel pipe that is steel conforming to ASTM A53/A53M.

2.6.8 Welding

a. Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

b. Comply with AWS D1.4/D1.4M unless otherwise specified. Do not tack weld reinforcing bars.

c. Welded assemblies of steel reinforcement produced under factory conditions, such as welded wire reinforcement, bar mats, and deformed bar anchors, are allowed.

PART 3 EXECUTION

3.1 EXAMINATION

a. Do not begin installation until substrates have been properly constructed; verify that substrates are level.

b. If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.

c. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

a. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

b. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

a. When subgrade material is semi-porous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor barrier.

b. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor barrier.

3.2.3 Subgrade Under Slabs on Ground

a. Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

b. Previously constructed subgrade or fill must be cleaned of foreign materials

c. Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

d. Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

3.2.4 Edge Forms and Screed Strips for Slabs

a. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.

b. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.5 Reinforcement and Other Embedded Items

a. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

b. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

3.3 FORMS

a. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade.

b. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch. Place chamfer strips in corners of formwork to produce beveled edges on permanently exposed surfaces.

c. Provide formwork with clean-out openings to permit inspection and removal of debris.

d. Inspect formwork and remove foreign material before concrete is placed.

e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.

f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.

g. Fasten form wedges in place after final adjustment of forms and before concrete placement.

h. Provide anchoring and bracing to control upward and lateral movement of formwork system.

i. Construct formwork for openings to facilitate removal and to produce opening dimensions as specified and within tolerances.

j. Provide runways for moving equipment. Support runways directly on formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of

formwork or structural members.

k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.

l. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete placement.

3.3.1 Coating

a. Cover formwork surfaces with an acceptable material that inhibits bond with concrete.

b. If formwork release agent is used, apply to formwork surfaces in accordance with manufacturer's recommendations before placing reinforcement. Remove excess release agent on formwork prior to concrete placement.

c. Do not allow formwork release agent to contact reinforcement or hardened concrete against which fresh concrete is to be placed.

3.3.2 Reuse

a. Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

b. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.

c. Remove leaked mortar from formwork joints before reuse.

3.3.3 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.4 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view.

3.3.5 Form Ties

a. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with ACI 301 Section 5 requirements.

3.3.6 Tolerances for Form Construction

a. Construct formwork so concrete surfaces conform to tolerances in ACI 117.

b. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within ACI 117 tolerances.

c. To maintain specified elevation and thickness within tolerances,

install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.

3.3.7 Removal of Forms and Supports

a. If vertical formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.

b. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform repairs and finishing operations required. If forms are removed before end of specified curing period, provide curing and protection.

c. Do not damage concrete during removal of vertical formwork for columns, walls, and sides of beams. Perform needed repair and finishing operations required on vertical surfaces. If forms are removed before end of specified curing period, provide curing and protection.

d. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place required strength of concrete is reached.

e. Form-facing material and horizontal facing support members may be removed before in-place concrete reaches specified compressive strength if shores and other supports are designed to allow facing removal without deflection of supported slab or member.

3.3.8 Strength of Concrete Required for Removal of Formwork

If removal of formwork, reshoring, or backshoring is based on concrete reaching a specified in-place strength, mold and field-cure cylinders in accordance with ASTM C31/C31M. Test cylinders in accordance with ASTM C39/C39M. Alternatively, use one or more of the methods listed herein to evaluate in-place concrete strength for formwork removal.

a. Tests of cast-in-place cylinders in accordance with ASTM C873/C873M. This option is limited to slabs with concrete depths from 5 to 12 in.

b. Penetration resistance in accordance with ASTM C803/C803M.

c. Pullout strength in accordance with ASTM C900.

d. Maturity method in accordance with ASTM C1074. Submit maturity method data using project materials and concrete mix proportions used on the project to demonstrate the correlation between maturity and compressive strength of laboratory cured test specimens to the Contracting Officer.

3.4 WATERSTOP INSTALLATION AND SPLICES

a. Provide waterstops in construction joints as indicated.

b. Install formwork to accommodate waterstop materials. Locate waterstops in joints where indicated in Contract Documents. Minimize number of splices in waterstop. Splice waterstops in accordance with

manufacturer's written instructions. Install factory-manufactured premolded mitered corners.

c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to ACI 301. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.

b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

Concrete Exposure	**Member**	**Reinforcement**	**Specified cover, in.**
Cast against and permanently in contact with ground	All	All	3
Exposed to weather or in contact with ground	All	No. 6 through No. 18 bars	2
		No. 5 bar, W31 or D31 wire, and smaller	1-1/2

Concrete Exposure	**Member**	**Reinforcement**	**Specified cover, in.**
Not exposed to weather or in contact with ground	Slabs, joists, and walls	No. 14 and No. 18 bars	1-1/2
		No. 11 bar and smaller	3/4
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	1-1/2

e. Precast nonprestressed or prestressed concrete members manufactured under plant conditions must have concrete cover for reinforcement, ducts, and end fittings given in the following table:

Concrete Exposure	Member	Reinforcement	Specified cover, in.
Exposed to weather or in contact with ground	Walls	No. 14 and No. 18 bars; tendons larger than 1-1/2 in. diameter	1-1/2
		No. 11 bars and smaller; W31 and D31 wire, and smaller; tendons and strands 1-1/2 in.	3/4
	All other	No. 14 and No. 18 bars; tendons larger than 1-1/2 in.	2
		No. 6 through No. 11 bars; tendons and strands larger than 5/8 in. diameter through 1-1/2 in.	1-1/2
		No. 5 bar, W31 or D31 wire, and smaller; tendons and strands 5/8 in. diameter and smaller	1-1/4

Concrete Exposure	Member	Reinforcement	Specified cover, in.
Not exposed to weather or in contact with ground	Slabs, joists, and walls	No. 14 and No. 18 bars; tendons larger than 1-1/2 in. diameter	1-1/4
		Tendons and strands 1-1/2 in. diameter and smaller	3/4
		No. 11 bar, W31 or D31	5/8
	Beams, columns, pedestals, and tension ties	Primary reinforcement	Greater of bar diameter and 5/8 and need not exceed 1-1/2
		Stirrups, ties, spirals, and hoops	3/8

3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

3.5.2 Vapor Barrier

a. Install in accordance with ASTM E1643. Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12

inches and tape.

b. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material.

3.5.3 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive must be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.5.4 Reinforcement Supports

Provide reinforcement support in accordance with CRSI RB4.1 and ACI 301 Section 3 requirements.

3.5.5 Splicing

As indicated in the Contract Documents. For splices not indicated follow ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 2 inches.

3.5.6 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.5.7 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.8 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

a. Provide fabrication tolerances that are in accordance with ACI 117.

b. Provide hooks and bends that are in accordance with the Contract Documents.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.5.9 Placing Reinforcement

Place reinforcement in accordance with ACI 301.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 301 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

b. Equip supports on ground and similar surfaces with sand-plates.

c. Support welded wire reinforcement as required for reinforcing bars.

d. Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

e. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.

f. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Contract Documents.

3.5.10 Spacing of Reinforcing Bars

a. Spacing must be as indicated in the Contract Documents.

b. Reinforcing bars may be relocated to avoid interference with other

reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.5.11 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.5.12 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

In accordance with ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.6.2 Mixing

a. Mix concrete in accordance with ASTM C94/C94M, ACI 301 and ACI 304R.

b. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F.

c. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and submitted water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required.

d. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

e. When fibers are used, add fibers together with the aggregates and never as the first component in the mixer. Fibers must be dispensed into the mixing system using appropriate dispensing equipment and procedure as recommended by the manufacturer.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment

thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5.

3.7.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.7.2 Cold Weather

Cold weather concrete must meet the requirements of ACI 301 unless otherwise specified. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.7.3 Hot Weather

Hot weather concrete must meet the requirements of ACI 301 unless otherwise specified. Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.4 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.8.1 Mixing Equipment

Before concrete pours, designate Contractor-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.3 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

Tolerances in accordance with ACI 117 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301.

3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

In accordance with ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

3.10.1.2 Floated

Use for exterior slabs where not otherwise specified. Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces and for reception of floor coverings. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

3.10.1.4 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Finish concrete in accordance with ACI 301 Section 5 for a dry-shake finish. After the selected material has been embedded by the two floatings, complete the operation with a broomed finish.

3.10.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.10.1.6 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.7 Chemical-Hardener Treatment

Apply liquid-chemical floor hardener after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats.

First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats.

Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.

3.10.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI 117 for tolerance tested by ASTM E1155.

a. Specified slabs on Grade:

Floor Flatness (Ff) 35; 24 minimum
Floor Levelness (FL) 25; 17 minimum

b. Specified Suspended Slabs:

Floor Flatness (Ff) 30; 24 minimum
Floor Levelness (FL) 20; 15 minimum

3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E1155.

3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.10.3 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints 1 inch deep, or one fourth the slab thickness whichever is deeper, with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Curbs

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 JOINTS

3.11.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.11.1.1 Maximum Allowable Construction Joint Spacing

a. In walls at not more than 60 feet in any horizontal direction.

b. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet.

3.11.1.2 Construction Joints for Constructability Purposes

a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.11.2 Isolation Joints in Slabs on Ground

a. Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

b. Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must

clean groove of foreign matter and loose particles after surface has dried.

3.11.3 Contraction Joints in Slabs on Ground

a. Provide joints to form panels as indicated.

b. Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.

c. Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.

3.11.4 Sealing Joints in Slabs on Ground

a. Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

b. Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.12 CURING AND PROTECTION

Curing and protection in accordance with ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer, hardener, or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.12.1 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.12.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with

forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.12.3 Curing Unformed Surfaces

a. Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

b. Accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

c. Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.12.4 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.12.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.12.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.13 FIELD QUALITY CONTROL

3.13.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

3.13.2 Testing

3.13.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is

not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.13.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.13.2.3 Compressive Strength Tests

ASTM C39/C39M. Make eight 6 inch by 12 inch 4 inch by 8 inch test cylinders for each set of tests in accordance with ASTM C31/C31M, ASTM C172/C172M and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, two cylinders at 56 days and hold two cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of this section, the Contract Document, and ACI 301. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.13.2.4 Chloride Ion Concentration

Chloride ion concentration must meet the requirements of the paragraph titled CORROSION AND CHLORIDE CONTENT. Determine water soluble ion concentration in accordance with ASTM C1218/C1218M. Perform test once for each mix design.

3.13.2.5 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

a. Failure to meet compressive strength tests as evaluated.

b. Reinforcement not conforming to requirements specified.

c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.

d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified.

e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

f. Poor workmanship likely to result in deficient strength.

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

3.13.2.6 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.13.2.7 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

b. Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.

c. Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

d. Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

e. Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.14 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

3.14.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.02 inches wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

3.14.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.14.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --

SECTION 03 45 00

PRECAST ARCHITECTURAL CONCRETE
05/16, CHG 2: 11/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2019; R 2022) Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2019) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1	(2009; R 2016) Washers: Helical

	Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA U1	(2023) Use Category System: User Specification for Treated Wood

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2020) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A615/A615M	(2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	(2023) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A1064/A1064M	(2022) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C31/C31M	(2023) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2023) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2023) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	(2022) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2023) Standard Specification for Ready-Mixed Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2022) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C311/C311M	(2022) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494/C494M	(2019; E 2022) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2023) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2023; E 2023) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989/C989M	(2022) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1157/C1157M	(2023) Standard Performance Specification for Hydraulic Cement

ASTM C1218/C1218M	(2020c) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1602/C1602M	(2022) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1056	(2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D5759	(2012; R 2020) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-117	(2013) Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products, 3rd Edition
PCI MNL-122	(2007) Architectural Precast Concrete, 3rd Edition

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre-Installation Meeting

SD-02 Shop Drawings

Precast Drawings; G

SD-03 Product Data

Cast-In Embedded Items And Connectors; G

Connection Devices; G

Admixtures

Gasket

SD-05 Design Data

Design Calculations; G

Contractor-Furnished Mix Design; G

Concrete Mix Design for Repair of Surface Defects; G

SD-06 Test Reports

Strength Tests; G

Slump

Air Content

Test for Concrete Materials

Water

Testing Precast Units for Strength

SD-07 Certificates

Manufacturer's Qualifications; G

Fabricator Quality Certifications

Erector Certification

SD-08 Manufacturer's Instructions

Installation; G

Cleaning; G

1.3 MODIFICATION OF REFERENCES

In the referenced ACI and PCI publications, consider the advisory provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.4 GENERAL REQUIREMENTS

Precast concrete units must be designed and fabricated by an experienced and certified precast concrete manufacturer. The manufacturer needs to have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. The Contractor must submit a statement detailing the Manufacturer's Qualifications. Coordinate precast work with the work of other trades.

1.5 DESIGN

1.5.1 Standards and Loads

Precast unit design must conform to ASCE 7-16, ACI 318 and PCI MNL-122. Indicate design loads for precast concrete on the drawings. A differential temperature of 192 degrees F, between interior and exterior faces of the units, must be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection must be accounted for in the design.

1.5.2 Connections

Connection of units to other members, or to other units must be of the type and configuration indicated. The design and sizing of connections for all design loads will be completed by the Contractor.

1.5.3 Concrete Proportion

Base the selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportion using the same type and brand of cement, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete and admixtures containing chloride ions, nitrates, or other substances that are corrosive will not be used in prestressed concrete.

1.5.4 Design Calculations

Calculations for design of members, connections and embedments not shown must be made by a registered professional engineer experienced in the design of precast architectural concrete. Calculation will include the analysis of member for lifting stresses and the sizing of the lifting inserts. Submit calculations for review and approval prior to fabrication, signed and sealed by the registered design professional who prepared the design.

1.5.5 Thermal Calculations

Submit thermal calculations prepared and sealed by a registered professional engineer for review complying with ASHRAE 90.1 - IP, for the steady state thermal resistance for the precast concrete wall panels. Thermal calculations must demonstrate the thermal conductivity of all components, the spacing of all connectors, the percent area of the wall that is solid concrete, and the thermal resistance of all components.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials, except for wall panels, to the project site in the original, unbroken packages or containers, each bearing a label clearly identifying manufacturer's name, brand name, weight or volume, and other pertinent information. Store packaged materials, and materials in containers, in a weathertight and dry place until ready for use.

Store products in manufacturer's unopened packaging in dry storage area, with ambient temperature between 30 degrees F and 120 degrees F, until installation.

1.7 STORAGE AND INSPECTION AT MANUFACTURER'S PLANT

Protect precast units temporarily stored at the manufacturer's plant from damage in accordance with PCI MNL-117 and PCI MNL-122. Immediately prior to shipment to the jobsite, all precast concrete units must be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality will include, but will not be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. Replace or repair all defective precast concrete units as approved.

1.8 PLANT INSPECTION

At the option of the Contracting Officer, precast units may be inspected. The Contractor is to give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.8.1 Fabricator Quality Certifications

Plants must be certified by the PCI Plant Certification Program for Group A, Category A1, or Architectural Precast Association (APA) certification or National Precast Concrete Association (NPCA). When plants are not currently enrolled in one of the three certification programs listed above then they must provide a product quality control system in accordance with PCI MNL-117 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory.

1.9 ERECTOR CERTIFICATION

Erector with erecting organization and all erecting crews certified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members.

1.10 ERECTOR QUALIFICATIONS

A precast erector that is not certified by PCI who retains a PCI-Certified Field Auditor, at the erector's expense, to conduct a field audit of a project in the same category as this project prior to start of precast concrete erection and must submit the Erector's Post Audit Declaration to be considered qualified.

1.11 CONCRETE SAMPLING AND TESTING

1.11.1 Test for Concrete Materials

Sample and test concrete materials proposed for use in the work in accordance with PCI MNL-117.

Submit reports for each material sampled and tested prior to the start of work. Reports must contain the project name and number, date, name of Contractor, name of precast unit manufacturer, name of concrete testing service, source of concrete aggregates, generic name of aggregate, and values specified.

1.11.2 Quality Control Testing During Fabrication

Sample and test concrete for quality control during fabrication as follows:

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Sampling fresh concrete	ASTM C172/C172M except modified for slump per ASTM C94/C94M	As required for each test
Slump test	ASTM C143/C143M	One for each concrete load at point of discharge and one for each set of compressive strength tests
Air Content by pressure method	ASTM C231/C231M	One for each set of compressive strength tests
Compressive test specimens	ASTM C31/C31M	One set of six specimens for each Compressive Strength test, one set per day or for every 20 cubic yards of concrete placed, whichever is greater.

Compression test specimens may be either standard 6 by 12 inch cylinders or 4-inch cubes. Cubes may be molded individually or cut from slabs. Preparation and testing of cube specimens must be as nearly consistent with the test methods specified as possible, with the exception that the concrete will be placed in a single layer.

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Concrete temperature		Each time a set of compression test specimens is made

Compressive strength tests	ASTM C39/C39M	One set of facing strength tests mix and one set of backing mix for every ten panels or fraction thereof cast in any one day; two specimens in each set tested at 7 calendar days; three specimens in each set tested at 28 calendar days, and one specimen in each set retained in reserve for testing if required

Evaluate compression test results at 28 days in accordance with ACI 214R using a coefficient of variation of 20 percent. Evaluate the strength of concrete by averaging the test results (two specimens) of standard cylinders tested at 28 days. Not more than 20 percent of the individual tests can have an average compressive strength less than the specified ultimate compressive strength. Submit test reports on the same day that tests are made.

Reports for Compressive Strength tests need to contain the project name and number, date of concrete placement, name of Contractor, name of precast concrete wall panel manufacturer, name of concrete testing service, panel identification letter and number, use of concrete mixture (facing or backing), design compressive strength at 28 calendar days, concrete-mix proportions and materials, and compressive breaking strength and type of break.

If 4-inch cubes are used for compressive strength specimens, average strength of the cubes at any test age must be multiplied by the factor of 0.8 to arrive at an estimate of the corresponding 6 by 12 inch cylinder strength. Report both of these values.

1.12 QUALITY ASSURANCE

1.12.1 Precast Drawings

Submit precast drawings with the following information:

a. Precast dimensions, cross-section, and edge details; location, size, and type of reinforcement, including reinforcement necessary for safe handling and erection of precast units and other embedded items. Comply with ACI SP-66.

b. Layout, dimensions, and identification of each precast unit, corresponding to installation sequence.

c. Setting drawings, instructions, and directions for installation of concrete inserts.

d. Location and details of anchorage devices and lifting devices embedded in panels, and connection details to building framing system.

1.12.2 Pre-Installation Meeting

Hold a meeting at the job site with representative of the manufacturer and all other trades that may be effected by work of this section. Notify the Contracting Officer at least 3 days in advance of the time of the meeting.

1.13 TOLERANCES

Dimensions of the finished panel, at the time of erection in the structure, must conform to the tolerances for precast, non-prestressed elements in PCI MNL-117, unless otherwise specified by the Architect.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor-Furnished Mix Design

ACI 211.1 and ACI 301. The Contractor must submit the mix design report giving the maximum nominal coarse aggregate size, the proportions of all ingredients and the type and amount of any admixtures that will be used in the manufacture of each strength and type of concrete, a minimum of sixty days prior to commencing operations. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. Plot a curve for each concrete mixture, showing the relationships between water-cementitious material ratios and compressive strengths. Maximum permissible water-cementitious material ratio must be that value not exceeding the maximum water-cementitious material ratio specified, indicated by the curve to produce a design minimum laboratory compressive strength at 28 calendar days not less than that specified. The mix design report is to contain the project name and number, date, name of Contractor, name of precast concrete wall panel manufacturer, name of concrete testing service, use of concrete mixture (facing or backing), source of concrete aggregates for each mixture. Submit certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, and aggregates. The statement must be accompanied by test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. Make no substitutions without additional tests to verify that the concrete properties are satisfactory. Concrete must have a 28-day compressive strength of 4000 psi. Air content of plastic concrete must be between 4 and 6 percent air by volume.

If, the compressive strength falls below that specified, adjust the mix proportions and water content and make necessary changes in the temperature, moisture, and curing procedures to secure the specified strength. Notify the Contracting Officer of all changes.

2.1.2 Backing Mixture

Provide the approved mix design.

2.2 MATERIALS

2.2.1 Fine Aggregates

ASTM C33/C33M. The optional method of reducing the No. 50 and No. 100 sieve aggregates does not apply. The restriction to use only fine aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement does apply.

2.2.2 Coarse Aggregate

ASTM C33/C33M, Size No. 57, Class 5S. The restriction to use only coarse aggregates that do not contain any materials that are deleteriously reactive with alkalis in cement does apply. Aggregate must not contain slag or crushed concrete.

2.2.3 Cementitious Materials

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, fly ash, and pozzolan.

2.2.3.1 Fly Ash

ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed 3 percent.

Add with cement. Fly ash content must be a minimum of 35 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.2.3.2 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirement for uniformity.

2.2.3.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.

b. The average particle size must not exceed 6 microns.

c. The sum of SiO_2 + Al_2O_3 + Fe_2O_3 must be greater than 77 percent.

2.2.3.4 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade 100 . Slag content must be a minimum of 25 percent by weight of cementitious material.

2.2.3.5 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type II, with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na_2O_e (sodium oxide) equivalent. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch.

2.2.3.6 Blended Cements

a. Blended cements must conform to ASTM C595/C595M Type IL, IP (HE), or ASTM C1157/C1157M Type MH.

b. Slag cement added to the Type IS blend must meet ASTM C989/C989M.

c. The pozzolan added to the Type IP blend must be ASTM C618 Class F, and must be interground with the cement clinker. The manufacturer must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of pozzolan used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

2.2.4 Admixtures

ASTM C260/C260M for air-entraining admixtures. Other admixtures: ASTM C494/C494M. Certify that admixtures are free of chlorides.

2.2.5 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

2.2.6 Reinforcement

All exposed steel must be phosphate treated, primed, and coated to prevent rust.

2.2.6.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A615/A615M, Grade 60,

2.2.6.2 Welded Wire Reinforcement

ASTM A1064/A1064M.

2.2.6.3 Supports for Concrete Reinforcement

Include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening in place in accordance with PCI MNL-117.

2.2.7 Tie Wire

Tie wire must be soft monel or 18-8 stainless steel.

2.2.8 Plates, Angles, Anchors and Embedment

ASTM A36/A36M, ferrous metal plate connectors for attachment to the structural framing using manufacturer standard construction procedures. Headed studs will use 60,000 psi steel with construction conforming to AWS D1.1/D1.1M, Type B. Deformed bar anchors must conform to ASTM A1064/A1064M. Coat steel items, other than stainless, with a rust-inhibiting paint or provide hot-dip galvanized after fabrication in

accordance with ASTM A153/A153M.

Furnish and install anchors, inserts, lifting devices, and other accessories which are to be embedded in the precast units in accordance with the approved detail drawings. Embedded items must be accurately positioned in their designed location, and have sufficient anchorage and embedment to satisfy design requirements.

2.2.9 Form Release Agent

Release agent must be manufacturer's standard non-staining type.

2.2.10 Grout

Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

2.3 CAST-IN EMBEDDED ITEMS AND CONNECTORS

2.3.1 Inserts

2.3.1.1 Threaded-Type Concrete Inserts

ASTM A47/A47M, Grade 32510 or 35018, or may be medium strength cast steel conforming to ASTM A27/A27M, Grade U-60-30. Provide galvanized ferrous casting having enlarged base with two nailing lugs minimum length less than the thickness of panel less 3/4 inch, and internally threaded to receive 3/4 inch diameter machine bolt. Ferrous castings must be ferritic malleable iron. Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

2.3.1.2 Wedge-Type Concrete Inserts

Provide galvanized, box-type ferrous castings with integral anchor loop at back of box to accept 3/4 inch diameter bolts having special wedge-shaped head. Provide ferrous castings ASTM A47/A47M, Grade 32510 or 35018, ferritic malleable iron or ASTM A27/A27M, Grade U-60-30, medium-strength cast steel. Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

2.3.1.3 Slotted-Type Concrete Inserts

Provide pressed steel plate, welded construction, box type with slot to receive 3/4 inch diameter square head bolt, and provide lateral adjustment of bolt. Length of insert body, less anchorage lugs, must be 4 1/2 inches minimum. Provide insert with knockout cover. Steel plate must be 1/8 inch minimum thickness, ASTM A283/A283M, Grade C. Provide inserts hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

2.3.1.4 Wood Nailer Inserts

Inserts will be kiln-dried "standard" grade Douglas fir or "No. 2" grade southern pine, surfaced 4 sides, and sized as indicated. Treat with waterborne pressure-preservative in accordance with AWPA U1, use category UC3A. All wood needs to be air or kiln dried after treatment. Verify

specific treatments by the report of an approved independent inspection agency. The AWPA U1 Quality Mark "UC3A" on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

2.3.1.5 Flashing Reglets

Reglets must be sheet metal open-type with continuous groove not less than 1-1/8 inches deep by 3/16-inch wide at opening and sloped upward, designed to anchor snap-lock counter flashing.

Metal must be minimum 0.011-inch thick conforming to ASTM A666, Type 302 or 304, No. 1 finish, soft temper.

Metal is to be 26-gage galvanized steel sheet conforming to ASTM A653/A653M, G90.

2.3.2 Connection Devices

2.3.2.1 Clip Angles

ASTM A36/A36M steel, galvanized after fabrication in accordance with ASTM A153/A153M.

2.3.2.2 Ferrous Casting Clamps

ASTM A47/A47M, Grade 32510 or Grade 35018 malleable iron or cast steel, or ASTM A27/A27M, Grade 60-30, cast steel casting, hot-dip galvanized in accordance with ASTM A153/A153M.

2.3.2.3 Threaded Fasteners

Provide galvanized machine bolts, washers and, when required, nuts.

a. Bolts: ASTM A449, 3/4 inch diameter machine bolts with hexagon head.

b. Washers: ASME B18.21.1, medium or heavy lock-spring washers.

c. Nuts: ASTM A563, Grade C, heavy, hexagon-type nuts.

d. Square Nuts: ASTM A563, Grade A, plain, square-type nuts where required for slotted-type concrete inserts.

2.4 PRECAST ELEMENT FABRICATION

2.4.1 Formwork and Fabrication Tolerances

Provide forms and form-facing materials of wood, metal, plastic, or other approved material to produce concrete having the specified finish. Construct forms mortar-tight and of sufficient strength to withstand all pressures due to concrete placing operations and temperature changes. Brace and stiffen against deformation. Provide form liners where required to produce indicated finish. Provide dimensional tolerances per PCI MNL-117.

2.4.2 Reinforcement

ACI 301. Place reinforcing bars and welded wire reinforcement. Secure in position with tie wires, bar supports, and spacers.

2.4.3 Preparation for Placing Concrete

Remove hardened concrete, excess form parting compound, standing water, ice, snow, or other deleterious substances from form interiors and reinforcement before concrete placement. Secure reinforcement and embedded items.

2.4.4 Concrete Mixing and Conveying

2.4.4.1 Batch Plant, Mixer, Mixing, and Measuring of Materials

ASTM C94/C94M.

2.4.4.2 Conveying

Prevent segregation and loss of materials.

2.4.5 Concrete Placing

ACI 304R. Deposit concrete in the forms continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the precast concrete units. Place concrete at a constant temperature of between 50 and 90 degrees F throughout fabrication of each unit. Make temperature of forms or molds the same as or close to the concrete temperature. For hot or cold weather, use methods recommended by ACI 305R and ACI 306.1. Vibrate and consolidate concrete to prevent segregation and to produce a high-density concrete free of honeycomb and rock pockets. When specified, the exposed-to-view facing mixture is required to be a minimum thickness of 3/4 inches. Place backing mixture before facing mixture attains initial set.

2.4.6 Identification Markings

Permanently mark each precast unit to indicate pick-up points, location, orientation in the building, and date of casting. Identification markings need to correlate with approved detail drawings. Do not locate in exposed-to-view finished surfaces.

2.4.7 Finishing

2.4.7.1 Unformed Concealed Surfaces (Standard Smooth Finish)

Provide a trowel finish. Level surface with a straightedge, and strike off. After surface water has disappeared, float and trowel surface. Provide smooth finished surface, free of trowel marks, and uniform in texture and appearance.

2.4.7.2 Smooth, Exposed-to-View Surfaces

Provide a standard smooth finish to all exposed-to-view surfaces of panels, unless otherwise indicated. Provide a concrete surface having the texture imparted by a steel form or other approved smooth surfaces form-facing material.

2.4.7.3 Other Surfaces

Surfaces of precast units not exposed to view or not otherwise indicated to

be finished are to be finished in accordance with ACI 301 for a Surface Finish of 1.0.

2.4.8 Curing

Provide moist or steam curing or curing compound. Do not remove precast units from forms; prevent moisture loss and maintain 50 degrees F minimum for at least 24 hours after finishing. Maintain precast units in a surface damp condition at 50 degrees F minimum until concrete has attained 75 percent minimum of the design compressive strength..

2.4.9 Repair of Surface Defects

Cut out defective areas to solid concrete, with edges of cuts perpendicular to the surface of the concrete, and clean thoroughly. Dampen area to be patched and brush-coat with nonshrink grout or bonding agent. Patch the surface in accordance with procedures previously submitted by the Contractor and approved by the Contracting Officer. Where exposed to view, the patches, when dry, needs to be indistinguishable from the surrounding surfaces.

2.4.9.1 Smooth, Concealed Surfaces

Acceptable defective area will be limited to holes left by rods and other temporary inserts, and to honeycomb or rock pockets of 1/4 inch diameter maximum. Remove fins and other projections on the surfaces.

2.4.9.2 Exposed-to-View Surfaces

The combined area of acceptable defective areas must not exceed 0.2 percent of the exposed-to-view surface area and will be limited to holes of 1/4 inch diameter maximum.

2.4.10 Stripping

Do not remove precast concrete units from forms until units develop sufficient strength to safely strip the formwork and to remove the precast concrete units from the forms to prevent damage to the units from overstress or chipping.

2.4.11 Built-In Anchorage Devices

Accurately position and securely anchor all anchorage devices. Openings in anchorage devices must be filled temporarily to prevent entry of concrete.

2.4.12 Lifting Devices

Lifting devices must be provided, and designed for a safety factor of 4, which includes 100 percent impact. Do not use brittle material.

2.4.13 Finishing for Formed Surfaces

Upon removal of forms, repair and patch defective areas. Where the finished surface will be exposed to view, the combined area of defective areas must not exceed 0.2 percent of the surface and will be limited to honeycomb or rock pockets not deep enough to expose the reinforcement. Where the finished surface will be concealed by other construction, defective areas are limited to holes left by the rods and other temporary inserts and honeycomb or rock pockets not deep enough to expose the

reinforcement. Defective areas must be cut out to solid concrete, cleaned, and patched with grout. Where concrete surface will be exposed to view, the patches, when dry, must be indistinguishable from the surrounding surfaces.

2.5 JOINT MATERIALS

Gasket must be elastomeric material, premolded to cross section indicated.

Material must be a vulcanized closed-cell expanded chloroprene conforming to ASTM D1056, Grade No. 2A2, with the following additional properties:

a. Brittleness temperature will be minus 40 degrees F when tested in accordance with ASTM D746.

b. Flammability resistance needs to be self-extinguishing when tested in accordance with ASTM D635.

c. Resistance to ozone must be "no cracks" after exposure of a sample, at 20 percent elongation, to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F when tested in accordance with ASTM D1149.

2.6 MISCELLANEOUS ARCHITECTURAL PRECAST CONCRETE SYSTEMS

PART 3 EXECUTION

3.1 PREPARATION

Deliver anchorage devices to the site in time to be installed before the start of concrete placing or during steel erection. Contractor must provide setting drawings, instructions, and directions for the installation of anchorage devices.

3.2 EXAMINATION

Do not begin installation until supporting structures have been properly prepared.

Verify that all parts of the supporting structure are complete and ready to receive the precast units and that site conditions are conducive to proper installation.

If support structure is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before proceeding.

3.3 INSTALLATION

Install precast concrete units and accessories in accordance with approve detail drawings and descriptive data, and as specified below.

3.3.1 Building Framing System

Provide supporting members, including anchorage items attached to or embedded in building structural elements, prior to placement of precast units.

3.3.2 Concrete Strength at Time of Precast Unit Installation

Do not install precast units until concrete has attained the minimum laboratory compressive strength at 28 calendar days specified.

Do not install precast units before 28 calendar days from the date of casting unless approval has been obtained to make one compressive strength test, ASTM C39/C39M, and one flexural strength test using simple beam with third-point loading, ASTM C78/C78M, on field cured concrete test specimens, ASTM C31/C31M, for each individual precast unit to determine the strength of the concrete.

3.3.3 Erection

Erect precast units in accordance with the detail drawings and without damage to other units or to adjacent members. Set units true to alignment and level, with joints properly spaced and aligned both vertically and horizontally. Erection tolerances must be in accordance with the requirements of PCI MNL-117 and PCI MNL-122. As units are being erected, shims and wedges will be placed as required to maintain correct alignment. After final attachment, grout precast units as shown. After erection, clean and touch-up welds and abraded surfaces of steel with a zinc-rich paint. Welds must be made by a certified welder in accordance with the manufacturer's erection drawings. Finish pickup points, boxouts, inserts, and similar items to match adjacent areas after erection. Erection of precast units must be supervised and performed by workmen skilled in this type of work. Welding and the qualifications of welders must be in accordance with AWS D1.1/D1.1M.

3.3.4 Erection Tolerances

Erect architectural precast concrete units level, plumb, square and in alignment without exceeding the noncumulative erection tolerances of PCI MNL-117, Appendix I.

3.3.5 Joints

Joint widths between precast units will be as specified unless otherwise indicated.

3.3.5.1 Joint Sealing

Joint sealing will be as specified in Section 07 92 00 JOINT SEALANTS.

3.3.6 Protection

Protect exposed-to-view facing from staining and other damage from subsequent operations. Do not allow laitance to penetrate, stain, or harden on exposed surfaces.

3.4 DEFECTIVE WORK

Repair precast concrete units damaged during erection as soon after occurrence as possible or replaced, as directed, using approved procedures. All repairs to precast concrete units must match the adjacent surfaces in color and texture, as approved. Unless otherwise approved, repair procedures will conform to PCI MNL-117.

3.5 JOINTS AND GASKETS

Joints between precast units must be the width indicated and within limits of installation tolerances.

Install gaskets in joints as indicated, continuous throughout the joint length, and compressed at least 25 percent by volume.

3.6 INSPECTION AND ACCEPTANCE PROVISIONS

3.6.1 Dimensional Tolerances

Precast units having dimensions outside the limits for fabrication tolerances will be rejected.

3.6.2 Surface Finish Requirements

Precast units will be rejected for the following surface finish deficiencies:

a. Exposed-to-view surfaces that do not match the color, aggregate size and distribution, and texture of the approved sample

b. Exposed-to-view surfaces that contain defects that affect the appearance of the finish, such as cracks, spalls, honeycomb, rock pockets, or stains and discoloration of aggregate or matrix that cannot be removed by cleaning

c. Concealed surfaces that contain cracks in excess of 0.01 inch wide, cracks that penetrate to the reinforcement regardless of width, honeycomb, rock pockets, and spalls except minor breakage at corners and edges

3.6.3 Strength of Precast Units

Strength of precast concrete units will be considered potentially deficient if the units fail to comply with the requirements that control the strength of the units, including the following conditions:

a. Failure to meet compressive strength tests

b. Reinforcement not conforming to the requirements specified

c. Concrete curing and protection of precast units against extremes of temperature during curing not conforming to the requirements specified

d. Precast units damaged during handling and erection

3.6.4 Testing Precast Units for Strength

When there is evidence that the strength of precast concrete units does not meet specification requirements, cores drilled from hardened concrete for compressive strength determination must be made in accordance with ASTM C42/C42M and as follows:

a. Take at least three representative cores from the precast-concrete units that are considered potentially deficient.

b. Test cores with the saturated surface dry.

c. Strength of cores will be considered satisfactory if their average is equal to or greater than 90 percent of the 28-day design compressive strength of 6 by 12 inch cylinders.

Submit test reports on the same day that tests are made. Reports must contain the project name and number, date, name of contractor, name of precast concrete wall units manufacturer, name of concrete-testing service, identification letter and number of units represented by core tests, nominal maximum size of aggregate, design compressive strength of concrete at 28 calendar days, compressive breaking strength and type of break, length of core test specimen before capping, compressive strength after correcting for length diameter ratio, direction of application of the load on the core test specimen with respect to the horizontal plane of the concrete as placed, and the moisture condition of the core test specimen at time of testing.

If the results of the core tests are unsatisfactory or if core tests are impractical to obtain, a static load tests of a precast unit will be evaluated in accordance with ACI 318.

Replace precast units used for core tests or static load tests with units that meet the requirements of this section.

3.7 SAMPLING AND TESTING

3.7.1 Rejection

Precast units in place may be rejected for any one of the following product defects or installation deficiencies remaining after repairs and cleaning have been accomplished. "Visible" means visible to a person with normal eyesight when viewed from a distance of 20 feet in broad daylight.

a. Nonconformance to specified tolerances.

b. Air voids (bugholes or blowholes) larger than 3/8 inch diameter.

c. Visible casting lines.

d. Visible from joints.

e. Visible irregularities.

f. Visible stains on precast unit surfaces.

g. Visible differences between precast unit and approved sample.

h. Visible non-uniformity of textures or color.

i. Visible areas of backup concrete bleeding through the facing concrete.

j. Visible foreign material embedded in the face.

k. Visible repairs.

l. Visible reinforcement shadow lines.

m. Visible cracks.

n. Precast units that are damaged during construction operations.

3.7.2 Field Quality Control

Perform field inspection of precast unit connections. Notify the Contracting Officer in writing of defective welds, bolts, nuts and washers within 7 working days of the date of inspection. All defective connections or welds are to be removed and re-welded or repaired as required by the Contracting Officer.

3.7.2.1 Welded Connection Visual Inspection

AWS D1.1/D1.1M, furnish the services of AWS-certified welding inspector for erection inspections. Welding inspector must visually inspect all welds and identify all defective welds.

3.8 CLEANING

Clean exposed-to-view surfaces of precast units thoroughly with detergent and water; use a brush to remove foreign matter. Remove stains that remain after washing in accordance with recommendations of the precast manufacturer. Surfaces must be clean and uniform in color. Include precast concrete wall panel manufacturer's written recommendations for installation and cleaning.

-- End of Section --

SECTION 04 20 00

UNIT MASONRY
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2019) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A951/A951M	(2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1008/A1008M	(2016) Standard Specification for Steel,

	Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C67/C67M	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C73	(2017) Standard Specification for Calcium Silicate Brick (Sand-Lime Brick)
ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C129	(2017) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C216	(2019) Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2019) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2019) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete
ASTM C1019	(2019) Standard Test Method for Sampling and Testing Grout
ASTM C1314	(2014) Standard Test Method for Compressive Strength of Masonry Prisms
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars

ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

THE MASONRY SOCIETY (TMS)

TMS MSJC	(2016) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cut CMU Drawings; G, AE

Reinforcement Detail Drawings; G, AE

SD-03 Product Data

Hot Weather Procedures; G, AE

Cold Weather Procedures; G, AE

Clay or Shale Brick; G, AE

Cement; G, AE

Cementitious Materials; G, AE

Insulation; G, AE

SD-04 Samples

Mock-Up Panel; G, AE

Clay or Shale Brick; G, AE

Dimension Stone Units; G, AE

SD-05 Design Data

Masonry Compressive Strength; G, AE

Bracing Calculations; G

SD-06 Test Reports

Prism Tests

SD-07 Certificates

Special Masonry Inspector Qualifications

Clay or Shale Brick

Concrete Masonry Units (CMU)

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

Insulation

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

1.3 QUALITY ASSURANCE

1.3.1 Masonry Mock-Up Panels

1.3.1.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work, construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the RPM, FEAD CM or Engineer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

1.3.1.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 8 feet long by 4 feet high.

1.3.1.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. When the panel represents reinforced masonry, include a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

1.3.1.4 Mock-Up Panel Construction Method

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly designed concrete foundation.

1.3.1.5 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the RPM, FEAD CM or Engineer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

1.3.2 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage,

and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.

b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'm, is as indicated for

each type of masonry .

2.1.2 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Unit Strength Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with RPM, FEAD CM or Engineer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2.2 Clay or Shale Brick

2.2.2.1 General

2.2.2.1.1 Sample Submittal

Submit brick samples as specified, showing the color range and texture of clay or shale brick. Limit units used on the project to those that conform to the approved sample. Submit sample of colored mortar with applicable masonry unit and color samples of three stretcher units and one unit for each type of special shape.

2.2.2.1.2 Uniformity

Deliver clay or shale brick units factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.2.1.3 Efflorescence Test

Test clay brick that will be exposed to weathering for efflorescence in accordance with ASTM C67/C67M. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Units meeting the definition of "effloresced" are subject to rejection.

2.2.2.2 Solid Clay or Shale Brick

Provide solid clay or shale brick that conforms to ASTM C216, Type FBS . Where brick cores, recesses, or deformation would be exposed to view, provide 100 percent solid units. Provide brick with texture and color tange to match the brick indicated.

Provide brick with specified sizes.

a. Modular size, 3-5/8 inches thick, 2-1/4 inches high, and 7-5/8 inches long.

2.2.3 Concrete Units

2.2.3.1 Aggregates

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641,visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates.

2.2.3.2 Concrete Masonry Units (CMU)

2.2.3.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

2.2.3.2.2 Size (Nominal size)

Provide units with specified dimension of 12 inches wide, 8 inches high, and 16 inches long.

2.2.3.2.3 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather.

2.2.3.2.4 Unit Types

a. Hollow Load-Bearing Units: ASTM C90, lightweight . Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C129, lightweight . Load-bearing units may be provided in lieu of non-load-bearing units.

2.2.3.2.5 Jamb Units

Provide jamb units of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved.

Provide sash jamb units with a 3/4 by 3/4 inch groove near the center at end of each unit.

2.2.3.3 Architectural Units

Provide architectural units with patterned face shell: split face.

Provide units that are integrally colored during manufacture, with color to be selected by Owner..

2.2.3.4 Patterned, Decorative Screen Units

Provide patterned, decorative screen units that conform to ASTM C90 . Provide units that have uniform through-the-wall pattern, color, and texture.

2.2.3.5 Concrete Brick

2.2.3.5.1 Sand-Lime Brick

Provide calcium-silicate (sand-lime) that conforms to ASTM C73, Grade SW, approximately 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long or modular, with smooth surfaces and natural color.

2.2.4 Precast Concrete Units

2.2.4.1 General

a. Provide precast concrete trim, lintels, splashblocks and sills that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum 4,000 psi compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 3/4 inch between reinforcement and faces of units.

b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 80 pounds provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.

c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with a smooth dense finish.

d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

e. Submit specified factory certificates.

f. Provide architectural cast stone masonry trim, heads, and sills that are manufactured in a plant by a producer regularly engaged in producing cast stone. Provide cast stone units that comply with ASTM C1364. Submit test reports and three exemplars of the same cast stone product installed in similar projects in similar climatic conditions.

2.2.4.2 Precast Concrete Lintels

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 36 inches in length. Provide at least 8 inches bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design

reinforced lintels in conformance with ACI 318 for flexural and shear strength, using concrete with a minimum 28 day compressive strength of 4,000 psi. Limit lintel deflection due to dead plus live load to L/600 or 0.3 inches.

2.2.4.3 Precast Concrete Sills and Copings

Cast sills and copings washes. For windows having mullions, cast sills in sections with head joints at mullions and a 1/4 inch allowance for mortar joints. Roughen the ends of sills, except a 3/4 inch wide margin at exposed surfaces, for bond. Provide rounded nosings on treads of door sills. Reinforce sills with not less than two No. 4 bars.

2.3 EQUIPMENT

2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by ASTM C270.

2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

2.4.1.3 Colored Mortar

Use mortar pigment that conforms to ASTM C979/C979M. Add pigment to mortar to produce a uniform color. Furnish pigments in accurately pre-measured and packaged units that can be added to a measured amount of cementitious materials or supply pigments via preblended cementitious materials or dry mortar mix.

a. In masonry cement or mortar cement, do not exceed 5 percent of cement weight for mineral oxide pigment; do not exceed 1 percent of cement weight for carbon black pigment.

b. In cement-lime mortar mix, do not exceed 10 percent of cementitious materials' weight for mineral oxide pigment; do not exceed 2 percent of cementitious materials' weight for carbon black pigment.

2.4.1.4 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

2.4.1.5 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

2.4.2 Grout and Ready-Mix Grout Materials

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by ASTM C476.

2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the RPM, FEAD CM or Engineer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the RPM, FEAD CM or Engineer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

2.5 MORTAR AND GROUT MIXES

2.5.1 Mortar Mix

a. Provide mortar Type S unless specified otherwise herein. Do not use masonry cement in the mortar. Do not use air-entrainment in the mortar.

b. For preblended mortar, follow manufacturer's mixing instructions.

2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to ASTM C476, fine . Use conventional grout with a slump between 8 and 11 inches. Use self-consolidating grout with slump flow of 24 to 30 inches and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of 2000 psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

2.6 ACCESSORIES

2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

2.6.2 Anchors, Ties, and Bar Positioners

2.6.2.1 General

a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.

b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.

c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.

d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.

e. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.2.2 Wire Mesh Anchors

Provide wire mesh anchors of 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 12 inches, at intersections of interior non-bearing masonry walls.

2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized W2.8 diameter steel wire. Provide rectangular wall ties no less than 4 inches wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum W2.8 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 1-1/4 inch between each element of the tie and maximum distance between connecting parts no more than 1/16 inch. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

2.6.2.4 Adjustable Anchors

2.6.2.4.1 Anchorage to Structural Steel

Provide hot-dip galvanized adjustable anchors for connecting masonry walls to the structural steel frame as detailed on the drawings .

2.6.2.5 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of

reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized. Bar positioners must be suitable for intended use and be corrosion resistant steel. Bar positioners not fully contained within the wythe must be hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size joint reinforcement to provide a minimum of 5/8 inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60.

2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

2.6.6 Clay Masonry Expansion-Joint Materials

Provide backer rod and sealant, adequate to accommodate joint compression and extension equal to 50 percent of the width of the joint. Provide the backer rod of compressible rod stock of closed cell polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Provide sealant in conformance with Section 07 92 00 JOINT SEALANTS with a maximum volatile organic compound (VOC) content of 600 grams/liter.

Submit one piece of each type of material used.

2.6.7 Through Wall Flashing and Weeps

2.6.7.1 General

Provide stainless steel sheetflashing indicated to terminate in reglets shall be metal or coated-metal flashing.

2.6.7.2 Stainless Steel Flashing

Provide stainless steel, ASTM A167, Type 304 or 316, 0.015 inch thick,

No. 2D finish.

2.6.7.3 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard 3/8 inch wide mortar joint and with height equal to the nominal height of the unit.

2.6.7.4 Metal Drip Edge

Provide stainless steel drip edge, 15-mil thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

2.6.8 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in running bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 1/2 inch. Adjust each unit to its final position while mortar is still soft and has plastic consistency.

b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.

c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the RPM, FEAD CM or Engineer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.

d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

e. In multi-wythe construction with collar joints no more than 3/4 inch wide, bring up the inner wythe not more than 16 inches ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave , using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.3.1.1.4 Joint Widths

a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.

b. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.

c. Provide 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.

d. Maintain mortar joint widths within tolerances permitted by TMS MSJC

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls,

corners, and other openings.

3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved by the RPM, FEAD CM or Engineer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.3.1.4 Clay Masonry Expansion Joints

Provide clay masonry expansion joints as indicated. Construct by filling with a compressible foam pad. Ensure that no mortar or other noncompressible materials are within the joint. Install backer rod and sealant in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.5 Control Joints

Provide control joints in concrete masonry as indicated. Construct by using special control-joint units in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement.

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 3/4 inch. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.6 Decorative Architectural Units

Place decorative masonry units with the patterned face shell properly aligned in the completed wall.

3.3.2 Clay or Shale Brick Masonry

3.3.2.1 Brick Placement

Blend all brick at the jobsite from several cubes to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable. Lay brick facing with the better face exposed. Lay brick in running bond with each course bonded at corners, unless otherwise indicated. Lay molded brick with the frog side down. Do not lay brick that is cored, recessed, or has other deformations in a manner that allows those deformations to be exposed to view; lay 100 percent solid units in these areas. Completely fill head and bed joints of solid units with mortar. Lay hollow units with mortar joints as specified for concrete masonry units.

Place exterior face of salvaged bricks towards the exterior.

3.3.2.2 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C67/C67M. Ensure that each unit is nearly saturated when wetted but surface dry when laid.

Test clay or shale brick daily on the job, prior to laying, as follows:

Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.3.2.3 Brick Sills

Lay brick on edge, slope not less than 3/4 inch downward to the outside, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.3.2.4 Partitions

a. Construct partitions continuous from floor to underside of floor or roof deck where shown. Fill openings in firewalls around joists and other structural members as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. Construct an isolation joint in the intersection between partitions and structural or exterior walls.

b. Tie interior partitions having 4 inch nominal thickness units to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and 7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Tie interior partitions over 4 inches thick together with joint reinforcement. Provide joint reinforcement with prefabricated pieces at corners and intersections of partitions.

c. Double-Faced Bases or Partitions: Construct double-faced clay unit bases and partitions of two-unit construction. Bond units by overlapping from opposite faces of the wall, 2 inches for 6 inch thick partitions and 4 inches for 8 inch thick or greater. A single wythe prefaced concrete masonry base or partition may be made with double faced units.

3.3.3 Anchored Veneer Construction

a. Construct exterior masonry wythes to the thickness indicated on the drawings. Provide a minimum 2 inch air space behind the masonry veneer. Provide means to ensure that the cavity space and flashings are kept clean of mortar droppings and other loose debris. Maintain chases and raked-out joints free from mortar and debris.

b. Place masonry in running bond pattern.

c. For veneer over stud framing, do not install veneer until the exterior sheathing, moisture barrier, veneer anchors and flashing have been installed on the backing. Take extreme care to avoid damage to the moisture barrier and flashing during construction of the masonry veneer. Repair or replace portions of the moisture barrier and flashing that are damaged prior to completion of the veneer. Provide a continuous cavity as indicated.

d. For veneer with a masonry backup wythe, lay up both the inner and the outer wythes together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up

together, install through-wall flashings with the exterior wythe, securing the top edge of the flashing with a termination bar and sealant, or protect flashings that are installed with the interior wythe from damage until they are fully enclosed in the wall.

e. Provide anchors (ties) to connect the veneer to its backing in sufficient quantity to comply with the following requirements: maximum wall area per anchor {tie) of 2.67 sf, and maximum vertical spacing of 16 inches, and maximum horizontal spacing of 24 inches. Provide additional anchors around openings larger than 16 inch in either direction. Space anchors around perimeter of opening at a maximum of 24 inches on center. Place anchors within 12 inches of openings. Anchors with drips are not permitted.

f. With solid units, embed anchors in mortar joint and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar cover to the outside face.

g. With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar or grout cover to outside face.

3.3.4 Composite Walls

Tie masonry wythes together with joint reinforcement or with unit wall ties. Embed wall ties at least 1-1/2 inch into mortar of solid units and at least 1/2 inch into the mortar of the outer face shell of hollow units. Provide at least one tie every 2.67 square feet for wire size W1.7 and at least one tie every 4.50 square feet for wire size W2.8. Space ties at a maximum of 36 inches horizontally and 24 inches vertically. Do not cross expansion joints or control joints with ties. Fill collar joints between masonry facing and masonry backup solidly with grout.

3.3.5 Reinforced, Single Wythe Concrete Masonry Units Walls

3.3.5.1 Concrete Masonry Unit Placement

a. Fully bed units used to form piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout in mortar under both face shells and webs. Provide mortar beds under both face shells for other units. Mortar head joints for a distance in from the face of the unit not less than the thickness of the face shell.

b. Solidly grout foundation walls below grade.

c. Stiffen double walls at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of each wall within the double wall. Adequately reinforce walls and partitions for support of wall-hung plumbing fixtures when chair carriers are not specified.

d. Submit drawings showing elevations of walls exposed to view and indicating the location of all cut CMU products.

3.3.5.2 Preparation for Reinforcement

Lay units in such a manner as to preserve the unobstructed vertical

continuity of cores to be grouted. Remove mortar protrusions extending 1/2 inch or more into cells before placing grout. Position reinforcing bars accurately as indicated before placing grout. Where vertical reinforcement occurs, fill cores solid with grout in accordance with paragraph PLACING GROUT in this Section.

3.3.6 Cavity Walls (Multi-Wythe Noncomposite Walls

Provide a continuous cavity as indicated. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings.

Securely tie the two wythes together with horizontal joint reinforcement, or provide ties to connect the masonry wythes in sufficient quantity to comply with the following requirements: maximum wall area per tie of 2.67 sf, and maximum vertical spacing of 16 inches, and maximum horizontal spacing of 24 inches. Provide additional ties around openings larger than 16 inches in either direction. Space ties around perimeter of opening at a maximum of 3 feet on center. Place ties within 12 inchesof openings. Ties with drips are not permitted.

3.3.7 ANCHORAGE

3.3.7.1 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.3.7.2 Anchorage at Intersecting Walls

Provide wire mesh anchors at maximum 16 inches spacing at intersections of interior non-bearing masonry walls.

Anchor structural masonry walls with reinforced bond beams as indicated, and horizontal joint reinforcement spaced no more than 16-inches, unless the drawings indicate a movement joint at the intersection.

3.3.8 Lintels

3.3.8.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated. Extend lintel reinforcement beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Support reinforcing bars in place prior to grouting and locate 1/2 inch above the bottom inside surface of the lintel unit.

3.3.8.2 Precast Concrete and Steel Lintels

Provide precast concrete and steel lintels as shown on the Drawings. Set lintels in a full bed of mortar with faces plumb and true. Provide steel and precast lintels with a minimum bearing length of 8 inches unless otherwise indicated. In partially grouted masonry, provide fully grouted units under the full lintel bearing length, unless otherwise indicated.

3.3.9 Sills and Copings

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 4 feet as indicated.

3.4 INSTALLATION

3.4.1 Bar Reinforcement Installation

3.4.1.1 Preparation

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1/4 inch per foot. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 2 inches of tops of walls.

3.4.1.2 Positioning Bars

a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.

b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.

c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.

d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent

when permitted by TMS MSJC.

3.4.1.3 Splices of Bar Reinforcement

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

3.4.2 Placing Grout

3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar join not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.2.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.4 Grout Holes and Cleanouts

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Fom such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units. provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of

the grout pour exceeds 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 3 by 3 inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.5 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.

b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.

c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.

d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches

in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.

f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.5 Flashing and Weeps

a. Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by securing the sheet metal flashing into a reglet cast into the concrete backup. Terminate the horizontal leg of the flashing by extending the sheet metal 1/2 inch beyond the outside face of masonry and turning downward with a hemmed drip extending the fabric flashing beyond the outside face of masonry and, when construction is complete, cutting the flashing flush with the face of masonry. Provide sealant below the drip edge of through-wall flashing.

b. Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of weep ventilators. Locate weeps not more than 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams,

and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to 16 inches on center and approved by the RPM, FEAD CM or Engineer. Maintain weeps free of mortar and other obstructions.

3.5 APPLICATION

3.5.1 Insulation

Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces. Tape or seal the joints between the boards.

3.5.2 Interface with Other Products

3.5.2.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

3.5.2.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 3/8 inch.

3.5.2.3 Bearing Plates

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Provide bedding mortar and non-shrink grout s specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Mortar

Perform mortar testing at the following frequency: One time per 5,000 sq. ft. of wall area or portion thereof. For each required mortar test, provide a minimum of three mortar samples. Perform initial mortar testing prior to construction for comparison purposes during construction.

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4. Prepare and test mortar compressive strength specimens in accordance with ASTM C780 Appendix A6.

3.6.1.2 Field Testing of Grout

a. Perform grout testing at the following frequency: One time per 5,000 sq. ft. of wall area or portion thereof. For each required grout property to be evaluated, provide a minimum of three specimens.

b. Sample and test conventional and self-conslidating grout for compressive strength and temperature in accordance with ASTM C1019.

c. Evaluate slump in conventional grout in accordance with ASTM C1019.

d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

3.6.1.3 Clay Brick Efflorescence Test

Test clay brick that will be exposed to weathering for efflorescence in accordance with ASTM C67/C67M. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Units meeting the definition of "effloresced" are subject to rejection.

3.6.1.4 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such tests for any building. Evaluate three prisms in each test. Fabricate, store, handle, and test prisms in accordance with ASTM C1314.

Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. If the compressive strength of any prism falls below the specified value by more than 500 psi, take steps to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, take three specimens for each prism test more than 500 psi below the specified value. Masonry in the area in question will be considered structurally adequate if the average compressive strength of three specimens is equal to or exceeds the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted.

3.6.2 Special Inspection

Perform special inspections and testing in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or

painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.7.2 Clay Brick Surfaces

Clean exposed clay brick masonry surfaces to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. Perform cleaning in accordance with the approved cleaning procedure demonstrated on the mockup.

After cleaning, examine the sample panel of similar material for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, change the method of cleaning to ensure that the masonry surfaces in the structure will not be adversely affected. Water-soak exposed masonry surfaces and then clean with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay brick manufacturer and manufacturer of the cleaning product. Apply the solution with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Use proprietary cleaning agents in conformance with the cleaning product manufacturer's printed recommendations. Remove efflorescence in conformance with the brick manufacturer's recommendations.

3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap packaging to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

-- End of Section --

SECTION 05 05 23.16

STRUCTURAL WELDING
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2016) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-105-2006)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel
AWS D14.4/D14.4M	(2012) Specification for Welded Joints for Machinery and Equipment
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E165/E165M	(2018) Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E709	(2015) Standard Guide for Magnetic Particle Examination

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welding Quality Assurance Plan; G

SD-03 Product Data

Welding Procedure Qualifications; G

Welder, Welding Operator, and Tacker Qualification

Previous Qualifications

Pre-Qualified Procedures; G

Welding Electrodes and Rods

SD-06 Test Reports

Nondestructive Testing

Weld Inspection Log

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)

Certified Brazing Procedure Specifications (BPS)

Certified Procedure Qualification Records (PQR)

Certified Welder Performance Qualifications (WPQ)

Certified Brazer Performance Qualifications (BPQ)

Certified Welding Inspector

Nondestructive Testing Personnel

1.3 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding must record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the procedure qualification records for each type of welding being performed. Submission ofthe welder, welding operator, or tacker qualification test records is also required. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or

suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.3.1 General Requirements

Fabricate work in an AISC Certified Fabrication Plant, Category BU. Erect work by an AISC Certified Erector, Category CSE.

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

(2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

(3) Reinforcing Steel: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

(1) Submit two copies of the Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) to the Contracting Officer for approval .

(2) Submit two copies of the Certified Welder Performance Qualifications (WPQ)and Certified Brazer Performance Qualifications (BPQ) to the Contracting Officer for approval within fifteen calendar days prior to any employee welding on the project material.

(3) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.3.2 Previous Qualifications

Welding procedures previously qualified by test in accordance with AWS D1.1/D1.1M, may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.3.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.3.4 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used within the applicable essential variables for welder qualification.

1.3.4.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.3.4.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.3.4.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the

processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability or there has been a gap greater than 6 months since he/she last used the process. In such a case, the tacker is required to pass the prescribed tack welding test.

1.3.5 Inspector Qualification

Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1. Submit qualifications for nondestructive testing personnel in accordance with the requirements of ANSI/ASNT CP-189 for Levels I or II in the applicable nondestructive testing method. Level I inspectors must have direct supervision of a Level II inspector.

1.3.6 Symbols and Safety

Use symbols in accordance with AWS A2.4, unless otherwise indicated. Follow safe welding practices and safety precautions during welding in conformance with AWS Z49.1.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

2.1.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (submitted for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and nondestructive testing; welding schedule; and other items deemed necessary by the attendees.

2.2 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, welding electrodes and rods, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator. Use welding electrodes. Provide welding equipment and materials that comply with the applicable requirements of AWS D1.1/D1.1M. Submit product data on welding electrodes and rods.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Test 50% of CJP welds using ultrasonic testing per Table 6.2 of AWS D1.1/D1.1M. Randomly test 50% of all PJP and fillet welds or as indicated by magnetic particle or dye penetrant testing. Verify the welds conform to paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165/E165M, and ASTM E709. Submit a Welding Quality Assurance Plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Submit all records of nondestructive testing.

3.3.1 Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface

conditioning shows that no unacceptable defect is present. Submit all records of nondestructive testing in accordance with paragraph STANDARDS OF ACCEPTANCE.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements for the original welds.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 207	(2016; R 2017) Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components
AISC 303	(2016) Code of Standard Practice for Steel Buildings and Bridges
AISC 325	(2017) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2016) Specification for Structural Steel Buildings
AISC 420	(2010) Certification Standard for Shop Application of Complex Protective Coating Systems
AISC DESIGN GUIDE 10	(1997) Erection Bracing of Low-Rise Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2016) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-105-2006)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1	(2009) Surface Texture, Surface Roughness, Waviness and Lay

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2017a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A29/A29M	(2016) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	(2007; R 2014) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2018) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2011; R 2015) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2016) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C827/C827M	(2016) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C1107/C1107M	(2017) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions

ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959/F959M	(2017a) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series
ASTM F1136/F1136M	(2011) Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F2329/F2329M	(2015) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F2833	(2011; R 2017) Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
ASTM F3125/F3125M	(2015a) Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019) Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR Part 1926, Subpart R	Steel Erection

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Erection and Erection Bracing Drawings; G

SD-02 Shop Drawings

Fabrication Drawings Including Details of Connections; G, AE

SD-03 Product Data

Shop Primer; AE

Welding Electrodes and Rods

Direct Tension Indicator Washers

Non-Shrink Grout; AE

Tension Control Bolts

SD-05 Design Data

Design Calculations for Steel Connections; G, AE

Shoring and Temporary Bracing

SD-06 Test Reports

Class B Coating

Bolts, Nuts, and Washers

Weld Inspection Reports

Direct Tension Indicator Washer Inspection Reports

Bolt Testing Reports

Embrittlement Test Reports

SD-07 Certificates

Steel

Bolts, Nuts, and Washers

Galvanizing

AISC Structural Steel Fabricator Quality Certification

AISC Structural Steel Erector Quality Certification

Welding Procedures and Qualifications

Welding Electrodes and Rods

Certified Welding Inspector

NDT Technician

Welding Procedure Specifications (WPS)

Overhead, Top Running Crane Rail Beam

1.3 AISC QUALITY CERTIFICATION

Work must be fabricated by an AISC Certified Structural Steel Fabricator, in accordance with AISC 207, Category BU. Submit AISC Structural Steel Fabricator quality certification.

Work must be erected by an AISC Structural Steel Certified Erector, in accordance with AISC 207, Category CSE. Submit AISC Structural Steel erector quality certification.

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

1.4.1.1 Erection and Erection Bracing Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to AISC 303. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

1.4.2 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 303, AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. Sign and seal fabrication drawings by a registered professional engineer. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Clearly highlight any deviations from the details shown on the contract drawings highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.4.3 Delegated Connection Design

Design structural steel connection indicated in the contract documents per AISC 303, Option 3, using the connection loads indicated. Submit design calculations for steel connections signed and sealed by a registered professional engineer.

1.4.4 Certifications

1.4.4.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer and galvanizing, complete and ready for use. Provide structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing in accordance with AISC 303, AISC 360, and UFC 3-301-01 except as modified in this contract.

2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

2.2.2 Structural Steel Tubing

ASTM A500/A500M, Grade C.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard) or as indicated.

2.3 BOLTS, NUTS, AND WASHERS

Submit the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

2.3.1 Common Grade Bolts

2.3.1.1 Bolts

ASTM A307, Grade A, plain finish hot dipped zinc coating. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.3.1.2 Nuts

ASTM A563, Grade A, heavy hex style.

2.3.1.3 Washers

ASTM F844.

2.3.2 High-Strength Bolts

High strength bolts and nuts must be shipped together in the same shipping container. Fasteners indicated to be galvanized shall be tested by the supplier to show that the galvanized nut with the supplied lubricant provided may be rotated from the snug tight condition well in excess of the rotation required for pretentioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

2.3.2.1 Bolts

ASTM F3125/F3125M, Grade A325M A325 , Type 1 Heavy Hex Head Style, plain finish hot dipped zinc coating.

2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.3.2.3 Direct Tension Indicator Washers

ASTM F959/F959M. Provide ASTM B695, Class 55, Type 1 galvanizing. Submit product data for direct tension indicator washers.

2.3.2.4 Washers

ASTM F436/F436M, plain carbon steel.

2.3.3 Tension Control Bolts

ASTM F3125/F3125M, Grade F1852, Type 1, twistoff style assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Assembly finish must be mechanically deposited zinc coating. Submit product data for tension control bolts.

2.3.4 Foundation Anchorage

2.3.4.1 Anchor Rods

ASTM F1554 Gr 55, Class 2A.

2.3.4.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.3.4.3 Anchor Washers

ASTM F844.

2.3.4.4 Anchor Plate Washers

ASTM A36/A36M.

2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M. Submit product data for welding electrodes and rods.

2.4.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Submit product data for non-shrink grout.

2.4.3 Welded Shear Stud Connectors

ASTM A29/A29M, Grades 1010 through 1020. AWS D1.1/D1.1M, Table 7.1, Type B.

2.5 GALVANIZING

ASTM F2329/F2329M, ASTM F1136/F1136M, ASTM F2833 or ASTM B695 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable. All steel to be (G90) hot dipped galvanized. Fill vent and drain holes that are exposed in the finished work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

2.6.1 Markings

Prior to erection, identify members by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

SSPC Paint 20 or SSPC Paint 29, (zinc rich primer). Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete surfaces to receive epoxy coatings, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding. If flash rusting occurs, re-clean the surface prior to application of primer. Apply primer in accordance with endorsement "SPE-P1" of AISC 420 or

approved equal NACE or SSPC certification to a minimum dry film thickness of 2.0 mil. Submit shop primer product data.

Prime slip critical surfaces with a Class B coating in accordance with AISC 325. Submit test report for Class B coating.

See Specification SEction 09 90 00 Paints and Coatings for additional requirements. Primer must be compatible with final painting and coating product(s).

Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer. Repair damaged primed surfaces with an additional coat of primer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.3 Epoxy Coated Surfaces

Clean and prepare surfaces to receive epoxy coatings in accordance with the manufacturer's recommendations.

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.7 DRAINAGE AND VENT HOLES

Drill adequate drainage and venting holes to eliminate water and galvanizing traps. Hole vent diameter must be 1/2 inch. Hole vent size and locations must not affect the structural integrity.

PART 3 EXECUTION

3.1 ERECTION

a. Erection of structural steel, except as indicated in item b. below, must be in accordance with the applicable provisions of AISC 325, AISC 303 and 29 CFR Part 1926, Subpart R.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), erect the structure in accordance with AISC DESIGN GUIDE 10.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.1.1 STORAGE

Store the material out of contact with the ground in such manner and location as to minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, design connections indicated in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

Tighten ASTM A307 bolts to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM F3125/F3125M, Grade A325 and Grade A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, fully tension bolts, progressing from the most rigid part of a connection to the free edges.

Fastener components shall be protected from dirt and moisture in closed containers at the site of the installation. Fastener components that are not incorporated into the work shall be returned to protected storage at the end of the work shift.

3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, install the DTIW under the bolt head and tighten the nut. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat washers under both the bolt head and nut when ASTM F3125/F3125M, Grade A490 bolts are used.

3.2.3 Tension Control Bolts

Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, fully tension bolts, progressing from the most rigid part of a connection to the free edges.

3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors is not permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Submit for approval all WPS, whether prequalified or qualified by testing.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field prime steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. Notify the Contracting Officer in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1.

Inspect proper preparation, size, gaging location, and acceptability of all welds; identification marking; operation and current characteristics of welding sets in use.

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. Ultrasonic testing must be performed in accordance with Table 6.2 of AWS D1.1/D1.1M. Test locations must be selected by the Contracting Officer. All personnel performing NDT must be certified in accordance with ANSI/ASNT CP-189 in the method of testing being performed. Submit certificates showing compliance with ANSI/ASNT CP-189 for all NDT technician

s. If more than 20 percent of welds made by a welder contain defects identified by testing, then all groove welds made by that welder must be tested by ultrasonic testing, and all fillet welds made by that welder must be inspected by magnetic particle testing (MT) or dye penetrant testing (PT) as approved by the Contracting Officer. When groove welds made by an individual welder are required to be tested, magnetic particle or dye penetrant testing may be used only in areas inaccessible to ultrasonic testing. Retest all repaired areas. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Ultrasonic	50 percent of CJP Welds
Magnetic Particle	50 percent of PJP and Fillet Welds
Dye Penetrant	50 percent of PJP and Fillet Welds

3.7.2 Direct Tension Indicator Washers

3.7.2.1 Direct Tension Indicator Washer Compression

Test direct tension indicator washers in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap, as required by ASTM F959/F959M. Submit direct tension indicator washer inspection reports.

3.7.2.2 Direct Tension Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, must test in place the direct tension indicator gaps on 20 percent of the installed direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. If more than 10 percent of the direct tension indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F959/F959M, test all in place direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. Test locations must be selected by the Contracting Officer.

3.7.3 High-Strength Bolts

3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.7.3.2 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and

report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspect calibration of torque wrenches for high-strength bolts.

3.7.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

3.7.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication. Submit embrittlement test reports.

3.7.5 Inspection and Testing of Steel Stud Welding

Perform verification inspection and testing of steel stud welding conforming to the requirements of AWS D1.1/D1.1M, Stud Welding Clause. The Contracting Officer will serve as the verification inspector. Bend test studs that do not show a full 360 degree weld flash or have been repaired by welding as required by AWS D1.1/D1.1M, Stud Welding Clause. Studs that crack under testing in the weld, base metal or shank will be rejected and replaced by the Contractor at no additional cost.

-- End of Section --

SECTION 05 21 00

STEEL JOIST FRAMING
05/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC Paint 15	(1999; E 2004) Steel Joist Shop Primer/Metal Building Primer
SSPC SP 2	(2018) Hand Tool Cleaning

STEEL JOIST INSTITUTE (SJI)

SJI LOAD TABLES	(2010; Errata 1 2011; Errata 2 2012) 42nd Edition Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders
SJI MANUAL	(2009) 80 Years of Open Web Steel Joist Construction

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.757	Steel Erection; Open Web Steel Joists

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welder Qualification

SD-02 Shop Drawings

Steel Joist Framing; G; AE

SD-03 Product Data

Recycled Content Of Steel Products; S

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Erection Inspection
Welding Inspections

SD-07 Certificates

Certification of Compliance

1.3 QUALITY ASSURANCE

Perform all work in compliance with the requirements set forth in 29 CFR 1926.

1.3.1 Drawing Requirements

Submit drawings of steel joist framing including fabrication, specifications for shop painting, and identification markings of joists . Show joist type and size, layout in plan, all applicable loads, deflection criteria, and erection details including methods of anchoring, framing at openings, type, size, and location and connections for and spacing of bridging, requirements for field welding, and details of accessories as applicable.

1.3.2 Certification of Compliance

Prior to construction commencement, submit certification for welder qualification, in compliance with AWS D1.1/D1.1M, welding operation, and tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. Submit certification of compliance for the following:

a. SJI MANUAL

b. Steel Joist Institute Member Fabricator

c. 29 CFR 1926

d. 29 CFR 1926.757

e. Statement from steel joist manufacturer, that work was performed in accordance with approved construction documents and with SJI standard specifications, in accordance with ICC IBC Section 1704.2.5.2.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store joists in a manner to prevent damage affecting their structural integrity. Verify piece count of all joist products upon delivery and inspect all joists products for damage. Report any damage to the joist supplier. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling. Store joists with top chord down and with joists in a vertical position. Store deep joists horizontally if they were shipped on their sides.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Designate steel joists on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

2.2 STEEL JOISTS

Provide steel joists conforming to SJI LOAD TABLES. Design joists designated K, and KCS to support the loads given in the applicable standard load tables of SJI LOAD TABLES. Submit design calculations for net uplift loads, non-SJI standard details, and field splices. Include cover letter signed and sealed by the joist manufacturer's registered design professional. All joists and components to be hot dipped galvanized (G90), primed and painted.

2.2.1 Steel Joist Camber

Camber joists according to SJI LOAD TABLES.

2.2.2 Special Steel Joists

Provide special joists and connections capable of withstanding the design loads indicated with a live-load deflection less than L/360 for roof joists.

2.2.3 Steel Joist Substitutes and Outriggers

Provide joist substitutes and outriggers conforming to SJI LOAD TABLES with steel angle or channel members.

2.3 RECYCLED CONTENT

Provide products with an average recycled content of steel products of postconsumer recycled content plus one half of preconsumer recycled content not less than 25 percent.

2.4 ACCESSORIES AND FITTINGS

2.4.1 Bridging

Provide bridging of material, size, and type required by SJI LOAD TABLES for type of joist, chord size, spacing and span. Furnish additional erection bridging if required for stability.

2.4.2 Bearing Plates

Fabricate steel bearing plats from ASTM A36/A36M steel of size and thickness indicated.

2.5 Hot dip galvanize (G90) all joists and components according to ASTM A123

2.6 SHOP PAINTING

SSPC Paint 15. Shop prime joists, except as modified herein, in accordance with SSPC PA 1. Clean joists in accordance with SSPC SP 2 before priming. If flash rusting occurs, re-clean the surface prior to application of primer. For joists which require finish painting under Section 09 90 00 PAINTS AND COATINGS, the primer paint must be compatible with the finish paint.

PART 3 EXECUTION

3.1 ERECTION

Install joists in conformance with SJI LOAD TABLES for the joist series indicated, and the requirements of 29 CFR 1926 and 29 CFR 1926.757. Handle and set joists avoiding damage to the members. Place the "tag end" of joists as shown on the joists placement plans. Ensure that square-end joists are erected right side up. Distribute temporary loads so that joist capacity is not exceeded. Remove damaged joists from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Do not repair, field modify, or alter any joists without specific written instructions from the Designer of Record and/or joist manufacturer.

Install and connect bridging concurrently with joist erection, before construction loads are applied. Do not apply loads to bridging. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams. Do not cut away vertical leg of bridging where bridging makes an elevation transition; weld a separate piece of bridging at the transition. Perform all welding in accordance with AWS D1.1/D1.1M.

3.2 BEARING PLATES

Provide bearing plates to accept full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate must be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Provide bedding mortar and grout as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joists , touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.

3.3.2 Field Painting

Paint joists requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

3.4 VISUAL INSPECTIONS

Perform the following visual inspections:

a. Verify that all joists are spaced properly.

b. Verify that there is sufficient joist bearing on steel beams, concrete, and masonry.

c. Verify all bridging lines are properly spaced and anchored.

d. Verify that damage has not occurred to the joists during erection.

e. Verify the joists are aligned vertically and there is no lateral sweep in the joists.

f. Where concentrated loads are present on the joists verify that they are located in accordance with the joists placement plan.

g. Verify welding of bridging and joist seats in accordance with AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors.

h. Verify proper bolting of diagonal bridging and joist seats where the bolts are snug-tight.

-- End of Section --

SECTION 05 30 00

STEEL DECKS
05/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100	(1991; R 2008) Cold-Formed Steel Design Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2019) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A1008/A1008M	(2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM D746	(2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM DS 1-28R	(1998) Data Sheet: Roof Systems

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

STEEL DECK INSTITUTE (SDI)

ANSI/SDI C	(2017) Standard for Composite Steel Floor Deck - Slabs
ANSI/SDI NC	(2017) Standard for Non-Composite Steel Floor Deck
ANSI/SDI QA/QC	(2017) Standard for Quality Control and Quality Assurance for Installation of Steel Deck
ANSI/SDI RD	(2017) Standard for Steel Roof Deck
SDI DDM04	(2015; Errata 1-3 2016; Add 1 2015; Add 2 20162006) Diaphragm Design Manual; 4th Edition
SDI DDP	(1987; R 2000) Deck Damage and Penetrations
SDI MOC3	(2016) Manual of Construction with Steel Deck (3rd Edition)

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019) Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006; Reprint Mar 2019) UL Standard for Safety Tests for Uplift Resistance of Roof Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G, AE

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Mechanical Fasteners; G, AE

Touch-Up Paint

Welding Equipment

Welding Rods and Accessories

SD-05 Design Data

Deck Units; G, AE

SD-07 Certificates

Powder-Actuated Tool Operator

Welder Qualifications

Welding Procedures

Fire Safety

Wind Storm Resistance

Manufacturer's Certificate

1.3 QUALITY ASSURANCE

1.3.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificate s attesting that the decking material meets the specified requirements.

1.3.2 Certification of Powder-Actuated Tool Operator

Provide manufacturer's certificate attesting that the operators are authorized to use the low velocity powder-actuated tool.

1.3.3 Qualifications for Welding Work

Follow Welding Procedures of AWS D1.3/D1.3M for sheet steel. Submit qualified Welder Qualifications in accordance with AWS D1.3/D1.3M for sheet steel, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.3.4 Regulatory Requirements

1.3.4.1 Wind Storm Resistance

Provide roof construction assembly capable of withstanding a nominal uplift pressure of 150 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28R or as described in UL 580 and in general compliance with UFC 3-301-01.

1.3.5 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, cant strips, ridge and valley plates, metal closure strips, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load must not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

1.5.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 DECK UNITS

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

2.1.1 Roof Deck

Conform to ASTM A792/A792M or ASTM A1008/A1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of the steel design thickness required by the design drawings and zinc-coated in conformance with ASTM A653/A653M, Z275 G90 coating class or aluminum-zinc coated in accordance with ASTM A792/A792M Coating Designation AZM165 AZ55. Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

2.1.2 Composite Deck

Conform to ASTM A653/A653M or ASTM A1008/A1008M for composite deck assembly. The steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A653/A653M, G90 coating class.

2.1.3 Length of Deck Units

Provide deck units of sufficient length to span three or more spacings where possible.

2.1.4 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured. See Specification Section 09 90 00 Paints and Coatings for additional requirements. Primer must be compatible with final painting and coating product(s).

2.1.5 Touch-Up Paint

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A780/A780M.

Provide touch-up paint for shop-painted units of the same type used for the shop painting , and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content . Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full

size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.0295 inch thick to close open ends at exposed edges of floors, end walls, eaves, and openings through deck.

2.2.3 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations. Provide rubber, plastic, or sheet steel closures above typical partitions. Provide sheet steel closures above fire-resistant interior walls and partitions located on both sides of wall or partition.

2.2.4 Flexible Closure Strips for Roof Decks

Provide strips made of vulcanized, closed-cell, synthetic rubber material specified and premolded to the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

Conforming to ASTM D1056, Grade 2A1, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance with a flame spread rating of less than 25 when tested in accordance with ASTM E84.

Resistance to ozone must be "no cracks" after exposure of a sample kept under a surface tensile strain of 25 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F and tested in accordance with ASTM D1149.

Provide a elastomeric type adhesive as recommended by the manufacturer of the flexible closure strips.

2.2.5 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 1/4 inch and over.

2.2.6 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.7 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominal 18 gagethick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.8 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.9 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.10 Hanger

Provide clips or loops for utility systems and suspended ceilings of one or more of the following types:

a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 0.0474 inch thick or more, and a structural concrete fill is used over deck.

b. Slots or holes punched in decking for installation of pigtails.

c. Tabs driven from top side of decking and arranged so as not to pierce electrical cells.

d. Decking manufacturer's standard as approved by the Contracting Officer.

2.2.11 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Bend strips to form a 45-degree cant not less than 5 inch wide, with top and bottom flanges a minimum 3 inch wide. Length of strips 10 feet.

2.2.12 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0358 inch thick before galvanizing. Provide plates of minimum 4-1/2 inch wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

2.2.13 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.2.14 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, and hot-dip galvanized in accordance with ASTM A123/A123M.

2.2.15 Mechanical Fasteners

Provide mechanical fasteners, such as powder actuated fasteners, pneumatically driven fasteners or self-drilling screws, for anchoring the deck to structural supports and adjoining units as indicated.

2.2.16 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch other metal accessories, 0.0358 inch unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with 29 CFR 1926, Subpart R - Steel Erection, ANSI/SDI QA/QC, ANSI/SDI RD and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap 2 inch deck ends. Do not use unanchored deck units as a work or storage platform. Do not fill unanchored deck with concrete. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units fastening with screws, powder-actuated fasteners, or pneumatically driven fasteners as indicated on the design drawings and in accordance with manufacturer's recommended procedure and ANSI/SDI C, or ANSI/SDI RD. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding or fastening. Anchoring the deck to structural supports with powder-actuated fasteners or pneumatically driven fasteners is prohibited. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Conform to the

recommendations of the Steel Deck Institute and the steel deck manufacturer for location, size, and spacing of fastening. Use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDM04. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M finish with the manufacturer's standard touch-up paint.

3.2.1.2 Mechanical Fastening

Anchor deck to structural supports and adjoining units with mechanical fasteners. Drive the powder-actuated fasteners with a low-velocity piston tool by an operator authorized by the manufacturer of the powder-actuated tool, or drive pneumatically fasteners with a low-velocity fastening tool and comply with the manufacturer's recommendations.

3.2.1.3 Sidelap Fastening

Lock sidelaps between adjacent floor deck units together by welding or screws as indicated.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings 6 to 12 inch across by 0.0474 inch thick steel sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel members and supported by the adjacent steel members. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. Deck manufacturer shall approve holes or openings larger than 6 inch in diameter prior to drilling or cutting.

3.2.3 Deck Damage

SDI MOC3, for repair of deck damage.

3.2.4 Touch-Up Paint

3.2.4.1 Roof Deck

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

3.2.4.2 Floor Deck

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with

paint for the repair of painted surfaces.

3.2.5 Accessory Installation

3.2.5.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

3.2.5.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.5.3 Closures Above Partitions

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4 inch nominal or less in thickness and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation.

3.2.5.4 Cover Plates

Where concrete leakage would be a problem, provide metal cover plates, or joint tape, at joints between decking sheets, cellular or noncellular, to be covered with concrete fill.

3.2.5.5 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

3.2.5.6 Access Hole Covers

Provide access whole covers to seal holes cut in decking to facilitate welding of the deck to structural supports.

3.2.5.7 Hangers

Provide as indicated to support utility system and suspended ceilings. Space devices so as to provide one device per 6.25 square feet.

3.2.6 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of ANSI/SDI C or ANSI/SDI NC.

3.3 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inch. Lap end joints a minimum 3 inch and secure with galvanized

sheet metal screws spaced a maximum 4 inch on center.

3.4 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.5 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.6 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.7 FIELD QUALITY CONTROL

3.7.1 Deck Weld Inspection

Visual inspect welds in accordance with AWS D1.3/D1.3M.

3.7.2 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges should not exceed manufacturing and construction tolerances of supporting members. When gap is more than the allowable, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING
05/15, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(2019; R 2022) Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	(2016) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI S110	(2007; Suppl 1; Reaffirmed 2012) Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames
AISI S200	(2007) North American Standard for Cold-Formed Steel Framing - General Provision
AISI S201	(2007) North American Standard for Cold-Formed Steel Framing - Product Data
AISI S202	(2011) Code of Standard Practice for Cold-formed Steel Structural Framing
AISI S211	(2007) North American Standard for Cold-Formed Steel Framing - Wall Stud Design
AISI S212	(2007) North American Standard for Cold-Formed Steel Framing - Header Design
AISI S213	(2007; Suppl 1 2009) North American Standard for Cold-Formed Steel Framing - Lateral Design
AISI S214	(2012) North American Standard for Cold-Formed Steel Framing – Truss Design

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel

AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A370	(2024) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2025) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1003/A1003M	(2023; E 2024) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM C955	(2024) Standard Specification for Cold-Formed Steel Structural Framing Members
ASTM C1007	(2020; R 2024) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	(2024) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM E119	(2024) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E329	(2025a) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E488/E488M	(2022) Standard Test Methods for Strength of Anchors in Concrete Elements
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

ASTM F1941/F1941M	(2016; R 2025) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F2329/F2329M	(2015; R 2023) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023; with Change 4, 2025) Structural Engineering

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components; G, AE

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

SD-05 Design Data

Metal Framing Calculations; G, AE

SD-07 Certificates

Load-Bearing Cold-Formed Metal Framing

Welds

1.3 DELIVERY, STORAGE, AND HANDLING

Steel framing and related accessories shall be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the

structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI S100.

Submit mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

1.5 MAXIMUM DEFLECTION

Deflections of structural members shall not exceed the more restrictive of the limitations of ICC IBC and UFC 3-301-01.

1.6 QUALITY ASSURANCE

a. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a registered professional engineer.

b. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.

c. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

d. Welding Qualifications: Qualify procedures and personnel according to the following:

(1) AWS D1.1/D1.1M, "Structural Welding Code - Steel".

(2) AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".

e. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.

f. AISI Specifications and Standards: Comply with:

(1) AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".

(2) AISI S110, "Standard for Seismic Design of Cold-Formed Steel Structural Systems - Special Bolted Moment Frames".

(3) AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provision".

(4) AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".

(5) AISI S202, "Code of Standard Practice for Cold-Formed Steel

Structural Framing".

(6) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".

(7) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".

(8) AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".

(9) AISI S214, "North American Standard for Cold-Formed Steel Framing - Truss Design".

1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories including the following:

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

Sign and seal fabrication drawings by a registered professional engineer.

1.6.2 Design Data Required

Submit metal framing calculations with design criteria and structural loading to verify sizes, thickness, and spacing of members and connections signed and sealed by a registered professional engineer registered in the State where Project is located. Show methods and practices used in installation.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C955 and the following.

a. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

(1) Grade: As required by structural performance.

(2) Coating: G90 (Z275).

b. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

(1) Minimum Base-Metal Thickness: 0.0428 inch.

(2) Flange Width: 1-5/8 inches.

c. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

(1) Minimum Base-Metal Thickness: Matching steel studs.

(2) Flange Width: 1-1/4 inches.

d. Roof Truss Members: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:

(1) Minimum Base-Metal Thickness: 0.0428 inch.

(2) Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or directly fastened construction.

2.1.1 Studs and Joists of 54 mils (0.054 Inch) and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, G90.

2.1.2 Studs and Joists of 43 mils (0.043 Inch) and Lighter

Studs and Joists of 43 mils (0.043 Inch) and Lighter, Track, and Accessories (All thicknesses): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 33 33,000 psi G60.

2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties

Size and thickness as required.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

a. An ICC number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

2.3.1 Steel-To-Concrete Connections

a. Anchor Rods: ASTM F1554, Grade 55; galvanized per ASTM A153/A153M.

b. Post-Installed Concrete Anchors: Adhesive or expansion anchors fabricated from corrosion-resistant materials with allowable load

capacities in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

c. Power-Actuated Fasteners: Fabricated from corrosion-resistant materials with allowable load capacities in accordance with ICC-ES AC 70 greater than or equal to the design load as determined by testing per ASTM E1190 conducted by a qualified testing agency.

2.3.2 Steel-To-Steel Connections

a. Screws: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel screws of the type and size indicated. Provide low-profile head beneath sheathing and manufacturer's standard elsewhere. Electroplated to a minimum of 5 micron zinc coating per ASTM F1941/F1941M or hot-dipped galvanized per ASTM A123/A123M or ASTM A153/A153M.

b. Bolts: ASTM A307 coated by hot-dip process per ASTM F2329/F2329M or zinc-coated by mechanical-deposition process per ASTM B695, Class 55.

c. Welding Electrodes: Comply with AWS standards.

2.4 PLASTIC GROMMETS

Supply plastic grommets for stud webs as recommended by stud manufacturer, to protect electrical wires and plumbing piping. Prevent metal-to-metal contact between wiring/piping and studs.

2.5 SEALER GASKET

Closed-cell neoprene foam, 1/4-inch thick, selected from manufacturer's standard widths to match width of bottom track on concrete slab or foundation.

PART 3 EXECUTION

3.1 TRUSS FABRICATION

a. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

b. Truss must be fabricated either on site or off site prior to erection.

c. Fabricate trusses using jigs or templates.

d. Splices can only occur at joints.

e. Cut truss members by sawing or shearing: do not torch cut.

f. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.

g. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

h. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses to prevent damage or permanent distortion.

3.2 FASTENING

Fasten framing members together by welding or by using self-drilling, self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.2.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI S100. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3/D1.3M. Submit certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 43 mils.

3.2.2 Screws

Screws shall be of the self-drilling self-tapping type, size, and location as required. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI S100. Screws covered by sheathing materials shall have low profile heads.

3.2.3 Anchors

Anchors shall be of the type, size, and location as required.

3.2.4 Powder-Actuated Fasteners

Powder-actuated fasteners shall be of the type, size, and location as required.

3.3 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are indicated.

3.3.1 Tracks

Provide accurately aligned runners at top and bottom of studs. Install sealer gasket under bottom of track on concrete slab or foundation. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.3.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors

and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI S100. Bracing shall be not less than the following:

LOAD	HEIGHT	BRACING
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.3.3 Joists and Trusses

a. Provide a stud directly under each joist or truss. The maximum spacing of studs as indicated shall be maintained.

b. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.

c. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

d. Do not alter, cut, or remove framing members or connections of trusses.

3.3.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/4 inch in 8 feet from a straight line;

(3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set

mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2016) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.21.2M	(1999; R 2014) Lock Washers (Metric Series)
ASME B18.22M	(1981; R 2017) Metric Plain Washers

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3	(2013) Safety Requirements for

	Powder-Actuated Fastening Systems American National Standard for Construction and Demolition Operations

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A467/A467M	(2020) Standard Specification for Machine Coil Chain
ASTM A475	(2003; R 2014) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A500/A500M	(2018) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	(2015a) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel

	Floor Plates
ASTM A924/A924M	(2019) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	(2018) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2012) Primer, Alkyd, Anti-Corrosive for Metal

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural Steel Door Frames, Fabrication Drawings; G, AE

Cover Plates and Frames, Installation Drawings; G

Bollards/Pipe Guards; G, AE

Wheel Guards, Installation Drawings; G

Embedded Angles and Plates, Installation Drawings; G

SD-03 Product Data

Corner Guards

Cover Plates and Frames; G

Structural Steel Door Frames; G, AE

Wheel Guards

Each Downspout Terminations Type; G

Recycled Content; S

SD-04 Samples

Expansion Joint Covers

SD-07 Certificates

Certificates of Compliance; G

Certified Mill Test Reports for Chemistry and Mechanical Properties; G

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store

items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 MISCELLANEOUS REQUIREMENTS

1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.5.2 Installation Drawings

Submit templates, erection, and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation in relation to the building construction.

PART 2 PRODUCTS

2.1 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied.

2.1.1 Structural Carbon Steel

Provide in accordance with ASTM A36/A36M.

2.1.2 Structural Tubing

Provide in accordance with ASTM A500/A500M.

2.1.3 Steel Pipe

Provide in accordance with ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Provide standard malleable iron fittings in accordance with ASTM A47/A47M.

2.1.5 Floor Plates, Patterned

Provide floor plate in accordance with ASTM A786/A786M. Provide steel plate not less than 14 gage.

2.1.6 Anchor Bolts

Provide in accordance with ASTM F1554. Where exposed, provide anchor bolts of the same material, color, and finish as the metal to which they are applied.

2.1.6.1 Expansion Anchors or Adhesive Anchors

Provide 1/2in. diameter expansion anchors or adhesive anchors. Minimum concrete embedment of 4in. Design values listed are as tested in accordance with ASTM E488/E488M.

a. Provide minimum ultimate pullout value of 2,500lb. Calculate pullout

capacity according to ACI 318.

b. Provide minimum ultimate shear value of 2,000lb. Calculate shear capacity according to ACI 318.

2.1.6.2 Lag Screws and Bolts

Provide in accordance with ASME B18.2.1, type and grade best suited for the purpose.

2.1.6.3 Toggle Bolts

Provide in accordance with ASME B18.2.1.

2.1.6.4 Bolts, Nuts, Studs and Rivets

Provide in accordance with ASME B18.2.2 or ASTM A307.

2.1.6.5 Powder Actuated Fasteners

Follow safety provisions in accordance with ASSP A10.3.

2.1.6.6 Screws

Provide in accordance with ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.1.6.7 Washers

Provide plain washers in accordance with ASME B18.22M, ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers in accordance with ASME B18.21.2M, ASME B18.21.1.

2.1.6.8 Welded Headed Shear Studs

Provide in accordance with ASTM A108.

2.1.7 Aluminum Alloy Products

Provide in accordance with ASTM B209M, ASTM B209 for sheet plate, ASTM B221M, ASTM B221M, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.2.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's printed instructions.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with a standard mill finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations. Provide in accordance with AA DAF45. Provide a polished satin finish on items to be anodized.

2.3 CORNER GUARDS

For jambs and sills of openings and edges of platforms provide steel shapes and plates anchored in masonry or concrete with welded steel straps or end-weld stud anchors. Form corner guards for use with glazed or ceramic tile finish on walls with 0.0625 inch thick corrosion-resisting steel with

satin finish, extend 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and securely anchor to the supporting wall. Provide galvanized corner guards on exterior.

2.4 COVER PLATES AND FRAMES

Fabricate cover plates of 1/4 inch thick rolled steel weighing not more than 100 pounds per plate with a selected raised pattern nonslip top surface. Provide galvanized plate. Reinforce to sustain a live load of 250 pounds per square foot. Provide structural steel shapes and plates for frames, securely fastened to the structure as indicated. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Provide holes for lifting tools. Provide holes and openings with 1/2 inch clearance for pipes and equipment. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/8 inch clearance at edges and between cover plates.

2.5 ROOF WALKWAYS

a. Provide slip resistant surface finishes.

b. Rooftop walkway: Minimum 2 feet wide, 14 gage, ASTM A653/A653M, G-90, steel with slip resistant surface. Furnish all brackets, connectors and other accessories. Support at minimum 5 foot intervals on hard rubber pads in accordance with manufacturer's instructions.

2.6 BOLLARDS/PIPE GUARDS

Provide bollards as indicated and in accordance with ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.7 DOWNSPOUT TERMINATIONS

Provide3 x 4.25 inch aluminum downspout tile adapter with manufacturer's standard powder coated finish. Units shall have all seams welded.

Provide aluminum cast downspout nozzle and flange.

2.8 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as required to support wall loads over openings. Provide with connections and welds. Construct to have at least 8 in bearing on masonry at each end.

Provide angles and plates in accordance with ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with ASTM A123/A123M.

2.9 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, minimum 3/16 inch diameter, with a minimum of twelve links per one foot, and snap

hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide boat type snap hooks. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area.

2.10 SECURITY GRILLES

Fabricate of channel frames with not less than two masonry anchors at each jamb and 1/2 inch hardened steel bars spaced not over 4 inches both ways and welded to frame. Provide 18 by 16 mesh screen and two layers of 1/4 inch hardware cloth clamped to frame.

2.11 STEEL PLATE WAINSCOTS FOR CONCRETE OR MASONRY COLUMNS

Shop bend to radius for round columns and at right angles for square and rectangular columns with slight 1/4 inch radius on corners, with no horizontal joints and not more than 2 vertical joints single strapped and butt welded with a thickness of 1/4 inch.

2.12 GUY CABLES

Provide guy cables as pre-stretched, galvanized wire rope of sizes indicated. Provide wire rope in accordance with ASTM A475, high strength grade with Class A coating. Guys must have a factory attached clevis top-end fitting, a factory attached open-bridge strand socket bottom-end fitting, and must be complete with oval eye, threaded anchor rods. Provide hot-dip galvanized fittings and accessories.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide countersuck rivets where exposed. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous

metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise.

3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete or masonry. Provide built-in metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

3.8 COVER PLATES AND FRAMES

Provide tops of cover plates and frames flush with finished surface. Test for trip hazards and adjust for any encountered lippage.

3.9 WHEEL GUARDS

Anchor guards to concrete or masonry in accordance with manufacturer's instructions. Fill hollow cores solid with concrete with minimum compressive strength of 2500 psi.

3.10 INSTALLATION OF BOLLARDS/PIPE GUARDS

Set bollards/pipe guards vertically in concrete piers. Fill hollow cores with concrete having a compressive strength of 3000 psi.

3.11 INSTALLATION OF DOWNSPOUT TERMINATIONS

Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.12 MOUNTING OF SAFETY CHAINS

Provide safety chains where indicated. Mount the top chain 3 feet 6 inches above the floor and mount the lower chain 2 feet above the floor.

3.13 STRUCTURAL STEEL DOOR FRAMES

Secure door frames to the floor slab by means of angle clips and expansion bolts. Provide any necessary reinforcements and drill and tap frames as required for hardware. Clean metal shavings from finished surfaces at the end of each work day.

For freight elevator hoistway entrances, include a non-skid metal sill installed in accordance with the elevator manufacturer's written installation instructions.

3.14 INSTALLATION OF WHEEL GUARDS

Fill wheel guards with concrete and anchor to slab in accordance with manufacturer's recommendations.

3.15 INSTALLATION MISCELLANEOUS PLATES AND SHAPES

Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as required to support wall loads over openings. Provide with connections and welds. Construct to have at least 8 inches bearing on masonry at each end.

-- End of Section --

SECTION 05 52 00

METAL RAILINGS
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 314	(1990; R 2013) Standard Specification for Steel Anchor Bolts

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60

	000 PSI Tensile Strength
ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM C514	(2004; R 2020) Standard Specification for Nails for the Application of Gypsum Board
ASTM E488/E488M	(2022) Standard Test Methods for Strength of Anchors in Concrete Elements

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001; R 2012) Pipe Railing Systems Manual

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within 30 days of contract award, submit fabrication drawings for the following items:

a. Steel railings and handrails

b. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

c. Steel railings and handrails

d. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

SD-03 Product Data

Concrete Inserts; G

Masonry Anchorage Devices; G

Protective Coating; G

Steel Railings and Handrails; G

Anchorage and Fastening Systems; G

SD-05 Design Data

Delegated Design Submittal; G

SD-08 Manufacturer's Instructions

Installation Instructions

1.4 QUALITY CONTROL

1.5 QUALITY ASSURANCE

1.5.1 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 325, AISC 326, ASCE 7-22, and the State Building Code where the Project is located. Fabrication drawings will not be reproductions of contract drawings. Sign and seal fabrication drawings by a registered professional engineer. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Clearly highlight any deviations from the details shown on the contract drawings highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.5.2 Delegated Connection Design

Design structural steel connection indicated in the contract documents per AISC 360. Submit Delegated Design Submittal signed and sealed by a registered professional engineer.

PART 2 PRODUCTS

2.1 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning, treating, and applying surface finishes, including zinc coatings.

Provide railing and handrail detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce adequate strength and durability in the finished product for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and straight sharp edges. Ensure that all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form the exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use countersunk Phillips flathead screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.1.1 Steel Handrails

Fabricate joint posts, rail, and corners by one of the following methods:

a. Flush-type rail fittings of commercial standard, welded and ground smooth, with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

b. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove-welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight-fitting interior sleeve not less than 6 inches long.

c. Railings may be bent at corners in lieu of jointing, provided that bends are made in suitable jigs and the pipe is not crushed.

2.1.2 Protective Coating

Provide hot-dipped galvanized steelwork as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.2 COMPONENTS

2.2.1 Performance Requirements

Delegated Design Submittal:

Engage a qualified professional engineer registered in the state where the project is located to design railings, including attachment to building construction. Provide signed and sealed drawings and calculations.

Structural Performance: Railing, including attachment to building construction, shall withstand the effects of gravity loads and the

following loads and stresses within limits and under conditions indicated:

a. Handrail and top rails of guards:

1. Service deflection not to exceed L/200 for railing and H/100 for posts.

b. Infill of Guards:

1. Infill load and other loads need not be assumed to act concurrently.

c. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F.

2.2.2 Structural-Steel Tubing

Provide structural-steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

2.2.3 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

Provide lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded nut type, multiple-unit class, Group I, Type 1, Class 2.

2.2.4 Fasteners

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ASTM A307, Grade A.

2.2.5 Steel Railings And Handrails

Design handrails to resist a concentrated load of 200 lb in any direction at any point of the top of the rail or 50 lb per foot applied horizontally to the top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

2.2.5.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M. Provide steel railings of 1 1/2 inch nominal size, hot-dip galvanized and shop-painted.

Provide kickplates between railing posts where indicated, and consisting of 1/8 inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

Provide galvanized railings, including pipe, fittings, brackets, fasteners,

and other ferrous metal components.

PART 3 EXECUTION

3.1 PREPARATION

Adjust stair railings and handrails before securing in place in order to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 6 feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

a. Anchor posts to steel with oval steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets of malleable iron castings, with not less than 3 inch projection from the finished wall surface to the center of the pipe, drilled to receive one 3/8 inch bolt. Locate brackets not more than 60 inches on center. Provide wall return fittings of cast iron castings, flush type, with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

b. For hollow masonry and stud partition anchorage, use toggle bolts having square heads.

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of stair railing and hand rail work:

a. Protective coating

b. Masonry anchorage devices

c. Steel railings and handrails

d. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications cited in this section.

3.2.1 Steel Handrail

Install handrail in pipe sleeves embedded in concrete and filled with nonshrink grout or quick-setting anchoring cement with anchorage covered with standard pipe collar pinned to post. Secure rail ends by steel pipe flanges

3.2.2 Touchup Painting

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Welding

Ensure that procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY
08/16, CHG 2: 11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	(2015) American Softwood Lumber Standard

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.5.2.1M	(2006; R 2011) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2010) Metric Round Head Square Neck Bolts
ASME B18.6.1	(2016) Wood Screws (Inch Series)

AMERICAN WOOD COUNCIL (AWC)

AWC NDS	(2015) National Design Specification (NDS) for Wood Construction
AWC WFCM	(2012) Wood Frame Construction Manual for One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M2	(2019) Standard for the Inspection of Preservative Treated Wood Products for Industrial Use
AWPA M6	(2013) Brands Used on Preservative Treated Materials

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM F547	(202) Standard Terminology of Nails for Use with Wood and Wood-Base Materials

FM GLOBAL (FM)

FM 4435	(2017) Roof Perimeter Flashing

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 3) Shield Expansion (Nail Anchors)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

SD-06 Test Reports

Preservative-treated Lumber and Plywood

SD-07 Certificates

Certificates of Grade

Preservative Treatment

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store, protect, handle, and install prefabricated structural elements in accordance with manufacturer's instructions and as specified. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store wood I-beams and glue-laminated beams and joists on edge. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special

fastening requirements. Do not use materials that have visible moisture or biological growth. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency must be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view must not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark must identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870. Surfaces that are to be exposed to view must not bear grademarks or other types of identifying marks.

1.4.3 Preservative-Treated Lumber and Plywood

The Contractor is responsible for the quality of treated wood products. Each treated piece must be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor must provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.4 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber must be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

1.5 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber must be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes must be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products must be as follows at the time of delivery to the job site:

a. Framing lumber and board, 19 percent maximum

b. Timbers 5 inches and thicker, 25 percent maximum

c. Materials other than lumber; moisture content must be in accordance with standard under which the product is produced

1.7 PRESERVATIVE TREATMENT

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood must be air or kiln dried after treatment. Specific treatments must be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Minimize cutting and avoid breathing sawdust. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. Plastic lumber must not be preservative treated. The following items must be preservative treated:

(1) Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.

(2) Wood members that are in contact with water.

(3) Exterior wood steps, platforms, and railings; and all wood framing of open, roofed structures.

(4) Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.

(5) Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.8 CERTIFICATIONS

1.8.1 Certified Wood Grades

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Natural Decay- and Insect-Resistant Wood

An occasional piece with corner sapwood is permitted if 90 percent or more of the width of each side on which the sapwood occurs is heartwood.

2.2 LUMBER

2.3 PLYWOOD

2.3.1 Plywood

Plywood for blocking. C-D Grade, Exposure 1 durability classification, Span rating of 24/16 or greater.

2.4 OTHER MATERIALS

2.4.1 Blocking

Blocking must be standard or number 2 grade.

2.5 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware must be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials must be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs must be hot-dip zinc-coated in accordance with ASTM A153/A153M.

2.5.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.5.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.5.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices must be 3/8 inch.

2.5.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.5.5 Wood Screws

ASME B18.6.1.

2.5.6 Nails

ASTM F547, size and type best suited for purpose. Nails used with treated lumber and sheathing must be hot-dipped galvanized in accordance with ASTM A153/A153M. Nailing must be in accordance with the recommended nailing schedule contained in AWC WFCM. Where detailed nailing requirements are not specified, nail size and spacing must be sufficient to develop an adequate strength for the connection. The connection's strength must be verified against the nail capacity tables in AWC NDS. Reasonable judgment backed by experience must ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector must be used.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Conform to AWC WFCM and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated. Apply nailing strips in straight parallel rows in the direction and spacing indicated. Strips must be surface applied.

a. Surface-Applied Nailers: Must be 3 inches wide and of thickness to finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c.

b. Embedded Nailers: Must be nominal 2 by 3 with 2 inch sides beveled. Set and anchor nailers to finish flush with the roof deck surface.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers must be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM 4435.

3.2.1.3 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, as indicated, specified, or necessary and of or 3/4 inch thick exterior plywood.

3.2.2 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.3 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.2.4 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction as specified. Forms and centering for cast-in-place concrete work are specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 WASTE MANAGEMENT OF WOOD PRODUCTS

In accordance with the Waste Management Plan and as specified. Separate and reuse scrap sheet materials larger than 2 square feet, Clearly separate damaged wood and other scrap lumber for acceptable alternative uses on site, including bracing, blocking, cripples, ties, and shims.

Separate treated, stained, painted, and contaminated wood and place in designated area for hazardous materials. Dispose of according to local regulations. Do not burn scrap lumber that has been pressure treated, or lumber that is less than one year old.

-- End of Section --

SECTION 06 41 16.00 10

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
08/10, CHG 1: 11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ASTM INTERNATIONAL (ASTM)

ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM F547	(202) Standard Terminology of Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.9	(2020) Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	(2016) Particleboard
CPA A208.2	(2016) Medium Density Fiberboard (MDF) for Interior Applications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A	(2013) Interior Architectural Wood Flush Doors

WOODWORK INSTITUTE (WI)

NAAWS 3.1	(2017; 2018 Errata Edition) North American Architectural Woodwork Standards

1.2 SYSTEM DESCRIPTION

Work in this section includes laminate clad custom casework as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Sand smooth and

apply a clear finish of polyurethane to all exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Installation

SD-03 Product Data

Wood Materials

Finish Schedule

SD-04 Samples

Plastic Laminates

Cabinet Hardware

SD-07 Certificates

Quality Assurance

Laminate Clad Casework

1.4 QUALITY ASSURANCE

1.4.1 General Requirements

Unless otherwise noted on the drawings, furnish all materials, construction methods, and fabrication conforming to and complying with the custom grade quality standards as outlined in NAAWS 3.1, Section for laminate clad cabinets. These standards apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work must be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Submit a quality control statement which illustrates compliance with and understanding of NAAWS 3.1 requirements, in general, and the specific NAAWS 3.1 requirements provided in this specification. The quality control statement must also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. Provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity in the quality control statement.

1.5 DELIVERY, STORAGE, AND HANDLING

Casework may be delivered knockdown or fully assembled. Deliver all units to the site in undamaged condition, stored off the ground in fully enclosed

areas, and protected from damage. Ventilate the storage area and do not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Do not install units in any room or space until painting, and ceiling installation are complete within the room where the units are located. Install floor cabinets before finished flooring materials are installed.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

a. Provide kiln-dried Grade III framing lumber to dimensions as shown on the drawings. Frame front, where indicated on the drawings, must be nominal 3/4 inch hardwood.b. Standing or running trim casework components, which are specified to receive a transparent finish, must be hardwood species, plain sawn. AWI grade must be premium. Indicate location, shape, and dimensions on the drawings.

2.1.2 Panel Products

2.1.2.1 Plywood

Use veneer core hardwood plywood, NAAWS 3.1 Grade AA panels for framing purposes. Indicate nominal thickness of plywood panels in this specification and on the drawings.

2.1.2.2 Particleboard

Provide industrial grade, medium density (40 to 50 pounds per cubic foot), 3/4 inch thick particleboard. Use a moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 as the substrate for plastic laminate covered countertops, backsplashes, components as located on the drawings, and other areas subjected to moisture. Provide particleboard meeting the minimum standards listed in ASTM D1037 and CPA A208.1.

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) must be an acceptable panel substrate where noted on the drawings. Provide medium density fiberboard meeting the minimum standards listed in CPA A208.2.

2.2 SOLID POLYMER MATERIAL

Provide solid surfacing casework components in conformance to the requirements of Section 06 61 16 SOLID SURFACING FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

Provide plastic laminates meeting the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Indicate design, colors, surface finish and texture, and locations on the drawings. Submit two samples of each plastic laminate pattern and color. Samples less than 5 by 7 inches in size are not acceptable. Provide plastic laminate types and nominal minimum thicknesses for casework components as indicated in the

following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Provide horizontal general purpose standard grade plastic laminate that is 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Provide vertical general purpose standard grade plastic laminate that is 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Cabinet Liner Standard (CLS) Grade

Provide cabinet liner standard grade plastic laminate that is 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.3.4 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness must be 0.020 inches. Provide backing sheets for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Use thermoset decorative overlays (melamine panels) for casework cabinet interior and drawer interior surfaces.

2.5 EDGE BANDING

Provide PVC vinyl, 0.020 inch thick, edge banding for casework doors and drawer fronts. Material width must be 15/16 inches. Color and pattern must match exposed door and drawer front laminate pattern and color .

2.6 CABINET HARDWARE

Submit one sample of each cabinet hardware item specified to include hinges, pulls, and drawer glides. Provide hardware conforming to ANSI/BHMA A156.9, unless otherwise noted, and consisting of the following components:

2.6.1 Door Hinges

Frameless concealed type, BHMA No. B02011.

2.6.2 Cabinet Pulls

Back mounted type, BHMA No. B0211.

2.6.3 Drawer Slide

Side mounted self-closing type, BHMA No. B05092 with full extension and a minimum 75 pound load capacity. Include an integral stop to avoid

accidental drawer removal.

2.6.4 Adjustable Shelf Support System

Recessed (mortised) metal standards, BHMA No. BO4071, finish: stainless steel. Support clips for the standards must be open type, BHMA No. B04091, finish: As indicated.

2.7 FASTENERS

Provide nails, screws, and other suitable fasteners that are the size and type best suited for the purpose and conforming to ASTM F547 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Use formula and type of adhesives recommended by AWI. Select adhesives for their ability to provide a durable, permanent bond and take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Meet local regulations regarding VOC emissions and off-gassing.

2.8.1.1 Wood Joinery

Use Type II for interior use polyvinyl acetate resin emulsion adhesives to bond wood members. Adhesives must withstand a bond test as described in ANSI/WDMA I.S.1A.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood must be a water-based contact adhesive. Adhere PVC edgebanding using a polymer-based hot melt glue.

2.8.2 Caulk

Use clear, 100 percent silicone caulk to fill voids and joints between laminated components and between laminated components and adjacent surfaces.

2.8.3 Sealant

Use sealant recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.9 ACCESSORIES

2.9.1 Grommets

Use plastic or metal material for cutouts with a diameter of 2-1/2 inches. Indicate locations on the drawings.

2.10 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Accomplish fabrication and assembly of components at the shop site to the maximum extent possible. Meet or exceed the requirements for

AWI custom grade unless otherwise indicated in this specification. Make cabinet style, in accordance with NAAWS 3.1, Section 400-G descriptions, as indicated on the drawings.

2.10.1 Base and Wall Cabinet Case Body

2.10.1.1 Cabinet Components

Use frame members that are glued-together, kiln-dried hardwood lumber. Brace top corners, bottom corners, and cabinet bottoms with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Construct cabinet components from the following materials and thicknesses:

2.10.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

3/4 inch medium density fiberboard (MDF) panel product

2.10.1.1.2 Face Frames and Rails

3/4 inch hardwood lumber

2.10.1.1.3 Shelving

3/4 inch medium density fiberboard (MDF) panel product

2.10.1.1.4 Cabinet Backs

1/4 inch medium density fiberboard (MDF) panel product

2.10.1.1.5 Drawer Sides, Backs, and Subfronts

1/2 inch hardwood lumber

2.10.1.1.6 Drawer Bottoms

1/4 inch medium density fiberboard (MDF) panel product

2.10.1.1.7 Door and Drawer Fronts

3/4-inch medium density fiberboard (MDF) panel product

2.10.1.2 Joinery Method for Case Body Members

2.10.1.2.1 Tops, Exposed Ends, and Bottoms

a. Steel "European" assembly screws (1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).

b. Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).

c. Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

d. Spline or biscuit, glued under pressure.

2.10.1.2.2 Exposed End Corner and Face Frame Attachment

2.10.1.2.2.1 Mitered Joint

lock miter or spline or biscuit, glued under pressure (no visible fasteners)

2.10.1.2.2.2 Non-Mitered Joint (90 degree)

butt joint glued under pressure (no visible fasteners)

2.10.1.2.2.3 Butt Joint

glued and nailed

2.10.1.2.3 Cabinet Backs (Wall Hung Cabinets)

Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Use the following fabrication method:

2.10.1.2.3.1 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 1/2 inchand minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Do not expose edge of back on finished sides. Anchor strips are not required when so attached.

2.10.1.2.4 Cabinet Backs (Floor Standing Cabinets)

2.10.1.2.4.1 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Do not expose edge of back on finished sides. Anchor strips are not required when so attached.

2.10.1.2.5 Wall Anchor Strips

Wall Anchor Strips are required for all cabinets with backs less than 1/2 inch thick. Use strips consisting of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attache to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.10.2 Cabinet Floor Base

Mount floor cabinets on a base constructed of nominal 2 inch thick lumber . Provide base assembly components that are treated lumber . Make finished height for each cabinet base as indicated on the drawings. Make bottom edge of the cabinet door or drawer face extend below the top of the base as indicated on the drawings.

2.10.3 Cabinet Door and Drawer Fronts

Fabricate door and drawer fronts from 3/4 inch medium density fiberboard (MDF. Surface all door and drawer front edges with high pressure plastic laminate, color and pattern as indicated on the drawings.

2.10.4 Drawer Assembly

2.10.4.1 Drawer Components

Provide drawer components consisting of a removable drawer front, sides, backs, and bottom. Construct drawer components of the following materials and thicknesses:

2.10.4.1.1 Drawer Sides and Backs For Laminate Finish

1/2 inch thick 7-ply hardwood veneer core substrate

2.10.4.1.2 Drawer Bottom

1/4 inch thick thermoset decorative overlay melamine panel product

2.10.4.2 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.

d. Set bottoms into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

2.10.5 Shelving

2.10.5.1 General Requirements

Fabricate shelving from 3/4 inch medium density fiberboard (MDF. Finish all shelving top and bottom surfaces with HPDL plastic laminate. Finish shelf edges in a thermoset decorative overlay (melamine). Shelving shall be routed to accept recessed shelf clips/pins.

2.10.5.2 Shelf Support System

The shelf support system is as follows:

2.10.5.2.1 Recessed (Mortised) Metal Shelf Standards

Mortise standards flush with the finishes surface of the cabinet interior side walls, two per side. Pposition and space standards on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Install and adjust standards vertically to provide a level, stable shelf surface when clips are in place.

2.10.5.2.2 Pin Hole Method

Drill holes on the interior surface of the cabinet side walls. Evenly space holes in two vertical columns Space the holes in each column at 1 inch increments starting 6 inches from the cabinet interior bottom and extending to within 6 inches of the top interior surface of the cabinet. Drill holes to provide a level, stable surface when the shelf is resting on the shelf pins. Coordinate hole diameter with pin insert size to provide a firm, tight fit.

2.10.6 Laminate Clad Countertops

Construct laminate countertop substrate of 3/4 inch medium density fiberboard (MDF) . Use a moisture-resistant substrate where countertops receive sinks, lavatories, or are subjected to liquids. Provide substrates that have sink cutout edges and seal with appropriate sealant against moisture. Do not make joints cutouts. A balanced backer sheet is required.

2.10.6.1 Edge Style

Make front and exposed side countertop edges in shapes and to dimensions as shown on the drawings. Use the following countertop edge material:

2.10.6.1.1 Post Formed Plastic Laminate

Make laminate edge integral with countertop surface. Make shape and profile as indicated and to dimensions as indicated.

2.10.6.1.2 Hardwood

Indicate species, finish, profile, shape, and dimensions as indicated on the drawings. Lap hardwood edge over the exposed countertop laminate edge and install flush with the countertop laminate surface.

2.10.6.1.3 Vinyl

Provide vinyl tee-mould edge in shape, thickness, and color as indicated on the drawings. Lap tee mould edge over the exposed countertop laminate edge and install flush with the countertop laminate surface.

2.10.6.1.4 Plastic Laminate PVC Self Edge

Flat, 90 degree "self" edge. Edge must be applied before top. Lap laminate edge over countertop laminate surface and ease to eliminate sharp corners.

2.10.6.2 Laminate Clad Splashes

Countertop splash substrate must be 3/4 inch MDF fiberboard. Provide and install loose, straight profile side splashes at the time of countertop installation. Match back and side splash laminate pattern and color to the adjacent countertop laminate.

2.10.7 Laminate Application

Apply laminate to substrates following the recommended procedures and instructions of the laminate manufacturer and ANSI/NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. Machined flush, file, sand, or buff all laminate edges to remove machine marks and ease (sharp corners removed). Clean up at easing must be such that no overlap of the member eased is visible. Perform fabrication in conformance to ANSI A161.2. Provide laminate types and grades for component surfaces as follows unless otherwise indicated on the drawings:

2.10.7.1 Base/Wall Cabinet Case Body

a. Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.

b. Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

2.10.7.2 Adjustable Shelving

2.10.7.2.1 Top and Bottom Surfaces

Thermoset Decorative Overlay (melamine)

2.10.7.2.2 All Edges

Thermoset Decorative Overlay (melamine)

2.10.7.3 Fixed Shelving

2.10.7.3.1 Top and Bottom Surfaces

Thermoset Decorative Overlay (melamine)

2.10.7.3.2 Exposed Edges

Thermoset Decorative Overlay (melamine)

2.10.7.4 Door, Drawer Fronts, Access Panels

2.10.7.4.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces

HPDL Grade VGS

2.10.7.4.2 Edges

PVC edgebanding

2.10.7.5 Drawer Assembly

All interior and exterior surfaces: HPDL Grade CLS.

2.10.7.6 Countertops and Splashes

All exposed and semi-exposed surfaces: HPDL Grade HGS

2.10.7.7 Tolerances

Meet the NAAWS 3.1 premium grade requirements for flushness, flatness, and joint tolerances of laminated surfaces.

2.10.8 Finishing

2.10.8.1 Filling

Do not expose fasteners on laminated surfaces. Make all nails, screws, and other fasteners in non-laminated cabinet components countersunk and fill the holes with wood filler consistent in color with the wood species.

2.10.8.2 Sanding

Prepare all surfaces requiring coatings by sanding with a grit and in a manner that scratches will not show in the final system.

PART 3 EXECUTION

3.1 INSTALLATION

Installation must comply with applicable requirements for NAAWS 3.1 custom quality standards. Install countertops and fabricated assemblies level, plumb, and true to line, in locations shown on the drawings. Attach and securely anchor cabinets and other laminate clad casework assemblies to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Utilize a floor anchoring system for base cabinets. Anchoring and mechanical fasteners must not be visible from the finished side of the casework assembly. Attach cabinet and shelving assemblies to anchored bases without visible fasteners. Where assembly abuts a wall surface, include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width to wall mount cabinet and shelving; securely attach to the wall side of the cabinet back, both top and bottom.

3.1.2 Hardware

Install casework hardware in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, use plastic or synthetic insertion dowels to receive 3/16 inch "Euroscrews". The use of wood screws without insertion dowels is prohibited.

3.1.3 Doors, Drawers and Removable Panels

Accomplish the fitting of doors, drawers and removable panels within target fitting tolerances for gaps and flushness in accordance with NAAWS 3.1 custom grade requirements.

3.1.4 Plumbing Fixtures

Install sinks, sink hardware, and other plumbing fixtures in locations as indicated on the drawings and in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

-- End of Section --

SECTION 06 61 16

SOLID SURFACING FABRICATIONS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2583	(2013a) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2015; R 2021; E 2021) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

INTERNATIONAL CAST POLYMER ASSOCIATION (ICPA)

ICPA SS-1	(2001) Performance Standard for Solid Surface Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

NSF INTERNATIONAL (NSF)

NSF/ANSI 51	(2023) Food Equipment Materials

1.2 SYSTEM DESCRIPTION

a. Work under this section includes counter tops and other items utilizing solid surfacing material fabrications as indicated on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected.

b. In most instances, installation of solid surfacing material fabricated components and assemblies requires strong correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid surfacing material fabricator/installer and other trades to ensure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, counter tops, shelving, and all other solid surfacing material fabrications to the degree and extent recommended by the solid surfacing material manufacturer.

c. Provide appropriate staging areas for solid surfacing material fabrications. Allow variation in component size and location of openings of plus or minus 1/8 inch.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Fabrication Drawings; G

Installation; G

SD-03 Product Data

SD-04 Samples

Material; G

Counter Tops; G

SD-06 Test Reports

Test Report Results

SD-07 Certificates

Qualifications

SD-10 Operation and Maintenance Data

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

To ensure warranty coverage, provide manufacturer certified solid surfacing fabricators to fabricate the solid surfacing material being utilized. Mark all fabrications with the fabricator's certification label affixed in an inconspicuous location. Minimum of 5 years of experience working with solid surfacing materials is required of fabricators. Submit solid surfacing material manufacturer's certification attesting to fabricator qualification approval.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver materials to project site until areas are ready for installation. Deliver components and materials to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Store materials indoors and take adequate precautions to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation, for duration of project.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials, excluding damages caused by physical or chemical abuse or excessive heat, and workmanship for a period of 10 years from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 MATERIAL

Submit detail fabrication drawings and installation drawings of each solid surfacing fabrication indicated. Include elevations, dimensions, clearances, details of construction and anchorage, and details of joints and connections.

Submit manufacturers' descriptive product data for each type of solid polymer fabrication indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of solid polymer fabrication in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Solid Surfacing Material

Provide solid polymer that is a homogeneous filled solid polymer; not coated, laminated or of a composite construction, complying with ICPA SS-1. Provide material that meets or exceeds the minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch must be repairable by sanding or polishing. Material thickness is as indicated below; required minimum thickness is 1/4 inch. Submit a minimum 4 inch by 4

inch sample of each color and pattern for approval; include full range of color and pattern variation. Retain approved samples as a standard for this work. Submit test report results from an independent testing laboratory attesting that the submitted solid surfacing materials meet or exceed each of the specified performance requirements.

a. Horizontal Surfaces: 1/2 inch thick material

b. Vertical Surfaces: 1/2 inch thick material

c. Provide materials that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type).

2.1.2 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material composed of acrylic polymer, mineral fillers, and pigments. Provide acrylic polymer that meets or exceeds the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4000 psi (max.)	ASTM D638
Hardness	55-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36-inches, 1/2 lb ball, no failure	
1/2 inch sheet	140-inches, 1/2 lb ball, no failure	
3/4 inch sheet	200-inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.1 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Smoke Developed	30 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51
Flexural Strength	6,800 psi (min.)	ASTM D790

2.1.3 Acrylic-modified Polymer Solid Surfacing Material

Cast, solid polymer material composed of a formulation containing acrylic and polyester polymers, mineral fillers, and pigments. Provide acrylic polymer content not less than 5 percent and not more than 10 percent in order to meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4100 psi (max.)	ASTM D638
Hardness	50-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36 inches, 1/2 lb ball, no failure	
1/2 inch sheet	140 inches, 1/2 lb ball, no failure	
3/4 inch sheet	200 inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.6 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Smoke Developed	100 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51
Flexural Strength	6,800 psi (min.)	ASTM D790

2.1.4 Material Patterns and Colors

Provide pattern and color for all solid surfacing material components and fabrications as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers. Provide products with consistent patterned color throughout thickness of the product.

2.1.5 Surface Finish

Provide a uniform appearance on exposed finished surfaces and edges. Exposed surface finish is semigloss; gloss rating of 25-50.

2.2 ACCESSORY PRODUCTS

Provide accessory products, as specified below, as manufactured by the solid surfacing material manufacturer or as approved by the solid surfacing material manufacturer for use with the solid surfacing materials being specified.

2.2.1 Adhesives

Provide a two-part seam adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid surfacing materials and components to create a monolithic appearance of the fabrication. Provide adhesive approved by the solid surfacing material manufacturer. Color-match adhesive to the surfaces being bonded where solid-colored, solid surfacing materials are being bonded together. Provide clear or color matched seam adhesive where particulate patterned, solid surfacing materials are being bonded together.

2.2.2 Seam and Sealant Emissions

Provide seam and other accessory materials that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type).

2.2.3 Silicone Sealant

Provide silicone sealant, mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, acid-curing; ASTM C920, Type S, Grade NS, Class 25, Use NT; clear formulation; approved for use by the solid surfacing material manufacturer.

2.2.4 Conductive Tape

Provide manufacturer's standard conductive foil tape, 4 mils thick, applied around the edges of cut outs containing hot or cold appliances.

2.2.5 Insulating Tape

Provide manufacturer's standard insulating tape for use with drop-in food wells used in commercial food service applications to insulate solid surfacing material from hot or cold appliances.

2.2.6 Heat Reflective Tape

Provide heat reflective tape as recommended by the solid surfacing material manufacturer for use with cutouts for heat sources.

2.2.7 Mounting Hardware

Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

2.3 FABRICATIONS

Provide factory or shop fabricate components to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Provide factory cutouts for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii must be routed to template, with edges smooth. Defective and inaccurate work will be rejected. Submit product data indicating product description, fabrication information, and compliance with specified performance requirements for solid surfacing material, joint adhesive, sealants, and heat reflective tape.

2.3.1 Joints and Seams

Form joints and seams between solid surfacing material components using manufacturer's approved seam adhesive. Provide inconspicuous joints in appearance without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Provide edge shapes and treatments, including any inserts, as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter Top Splashes

Fabricate backsplashes and end splashes from 1/2 inch thick solid surfacing material to be 4 inches high. Provide backsplashes and end splashes for all counter tops. Shop fabricate backsplashes and provide loose, to be field attached.

2.3.3.1 End Splashes

Provide end splashes loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Window Stools

Fabricate window stools from 1/2 inch thick solid surfacing material; dimensions, edge shape, and other details as indicated. Provide bullnose edge profile.

2.3.5 Counter Tops

Fabricate all solid surfacing material, counter top components from 1/2 inch. Attach 2 inch wide reinforcing strip of solid surfacing material under each horizontal counter top seam. Submit a minimum 1 foot wide by 6 inch deep, full size sample for each type of counter top shown on the project drawings; include the edge profile and backsplash as detailed on the drawings and at least one seam. Retain approved sample as standard for this work. Provide bullnose edge profile.

2.3.5.1 Counter Tops with Sinks

b. Provide manufacturer's standard solid polymer sinks, pre-molded product specifically designed for attachment to solid surfacing material counter tops. See paragraph SOLID POLYMER SINKS for additional requirements.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Components

Install all components and fabricated units plumb, level, and rigid. Make field joints between solid surfacing material components using solid surfacing material manufacturer's approved seam adhesives, to provide a monolithic appearance with joints inconspicuous in the finished work. Attach metal or vitreous china sinks and lavatory bowls to counter tops using solid surfacing material manufacturer's recommended clear silicone sealant and mounting hardware. Install solid polymer sinks and bowls using a color-matched seam adhesive.

3.1.2 Silicone Sealant

Use specified silicone sealant to seal all expansion joints between solid surfacing material components and all joints between solid surfacing material components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Provide sealant bead smooth and uniform in appearance and minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Provide continuous bead and run the entire length of the joint being sealed.

3.1.3 Plumbing

Make plumbing connections to sinks and lavatories in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 CLEAN-UP

Components must be cleaned after installation and covered to protect against damage during completion of the remaining project items. Damaged components must be repaired or replaced at the Contractor's sole expense.

-- End of Section --

SECTION 06 71 33

FIBERGLASS REINFORCED PLASTIC (FRP) LADDERS
05/18

PART 1 GENERAL

This Section includes, but is not limited to, new fiberglass reinforced plastic (FRP) ladder systems, including safety ladder cages, mounting systems and related accessories.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3	(2008; R 2018) Ladders - Fixed - Safety Requirements

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023; Supp 3 2025) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D430	(2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue
ASTM D495	(1999; R 2004) Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1148	(2013; R 2018) Standard Test Method for Rubber Deterioration—Discoloration from Ultraviolet (UV) or UV/Visible Radiation and Heat Exposure of Light-Colored Surfaces
ASTM D2344/D2344M	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite

	Materials and Their Laminates
ASTM D4000	(2016) Standard Classification System for Specifying Plastic Materials
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2018; ERTA 18-1; ERTA 18-2; ERTA 18-3; ERTA 18-4; TIA 18-1; TIA 18-2; TIA 18-3; TIA 18-4) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	(N0v 2016) Scaffolds and Roope Descent Systems
29 CFR 1926	Safety and Health Regulations for Construction

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within 30 calendar days of Contract Award, a preinstallation meeting will be scheduled by the RPM, FEAD CM or Engineer. Submit the following for review:

a. Qualification of Manufacturer

b. Qualification of RPM, FEAD CM or Engineer

c. Manufacturer's Catalog Data

Include two copies of manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:

(1) FRP Ladders

(2) Anchorage Materials

d. Fabrication and Installation Drawings and Details

Include plans, elevations, sections, and details of FRP fabrications and their connections. Show anchorage and all accessory items.

Provide templates for anchors and bolts specified for installation under other Sections.

Provide structural analysis data complying with design loads, signed and sealed by the qualified professional RPM, FEAD CM or Engineer responsible for their preparation.

e. Manufacturer's Recommendations

Provide shipping, handling, and erection procedures, along with

instructions for care and maintenance after installation.

f. Manufacturer's Sample Warranty

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualification of Manufacturer

Qualification of RPM, FEAD CM or Engineer

SD-02 Shop Drawings

Fabrication and Installation Drawings and Details; G, AE

SD-03 Product Data

Manufacturer's Catalog Data; G, AE

SD-06 Test Reports

Ultraviolet Testing; G

Thermal Expansion; G

Flame Spread; G

SD-07 Certificates

Manufacturer's Sample Warranty

SD-08 Manufacturer's Instructions

Manufacturer's Recommendations

SD-11 Closeout Submittals

Manufacturer's Warranty

1.4 QUALITY CONTROL

1.4.1 Qualification of Manufacturer

Fiberglass reinforced plastic (FRP) manufacturer is required to have a minimum of 10 years of experience in manufacturing FRP products.

A record of a minimum of five separate, similar installations within the last 10 years is required.

Provide manufacturer's warranty for all FRP products against defects in material and workmanship for a minimum of 5 years.

1.4.2 Qualification of RPM, FEAD CM or Engineer

Ensure that the RPM, FEAD CM or Engineer is currently licensed within the jurisdiction of the project.

Provide documentation that the RPM, FEAD CM or Engineer is approved, authorized, and currently licensed by the State of Pennsylvania, and has a minimum of 5 years of experience as an approved RPM, FEAD CM or Engineer for manufacturers of similar ladder systems. Supply the names and locations of five projects of similar size and scope for which the RPM, FEAD CM or Engineer has provided engineering calculations using the manufacturer's products submitted for this project within the previous 3 years. Provide RPM, FEAD CM or Engineer-certified engineering calculations and sealed documents for:

a. Meeting ASCE 7-22 requirements in accordance with the International Building Code

b. Fabrication and installation drawings and details

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver all manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturers, clearly marked and identified relative to the complete system. Provide all adhesives, resins, and their catalysts and hardeners in clearly marked or noted crates or boxes. Store all manufactured materials in a dry indoor facility with a constant temperature range between 70 and 85 degrees F until they are required.

Submit manufacturer's recommendations for shipping and handling. Handle all materials to prevent abrasion, cracking, chipping, twisting, or other deformations and other types of damage.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Ensure that all ladder side rails, rungs, mounting brackets, cage straps, and related safety rail system are FRP structural shapes manufactured to comply with or exceed the standards identified in this Section. Provide FRP ladders and ladder safety cages and anchorage materials, including cage hoops, brackets, and all other structural shapes composed of reinforced fiberglass components and resin in qualities, quantities, properties, arrangements, and dimensions as specified in the Contract Documents. Ensure that the complete assembly meets the minimum requirements of ASCE 7-22 and 29 CFR 1910.27.

2.1.1 Design Requirements

Ensure that fiberglass reinforcement is a combination of continuous roving, continuous strand mat, bidirectional roving mat, and surfacing veil in sufficient quantities as required by the application, the physical properties, or both. Clearly identify components as specified in ASTM D4000. Submit documentation verifying structural integrity in relation to thermal expansion.

Ensure that all finished surfaces of FRP items are smooth, resin-rich, and free of voids, dry spots, cracks, crazes or unreinforced areas. Provide a

system that is completely covered with resin protection against wear, weathering, and damage from ultraviolet light. Submit ultraviolet testing (UV) results and documented protection with:

a. Integral UV inhibitors in the resin

b. A synthetic, resin-rich surfacing veil, meeting or exceeding the requirements of ASTM D1148.

Provide FRP products that have a tested flame spread rating of 25 or less as specified in ASTM E84 Tunnel Test, with a ladder system meeting the minimum requirements of ASTM D430 and ASTM D495.

Provide 316 stainless steel bolts for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, wall brackets to the ladder, and landing safety rails to the system. Mechanically attach all rungs to the ladder with 18-8 stainless-steel rivets, and chemically bond with resin.

All ladder and cage components are to be integrally pigmented yellow. All wall and vertical rail base mount brackets are to be light gray.

2.1.2 Performance Requirements

Provide structural shapes in the ladder system meeting minimum longitudinal mechanical properties as follows:

Tensile Strength	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2,500,000 psi
Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1,800,000 psi
Flexural Modulus-Full Section		2,800,000 psi
Short Beam Shear	ASTM D2344/D2344M	4,500 psi
Shear Modulus-Transverse		450,000 psi
Coefficient of Thermal Expansion	ASTM D696	0.000008 in/in/F
Flame Spread	ASTM E84	25 or less

2.1.2.1 Structural Performance of Ladders

Provide ladders capable of withstanding the effects of gravity loads as specified in ASCE 7-22 and the International Building Code, as well as loads and stresses within limits and under conditions specified in 29 CFR 1910.27 and ALI A14.3.

Provide ladders that to support a concentrated vertical load of 1200 pounds applied at mid-span of the rung.

2.1.2.2 Thermal Movements

Provide exterior metal fabrications that withstand thermal movements resulting from maximum change (range) between 120 degrees F, ambient, and 180 degrees F, material surface. Specifically, prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.1.2.3 Safety Performance of Ladders

Provide a ladder system that fully complies with NFPA 101, OSHA 29 CFR 1910.27, and ALI A14.3 for distance between rungs, cleats, and steps and for minimum clearances for cages and climbing space.

2.2 COMPONENTS

2.2.1 Ladders

Fabricate ladder side rails of a continuous pultruded, 1 3/4 inch square tube with a minimum wall thickness of 1/4 inch or greater. Fabricate ladder rungs to be 1 1/4 inch diameter pultruded structural shapes, continuously fluted to provide a nonslip surface. Rungs that are gritted as a secondary operation are not permitted. Fit the rungs in the centerline of the side rails.

Fabricate ladder walls and floor mounts from pultruded angles, 3/8 inch minimum thickness. Mechanically attach all ladder rungs to ladder side rails by use of stainless-steel rivets and a chemical bond of epoxy.

Protect all pultruded ladder components from ultraviolet (UV) attack by providing integral UV inhibitors in the resin and a synthetic surfacing veil to help produce a resin-rich surface.

PART 3 EXECUTION

3.1 INSTALLATION

Install fabricated FRP work in accordance with the approved detail drawings and descriptive data for each item of fabricated FRP, in conformance with 29 CFR 1926, and as specified.

Assemble and install ladder systems and all components in strict accordance with the manufacturer's assembly documentation. Seal cut or drilled surfaces in accordance with the manufacturer's instructions. Provide adequate ventilation during all drilling, cutting, and resin application procedures.

3.1.1 Fabrication

Ensure that the design and layout of ladders and safety cages complies with ALI A14.3 and OSHA 29 CFR 1910.27. Ensure that all ladder rungs penetrate the tube side wall of the ladder rails. Provide ladder rung connections that are both chemically locking epoxy and mechanically locking rivets.

Field-attach hoops to the brackets. Seal all cut, machined edges, holes, and notches to provide maximum corrosion resistance. Coat all field-fabricated cuts in accordance with the manufacturer's instructions.

3.1.2 Fastening to Construction-In-Place

Provide anchorage devices and fasteners where necessary for fastening fabricated FRP items to construction-in-place. Provide threaded fasteners for concrete inserts embedded in cast-in-place concrete; masonry anchorage devices and threaded fasteners for solid masonry and concrete-in-place; toggle bolts for hollow masonry and stud partitions; through-bolting for masonry and wood construction; lag bolts and wood screws for wood construction; and connections for structural steel.

3.2 CLOSEOUT ACTIVITIES

3.2.1 Manufacturer's Warranty

Submit three (3) copies of manufacturer's warranty 30 calendar days before final inspection.

-- End of Section --

SECTION 06 73 01

FIBERGLASS REINFORCED PLASTIC (FRP) GRATING
05/18

PART 1 GENERAL

This Section includes, but is not limited to, new fiberglass reinforced plastic (FRP) grating for elevated platforms and walkways.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023; Supp 3 2025) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D953	(2019) Standard Test Method for Pin-Bearing Strength of Plastics
ASTM D2344/D2344M	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D2863	(2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E84	(2018a) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E662	(2019) Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM G154	(2016) Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
ASTM G155	(2013) Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

SAE CMH-17-36	(2012) Composite Materials Handbook, Vol. 3, Polymer Matrix Composites Material Usage, Design, and Analysis

UNDERWRITERS LABORATORIES (UL)

UL 94	(2013; Reprint Sep 2017) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings, Templates, and Directions; G, AE

SD-03 Product Data

FRP Grating; G, AE

Clips and Anchorage; G, AE

SD-06 Test Reports

Bearing Strength Testing

Flexural Properties

Shear Strength

Tensile Properties

SD-07 Certificates

Manufacturer's Sample Warranty

Manufacturer's Certification of State Product Approval

Certification of Anchorage System compliance with ASCE 7-22

Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR)

SD-08 Manufacturer's Instructions

Shipping, Handling, And Erection Procedures

Care and Maintenance Instructions

SD-09 Manufacturer's Field Reports

Manufacturer's Certification of Installation

SD-11 Closeout Submittals

Manufacturer's Warranty

1.3 QUALITY CONTROL

Provide items by manufacturers having a minimum of 10 years of experience in the design and manufacture of similar products and systems. In addition, if requested, provide a record of at least five separate, similar, successful installations in the last 5 years. Submit manufacturer's catalog data, to include two copies of the manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:

a. FRP Grating

b. Clips and Anchorage

Provide 3-year manufacturer's limited warranty on all FRP products against defects in materials and workmanship. Submit the Manufacturer's Sample Warranty before work starts.

Submit installation drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are embedded in concrete or masonry.

Submit Certification of Anchorage System compliance with ASCE 7-22. Deliver such items to the RPM, FEAD CM or Engineer and the project site before installation starts.

Submit the Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR).

1.4 DELIVERY, HANDLING, AND STORAGE

Submit the manufacturer's recommendations for shipping, handling, and erection procedures, and care and maintenance instructions. Deliver manufactured materials in original, unbroken pallets, packages, containers,

or bundles bearing the label of the manufacturer. Ensure that all adhesives, resins, and their catalysts and hardeners are crated or boxed separately, and noted as such.

Handle all materials to prevent abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Store adhesives, resins and their catalysts in dry indoor facilities between 70 and 85 degrees F until they are required.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide gratings composed of continuous roving fiberglass reinforcement and resin in qualities, quantities, properties, arrangements, and dimensions as necessary to meet the design requirements and dimensions as specified.

Provide resin of isophthalic polyester with chemical formulations as necessary to provide the corrosion resistance, strength, and other physical properties conforming to the specified requirements.

Ensure that all surfaces of FRP items and fabrications are nonslip grit, resin-rich, and free of voids, dry spots, cracks, and unreinforced areas. Completely cover all glass fibers with resin to protect against their exposure to ultraviolet light, wear, or weathering.

2.1.1 Design Requirements

Submit documentation for the following product tests before work starts:

Test	Standard	Structural Performance Requirements	Minimum Flexural Strength	Minimum Flexural Modulus
Bearing Strength Testing	ASTM D953			
Flexural Properties	ASTM D790		30,000 psi	(1.8 x 10 to power of 6) psi
Ultraviolet Testing	ASTM G155 ASTM G154			
Shear Strength	ASTM D2344/D2344M	4,500 psi		
Tensile Properties	ASTM D638	30,000 psi		
Toxicity Testing	SAE CMH-17-36			
Coefficient of Lineal Thermal Expansion	ASTM D696	8.0 x 10 power minus 6 in/in/degree F		

Test	Standard	Structural Performance Requirements	Minimum Flexural Strength	Minimum Flexural Modulus
Flame Spread Testing	ASTM D2863 ASTM E662 UL 94			

2.1.2 Performance Requirements

2.1.2.1 Structural Performance of Gratings

Provide gratings capable of withstanding the effects of gravity loads in accordance with ASCE 7-22, ICC IBC, and the following loads and stresses within the limits and under the conditions indicated:

Walkways and Elevated Platforms Other Than Exits: As indicated on drawings.

Walkways and Elevated Platforms Used as Exits: As indicated on drawings.

Provide grating products with a flame spread rating of 25 or less per ASTM E84 Tunnel Test. Test gratings for burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per ASTM D635.

2.2 FABRICATION

2.2.1 Molded FRP Grating

Ensure that all field-fabricated and shop-fabricated grating cuts are coated with vinyl ester resin to provide maximum corrosion resistance in accordance with the manufacturer's instructions.

Provide grating made as one-piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane with a rectangular mesh pattern providing unidirectional strength and reinforced with continuous roving of an equal number of layers in each direction. Ensure that the top layer of reinforcement is no more than 1/8 inch below the top surface of the grating to provide maximum stiffness and prevent resin chipping of unreinforced surfaces having percentage of glass (by weight) not exceeding 35 percent.

Ensure that no dry glass fibers are visible on any surface of bearing bars or cross bars after molding, and that all bars are smooth and uniform, with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin-rich areas or resin-starved areas.

Provide nonslip surfacing manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance.

Fillet grating bar intersections to a minimum radius of 1/16 inch to eliminate local stress concentrations and the possibility of resin cracking at these locations.

Provide fire-retardant grating with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84.

2.2.2 Fasteners

Provide Type 316 stainless-steel fasteners, clips, and anchorage for exterior use. Select fasteners for type, grade, and class required.

PART 3 EXECUTION

3.1 INSTALLATION

Install items at locations indicated, according to the manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Include all materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines; and levels and free of rack. Comply with recommendations of cited bar grating standards, including installation clearances and standard anchoring details.

a. Attach removable units to supporting members with the type and size of clips and fasteners indicated or, if not indicated, as recommended by the grating manufacturer for the type of installation conditions shown.

b. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.1.1 Anchorage, Fastenings, and Connections

Provide anchorage where necessary for fastening miscellaneous FRP items securely in place.

3.2 CLOSEOUT ACTIVITIES

3.2.1 Manufacturer's Warranty

Submit original and two copies of manufacturer's signed Warranty.

-- End of Section --

SECTION 06 82 14

FIBERGLASS REINFORCED PLASTIC (FRP) PIPE AND TUBE RAILINGS
05/18

PART 1 GENERAL

This Section includes new fiberglass reinforced plastic (FRP) pipe and tube railing/guards, mounting systems and accessories.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023; Supp 3 2025) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.21.2M	(1999; R 2014) Lock Washers (Metric Series)

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.3	(2013) Safety Requirements for Powder-Actuated Fastening Systems American National Standard for Construction and Demolition Operations

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D430	(2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1148	(2013; R 2018) Standard Test Method for Rubber Deterioration—Discoloration from Ultraviolet (UV) or UV/Visible Radiation and Heat Exposure of Light-Colored Surfaces
ASTM D2344/D2344M	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2018; ERTA 18-1; ERTA 18-2; ERTA 18-3; ERTA 18-4; TIA 18-1; TIA 18-2; TIA 18-3; TIA 18-4) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.23	(Nov 2016) Ladders
29 CFR 1926	Safety and Health Regulations for Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the

Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G

Qualifications of RPM, FEAD CM or Engineer; G

SD-02 Shop Drawings

Installation Drawings; G, AE

SD-03 Product Data

FRP Pipe and Tube; G, AE

Railings/Guards; G, AE

Anchorage Materials; G, AE

Adhesives; G, AE

Resins; G, AE

Hardeners; G, AE

Manufacturer's Sample Warranty

SD-06 Test Reports

Ultraviolet Test Reports

Thermal Expansion Test Reports

Flame Spread Test Reports

SD-07 Certificates

Manufacturer's Certification by the State of Pennsylvania Product Approval

Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR)

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-09 Manufacturer's Field Reports

Manufacturer's Certification of Installation

SD-11 Closeout Submittals

Manufacturer's Warranty

1.3 QUALITY CONTROL

1.3.1 Qualifications of Manufacturer

Submit Qualifications Of Manufacturer documentation certifying that the Fiberglass Reinforced Plastic (FRP) manufacturer has a minimum of 10 years of experience in manufacturing FRP products.

Provide items within this section from manufacturers having a minimum of 5 years of experience in the design and manufacture of similar products and systems.

Submit documentation proving a minimum of five separate, similar installations within the last 5 years.

Submit the Proof of Certification from a minimum of two quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR).

Submit the manufacturer's certification by the State of Pennsylvania Product Approval.

Provide the manufacturer's sample warranty for all FRP products against defects in material and workmanship for a minimum of 5 years. Provide evidence of manufacturer's ISO 9001:2000 standard certification.

1.3.2 Qualifications of RPM, FEAD CM or Engineer

Submit Qualifications of RPM, FEAD CM or Engineer documentation that the RPM, FEAD CM or Engineer is currently licensed within the jurisdiction of the project.

Submit documentation that the RPM, FEAD CM or Engineer is approved, authorized, and currently licensed by the State of Pennsylvania, and has a minimum of 5 years of experience as an approved RPM, FEAD CM or Engineer for manufacturers of similar pipe and tube railing systems. Require the RPM, FEAD CM or Engineer to supply the name and location of five projects of similar size and scope for which they have provided engineering calculations using the manufacturer's products submitted for this project within the previous 3 years. Provide certified and signed calculations prepared by RPM, FEAD CM or Engineer for:

a. The design in accordance with International Building Code and ASCE 7-22

b. Installation drawings

1.4 DELIVERY, HANDLING, AND STORAGE

Deliver all manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturers, clearly marked and identified relative to the complete system. Provide all adhesives, resins and their catalysts and hardeners in clearly marked or noted crates or boxes. Store all manufactured materials in dry indoor facilities with a constant temperature range between 70 and 85 degrees F until they are required.

Handle all materials to prevent abrasion, cracking, chipping, twisting, or other deformations, and other types of damage.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Installation Drawings

Submit templates and erection and installation drawings indicating thickness, type, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Include plans, elevations, sections, details, and attachments to other work. Indicate for installed products to comply with design loads. Include structural analysis data signed and sealed by the qualified professional RPM, FEAD CM or Engineer responsible for their preparation.

2.1.2 Product Data

Submit the manufacturer's catalog data including two copies of manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:

a. FRP Pipe and Tube

b. Railings/Guards

c. Anchorage Materials

d. Adhesives

e. Resins

f. Hardeners

2.1.3 Design Requirements

Ensure that all posts and rails are FRP structural shapes manufactured by the pultrusion process. Compose structural shapes of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements, and dimensions as necessary to meet the design requirements in accordance with ASCE 7-22, 29 CFR 1910.23, NFPA 101, and dimensions specified.

Ensure that fiberglass reinforcements are a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application required, the physical properties required, or both.

Provide resins, with appropriate hardeners, of isophthalic polyester, with the chemical formulation necessary for corrosion resistance, strength, and other physical properties.

Ensure that all finished surfaces of FRP items, including FRP pipe and tube, railings/guards, anchorage materials, and fabrications, are smooth, resin-rich, and free of voids, dry spots, cracks, and unreinforced areas. Provide complete coverage of all glass fibers with resin to protect against their exposure to wear or weathering.

Protect all pultruded structural shapes from ultraviolet (UV) attack with:

a. Integral UV inhibitors within the resin

b. Synthetic surfacing veil to help produce a resin-rich surface

c. UV-resistant coating for outdoor exposures

Provide FRP products that have a flame spread rating of 25 or less as specified in ASTM E84, Tunnel Test. Submit three (3) copies of Flame Spread Test Reports to the RPM, FEAD CM or Engineer.

Ensure that rails, posts, and kick plates are integrally pigmented yellow. Submit three (3) copies of Ultraviolet Test Reports for FRP material, similar to the requirements of ASTM D1148 for rubber deterioration, and ASTM D430, to the RPM, FEAD CM or Engineer. Submit testing data relating to Thermal Expansion Test Reports.

Provide structural shapes in the guardrail system to meet minimum longitudinal mechanical properties as follows:

Tensile Strength	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2,500,000 psi
Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1,800,000 psi
Flexural Modulus-Full Section		2,800,000 psi
Short Beam Shear	ASTM D2344/D2344M	4,500 psi
Shear Modulus-Transverse		450,000 psi
Coefficient of Thermal Expansion	ASTM D696	.000008 in/in/F
Flame Spread	ASTM E84	25 or less

2.1.4 Performance Requirements

2.1.4.1 Structural Performance of Pipe and Tube Railings

Provide a pipe and tube railing system capable of withstanding the effects of gravity loads in accordance with ASCE 7-22 and International Building Code, ICC IBC the State of Pennsylvania Building Code, with the following loads and stresses within limits and under the conditions indicated:

a. Handrails:

(1) Uniform load of 50 lbf/foot applied in any direction.

(2) Concentrated load of 200 lbf applied in any direction.

(3) Uniform and concentrated loads need not be assumed to act concurrently.

b. Top Rails of Guards:

(1) Uniform load of 50 lbf/foot applied in any direction.

(2) Concentrated load of 200 lbf applied in any direction.

(3) Uniform and concentrated loads need not be assumed to act concurrently.

c. Infill of Guards:

(1) Concentrated load of 50 lbf applied horizontally on an area of 1 square foot.

(2) Uniform load of 25 lbf/square foot applied horizontally.

(3) Infill load and other loads need not be assumed to act concurrently.

2.2 FABRICATION

Perform fabrication of the handrail post/rail connection such that the rails are unbroken and continuous through the post without the use of packs or splices. Install the bottom rail through the post at a prepared hole made to fit the outside dimensions of the rail, and the top rail fit into a machined, u-shaped pocket formed into the top of the post such that the rail is located at the center of the post. Radius all exposed corners to eliminate sharp edges. Join the rails to the post through a combination of bonding and riveting. Ensure that no sharp, protruding edges remain after assembly of the handrail. Space the posts no more than 72 inches apart. Attach post bases according to the construction contract drawings. Reinforce post bases to a height of 8 1/2 inches. Coat all field-fabricated and shop-fabricated cuts with a vinyl ester resin to provide maximum corrosion resistance.

2.3 MATERIALS

2.3.1 Fasteners

Provide Type 316 stainless-steel concealed fasteners, unless unavoidable or standard for railings indicated.

2.3.2 Anchors

Provide cast-in-place epoxy mechanical anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the design load imposed when installed in unit masonry and equal to four times the design load imposed when installed in concrete, as determined by testing as specified in ASTM E488/E488M.

2.3.3 Grout And Anchoring Cement

Provide factory-packaged, nonshrink, nonmetallic grout complying with ASTM C1107/C1107M; or water-resistant, nonshrink anchoring cement; recommended by the manufacturer for exterior use. Ensure that all other adhesives conform to the manufacturer's recommendations and instructions.

2.3.4 Component Connections

2.3.4.1 Lag Screws and Bolts

Provide lag screws and bolts conforming to ASME B18.2.1, of the type and grade best suited for the purpose.

2.3.4.2 Toggle Bolts

Provide toggle bolts conforming to ASME B18.2.1.

2.3.4.3 Bolts, Nuts, Studs, and Rivets

Provide bolts, nuts, studs, and rivets conforming to ASME B18.2.2 and ASTM A307.

2.3.4.4 Powder-Driven Fasteners

Follow safety provisions of ASSP A10.3 .

2.3.4.5 Screws

Provide screws conforming to ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.3.4.6 Washers

Provide plain washers conforming to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers conforming to ASME B18.21.2M and ASME B18.21.1.

PART 3 EXECUTION

3.1 INSTALLATION

Install items in accordance with 29 CFR 1910.23 and 29 CFR 1926 at locations indicated, according to the manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Include all materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation. Submit three (3) signed copies of Manufacturer's Certification of Installation.

a. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

b. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

3.1.1 Anchorage, Fastenings, and Connections

Provide anchorage where necessary for fastening miscellaneous FRP items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through-bolts for masonry; machine and carriage bolts for steel; through-bolts and screws. Conceal fastenings where practicable.

3.1.2 Workmanship

Ensure that FRP work is well formed to shape and size, with sharp lines and angles and true curves. Ensure that drilling and punching produces clean true lines and surfaces. Ensure that exposed surfaces of work-in-place to have smooth finishes. Mill joints where tight fits are required. Ensure that corner joints are coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fasten in place. Ensure that the installation is in accordance with the manufacturer's installation instructions and the approved drawings, cuts, and details.

3.2 CLOSEOUT ACTIVITIES

3.2.1 Warranty

Submit three (3) signed copies of the Manufacturer's Warranty 30 calendar days before final inspection.

3.2.2 Manufacturer's Instructions

Submit the manufacturer's instructions for shipping and handling, and procedures for erection, care, and maintenance upon completion of installation.

-- End of Section --

SECTION 07 19 00

WATER REPELLENTS
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.2	(2015) Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 259	(2002; R 2017) Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration
AASHTO T 260	(2021) Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

ASTM INTERNATIONAL (ASTM)

ASTM C140/C140M	(2022c) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C642	(2021) Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM D1653	(2013; R 2021) Standard Test Methods for Water Vapor Transmission of Organic Coating Films
ASTM D2369	(2020) Standard Test Method for Volatile Content of Coatings
ASTM D3278	(2021) Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E96/E96M	(2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E514/E514M	(2020) Standard Test Method for Water Penetration and Leakage Through Masonry

ASTM G154 (2023) Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000 Air Contaminants

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water Repellents

SD-06 Test Reports

Water Absorption

Accelerated Weathering

Resistance to Chloride Ion Penetration

Moisture Vapor Transmission

Water Penetration and Leakage

SD-07 Certificates

Manufacturer's Qualifications

Applicator's Qualifications

Evidence of Acceptable Variation

Warranty

SD-08 Manufacturer's Instructions

Application Instructions

Manufacturer's Safety Data Sheets (For Reference Only)

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

a. Manufacturer's qualifications: Minimum five years record of successful in-service experience of water repellent treatments manufactured for concrete masonry, application.

b. Applicator's qualifications: Minimum five years successful experience in projects of similar scope using specified or similar treatment materials and manufacturer's approval for application.

1.3.2 Performance Requirements

a. Water absorption: ASTM C140/C140M. Comparison of treated and untreated specimens.

b. Moisture vapor transmission: ASTM E96/E96M. Comparison of treated and untreated specimens.

c. Water penetration and leakage through masonry: ASTM E514/E514M.

d. Resistance to chloride ion penetration: AASHTO T 259 and AASHTO T 260.

e. Resistance to Accelerated weathering: ASTM G154

1.3.3 Evidence of Acceptable Variation

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the Contracting Officer, evidence that the proposed product is either equal to or better than the product specified. Include the following:

a. Identification of the proposed substitution;

b. Reason why the substitution is necessary;

c. A comparative analysis of the specified product and the proposed substitution, including tabulations of the composition of pigment and vehicle;

d. The difference between the specified product and the proposed substitution; and

e. Other information necessary for an accurate comparison of the proposed substitution and the specified product.

1.4 SAMPLE TEST PANEL

The approved Sample Test Panel will serve as the standard of quality for all other water repellent coating work. Do not proceed with application until the sample panel has been approved by the Contracting Officer.

1.4.1 Preparation of Sample Test Panel

Prior to commencing work, including bulk purchase and delivery of material, apply water repellent treatment to a minimum 4 feet high by 4 feet long concrete masonry, test-panel specified in. Provide a full height expansion joint at mid-panel length. Prepare and seal joint with materials approved for project use.

1.4.1.1 Testing

Similar to AAMA 501.2 hose testing, provide field water testing of water repellent treated surfaces in the presence of the Contracting Officer and the water repellent treatment manufacturer's representative as follows.

a. Apply water repellent to left side of mock-up and allow to cure prior to application of treatment to right side.

b. Twenty days after completion of application of treatment, test mock-up with 5/8 inch garden hose, with spray nozzle, located 10 feet from wall and aimed upward so water strikes wall at 45-degree downward angle. After water has run continuously for three hours observe back side of mock-up for water penetration and leakage. If leakage is detected, make changes as needed and retest.

c. Coordinate testing procedures and modify project treatment application as required to pass mock-up tests for water penetration and leakage resistance.

1.4.1.2 Approval

Proceed with water repellent treatment work only after completion of field test application and approval of mock-up and tests by the Contracting Officer.

1.4.2 Pre-Installation Meeting

a. Attend pre-installation meeting required prior to commencement of concrete masonry, installation.

b. Review procedures and coordination required between water repellent treatment work and work of other trades which could affect work to be performed under this section of the work.

c. Convene additional pre-installation meeting prior to water repellent treatment application for coordination with work not previously coordinated including joint sealants.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS for environmental protection, provide coating materials that conform to the restrictions of the Local Air Pollution Control jurisdiction . Notify the Contracting Officer of water repellent coating specified herein which fails to conform to the local Air Quality Management District Rules at the location of the Project. In localities where the specified coating is prohibited, the Contracting Officer may direct the substitution of an acceptable coating.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original sealed containers, clearly marked with the manufacturer's name, brand name, type of material, batch number, percent solids by weight and volume, and date of manufacturer. Store materials off the ground, in a dry area where the temperature will be not less than 50 degrees F nor more than 85 degrees F.

1.7 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS, and the following:

1.7.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the

most stringent guidance of:

a. The coating manufacturer when using solvents or other chemicals. Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.

b. 29 CFR 1910.1000.

c. Threshold Limit Values (R) of the American Conference of Governmental Industrial Hygienists.

d. Manufacturer's Safety Data Sheets.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Weather and Substrate Conditions

Do not proceed with application of water repellents under any of the following conditions, except with written recommendations of manufacturer.

a. Ambient temperature is less than 40 degrees F.

b. Substrate faces have cured less than one month.

c. Rain or temperature below 40 degrees F are predicted for a period of 24 hours before or after treatment.

d. Earlier than three days after surfaces are wet.

e. Substrate is frozen or surface temperature is less than 40 degrees F and falling.

1.8.2 Moisture Condition

Determine moisture content of substrate meets manufacturer's requirements prior to application of water repellent material.

1.9 SEQUENCING AND SCHEDULING

1.9.1 Masonry Surfaces

Do not start water repellent coating until all joint tooling, pointing and masonry cleaning operations have been completed. Allow masonry to cure for at least 60 days under normal weather conditions before applying water repellent.

1.9.2 Plaster Surfaces

Do not start water repellent coating until all shrinkage and stress cracks are repaired and sound, all surfaces are free of defects and cleaning operations have been completed. Allow plaster to cure for at least 30 days under normal weather conditions before applying water repellent.

1.9.3 Concrete Surfaces

Do not start water repellent coating until all patching, pointing and cleaning operations have been completed and concrete has cured a minimum of

30 days under normal weather conditions.

1.9.4 Sealants

Do not apply water repellents until the sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.

a. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

b. Provide manufacturers' test results of compatibility.

1.10 INSPECTIONS

Notify the manufacturer's representative a minimum of 72 hours prior to scheduled application of water repellents for field inspection. Inspect surfaces and obtain approval in writing from the manufacturer's representative prior to application of water repellent coating.

1.11 SURFACES TO BE COATED

Coat all exterior masonry, surfaces where indicated on Drawings. This includes back faces of parapets, top of walls, edges and returns adjacent to windows and door frames and free-standing walls.

1.12 WARRANTY

Provide a warranty, issued jointly by the manufacturer and the applicator of the water repellent treatment against moisture penetration through the treated structurally sound surface for a period of five years. Warranty to provide the material, labor, and equipment necessary to remedy the problem. At the satisfactory completion of the work, complete the warranty sign, notarize, and submit to the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

Provide a clear, non-yellowing, deep-penetrating, VOC compliant water repellent solution. Material must not stain or discolor and must produce a mechanical and chemical interlocking bond with the substrate to the depth of the penetration.

2.2 WATER REPELLENTS

2.2.1 Silane, 20 Percent Solids

Penetrating water repellent. A monomeric compound containing approximately 20 percent alkyltrialkoxysilanes with alcohol, mineral spirits, water, and other proprietary solvent carrier.

a. Composition: Modified alkylalkoxysilane.

b. Active alkylalkoxysilane content: ASTM D2369 20 percent by weight, plus or minus 1 percent.

c. Appearance: White, milky liquid.

d. Average depth of penetration: Up to 3/8 inch depending on substrate.

e. VOC content: Less than 350 grams per liter.

f. Flash point, ASTM D3278.

g. Specific gravity, at 78 degrees F: 0.96 to 0.98.

h. Density: .0 to 8.2 pounds per gallon.

2.2.2 Silane, 40 Percent Solids

Penetrating water repellent. A monomeric compound containing approximately 40 percent alkyltrialkoxysilanes with alcohol, mineral spirits, or water.

a. Composition: Modified alkylalkoxysilane.

b. Active alkylalkoxysilane content: ASTM D2369 40 percent by weight, plus or minus 1.5 percent.

c. Appearance: White, milky liquid.

d. Average depth of penetration: Up to 3/8 inch depending on substrate.

e. VOC content: Less than 350 grams per liter.

f. Flash point, ASTM D3278.

g. Specific gravity, at 78 degrees F: 0.94 to 0.97.

h. Density: 7.8 to 8.1 pounds per gallon.

2.2.3 Silane, 85 Percent Solids or Greater

Penetrating water repellent. A monomeric compound containing 85 percent or greater alkyltrialkoxysilanes with alcohol, mineral spirits, or water.

a. Composition: Modified alkylalkoxysilane.

b. Active alkylalkoxysilane content: ASTM D2369 85 percent by weight, plus or minus 1 percent.

c. Appearance: White, milky liquid.

d. Average depth of penetration: Up to 3/8 inch depending on substrate.

e. VOC content: Less than 350 grams per liter.

f. Flash point, ASTM D3278.

g. Specific gravity, at 78 degrees F: 0.96 to 0.98.

h. Density: 8.0 to 8.2 pounds per gallon.

2.2.4 Siloxanes

Penetrating water repellent. Alkylalkoxysiloxanes that are oligomerous with alcohol, ethanol, mineral spirits, or water.

a. Solids by weight: ASTM D2369, 7.5 to 16.0 percent.

b. Volatile Organic Content (VOC) after blending: Less than 175 grams per liter.

c. Density, activated: 8.4 pounds per gallon, plus or minus one percent.

d. Flash point, ASTM D3278: Greater than 212 degrees F.

2.2.5 Low-Solids Acrylic

Water-clear, breathing coating of acrylic resins, water-based, solvent-based, or acrylic emulsions solution containing less than 15 percent solids by volume.

2.2.6 High-Solids Acrylic

Water-clear, breathing coating of acrylic resins, water-based, solvent-based, or acrylic emulsions solution containing 15 percent solids or more by volume.

2.2.7 VOC-Complying Water Repellents

Products certified by the manufacturer that they comply with local regulations controlling use of volatile organic compounds (VOC's).

2.3 PERFORMANCE CRITERIA

2.3.1 Silane, 20 Percent Solids

a. Water absorption test: ASTM C642 and ASTM E514/E514M.

b. Moisture vapor transmission: ASTM D1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.

c. Resistance to chloride ion penetration: AASHTO T 259 and AASHTO T 260.

d. Water penetration and leakage through masonry, ASTM E514/E514M percentage reduction of leakage: 97 percent minimum.

e. Resistance to accelerated weathering, ASTM G154 testing 2,500 hours: No loss in repellency.

f. Drying time under normal conditions: Four hours per 75 degrees F.

2.3.2 Silane, 40 Percent Solids

a. Average depth of penetration: 3/8 inches depending on substrate

b. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

c. Water absorption test, ASTM E514/E514M: 0.42 percent per 48 hours; 1.2 percent per 50 days.

d. Moisture vapor transmission: ASTM D1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.

e. Resistance to accelerated weathering, ASTM G154. Testing 2,500 hours:

No loss in repellency.

f. Drying time under normal conditions: Four hours per 75 degrees F.

2.3.3 Silane, 85 Percent Solids or Greater

a. Average depth of penetration: 3/8 inches depending on substrate.

b. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

c. Water absorption test, ASTM E514/E514M: 0.42 percent per 48 hours; 1.2 percent per 50 days.

d. Moisture vapor transmission: ASTM D1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.

e. Resistance to accelerated weathering, ASTM G154. Testing 2,500 hours: No loss in repellency.

f. Drying time under normal conditions: Four hours per 75 degrees F.

2.3.4 Siloxanes

a. Dry time for recoat, if necessary: One to two hours depending on weather conditions.

b. Penetration: 3/8 inch, depending on substrate.

c. Water penetration and leakage through masonry, ASTM E514/E514M, percentage reduction of leakage: 97.0 percent minimum.

d. Moisture vapor transmission, ASTM E96/E96M: 47.5 perms or 82 percent maximum compared to untreated sample.

e. Resistance to accelerated weathering, ASTM G154. Testing 2,500 hours: No loss in repellency.

f. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

PART 3 EXECUTION

3.1 EXAMINATION

Examine concrete, or masonry surfaces to be treated to ensure that:

a. All visible cracks, voids or holes have been repaired.

b. All mortar joints in masonry are tight and sound, have not been re-set or misaligned and show no cracks or spalling.

c. Moisture contents of walls does not exceed 15 percent when measured on an electronic moisture register, calibrated for the appropriate substrate.

d. Concrete surfaces are free of form release agents, curing compounds and other compounds that would prevent full penetration of the water repellent material.

Do not start water repellent treatment work until all deficiencies have

been corrected, examined, and found acceptable to the Contracting Officer and the water repellent treatment manufacturer. Do not apply treatment to damp, dirty, dusty, or otherwise unsuitable surfaces. Comply with the manufacturer's recommendations for suitability of surface.

3.2 PREPARATION

3.2.1 Surface Preparation

Prepare substrates in accordance with water repellent treatment manufacturer's recommendation. Clean surfaces of dust, dirt, efflorescence, alkaline, and foreign matter detrimental to proper application of water repellent treatment.

3.2.2 Protection

Provide masking or protective covering for materials which could be damaged by water repellent treatment.

a. Protect glass, glazed products, and prefinished products from contact with water repellent treatment.

b. Protect landscape materials with breathing-type drop cloths; plastic covers are not acceptable.

3.2.3 Compatibility

a. Confirm treatment compatibility with each type of joint sealer within or adjacent to surfaces receiving water repellent treatment in accordance with manufacturer's recommendations.

b. When recommended by joint sealer manufacturer, apply treatment after application and cure of joint sealers. Coordinate treatment with joint sealers.

3.3 MIXING

Mix water repellent material thoroughly in accordance with the manufacturer's recommendations. Mix, in quantities required for that day's work, all containers prior to application. Mix each container the same length of time.

3.4 APPLICATION

In strict accordance with the manufacturers written requirements. Do not start application without the manufacturer's representative being present or their written acceptance of the surface to be treated. Submit manufacturer's instructions including preparation, application, recommended equipment to be used, safety measures, and protection of completed application.

3.4.1 Water Repellent Treatment

3.4.1.1 Spray Application

Spray apply water repellent material to exterior concrete, and masonry surfaces using low-pressure airless spray equipment in strict accordance with manufacturer's printed application, instructions, and precautions. Maintain copies at the job site. Apply flood coat in an overlapping

pattern allowing approximately 8 to 10 inch rundown on the vertical surface. Maintain a wet edge at all overlaps, both vertical and horizontal. Hold gun maximum 18 inches from wall.

3.4.1.2 Brush or Roller Application

Brush or roller apply water repellent material only at locations where overspray would affect adjacent materials and where not practical for spray applications.

3.4.1.3 Covered Surfaces

Coat all exterior concrete, or masonry surfaces including back faces of parapets, tops of walls, edges and returns adjacent to window and door frames, window sills, and free-standing walls.

3.4.1.4 Rate of Application

Apply materials to exterior surfaces at the coverages recommended by the manufacturer and as determined from sample panel test. Increase or decrease application rates depending upon the surface texture and porosity of the substrate to achieve even appearance and total water repellency.

3.4.1.5 Number of Coats

The results of the sample panel test determines the number of coats required to achieve full coverage and protection.

3.4.1.6 Appearance

If unevenness in appearance, lines of work termination or scaffold lines exist, or detectable changes from the approved sample panel occur, the Contracting Officer may require additional treatment at no additional cost to the Government. Apply required additional treatment to a natural break off point.

3.5 CLEANING

Clean all runs, drips, and overspray from adjacent surfaces while the water repellent treatment is still wet in a manner recommended by the manufacturer.

3.6 FIELD QUALITY CONTROL

Do not remove drums containing water repellent material from the job site until completion of all water repellent treatment and until so authorized by the Contracting Officer.

3.6.1 Field Testing

At a time not less than twenty days after completion of the water repellent coating application, subject a representative wall area of the building to the Navy Hose Stream Field Test similar to AAMA 501.2 hose test to simulate rainfall for a period of three hours. Use a minimum 5/8 inch diameter hose and a fixed lawn sprinkler spray head which will direct a full flow of water against the wall. Place the sprinkler head so that the water will strike the wall downward at a 45-degree angle to the wall. If the inside of the wall shows traces of moisture during or following the test, apply another coat of water repellent, at the manufacturer's recommended coverage

rate to the entire building. Repeat testing and re-coating process until no moisture shows on the inside wall face. Accomplish required work retesting and re-coating at no additional cost to the Government.

3.6.2 Site Inspection

Inspect treatment in progress by manufacturer's representative to verify compliance with manufacturer instructions and recommendations.

-- End of Section --

SECTION 07 21 13

BOARD AND BLOCK INSULATION
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C578	(2022) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C930	(2019) Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D3833/D3833M	(1996; R 2019) Standard Test Method for Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E96/E96M	(2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E154/E154M	(2008a; R 2019) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Manufacturer's Standard Details

SD-03 Product Data

Environmental Data for Materials

Block or Board Insulation

Vapor Retarder; G

Pressure Sensitive Tape

Accessories including sealants

SD-08 Manufacturer's Instructions

Insulation Installation and Handling

SD-11 Closeout Submittals

Draft Guarantee

Final Guarantee

Draft Warranty

Final Warranty

1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.4 PRODUCT DATA

Include environmental data for materials descriptions, recommendations for product shelf life, requirements for precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.5.2 Storage

Inspect materials delivered to the site for damage and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Keep materials wrapped and separated from off-gassing materials (such as drying paints). Do not use materials that have visible moisture or biological growth. Comply with manufacturer's recommendations for handling, storage, and protection of materials before and during installation.

1.6 SAFETY PRECAUTIONS

1.6.1 Other Safety Considerations

Comply with the safety requirements of ASTM C930.

1.7 SPECIAL WARRANTIES

1.7.1 Guarantee

Guarantee insulation installation against failure due to ultraviolet light exposure for a period of three years from the date of Beneficial Occupancy or Substantial Completion. Submit draft guarantee and final guarantee.

1.7.2 Warranty

Provide manufacturer's material warranty for all system components for a period of three years from the date of Beneficial Occupancy or Substantial Completion. Submit draft warranty and final warranty.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide thermal insulating materials as recommended by manufacturer for each type of application indicated. Provide insulation with the following physical properties and in accordance with the following standards:

a. Extruded Preformed Cellular Polystyrene (XPS): ASTM C578 REV A, TypeIV

2.1.1 Prohibited Materials

Do not provide materials containing asbestos.

2.2 VAPOR RETARDER

2.2.1 Vapor Retarder under Floor Slab

a. Water vapor permeance: 0.2 Perm or less when tested in accordance with ASTM E96/E96M.

b. Puncture resistance: Maximum load no less than 40 pounds when tested according to ASTM E154/E154M REV A.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder(s). Match water vapor permeance rating for each vapor retarder specified. Provide tape in accordance with ASTM D3833/D3833M.

2.4 ACCESSORIES

2.4.1 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Insulation Installation and Handling

Provide insulation in accordance with the manufacturer's printed installation instructions. Keep material dry and free of extraneous materials.

3.1.2 Cold Climate Requirement

Place insulation on the outside of pipes.

3.1.3 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

3.1.4 Coordination

Verify final installed insulation thicknesses comply with thicknesses indicated and with the approved insulation submittal(s).

3.2 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls, slab edges in slab-on-grade, or floating slab construction.

3.2.1 Manufacturer's Instructions

Layout insulation, tape edges, provide vapor retarder and other required accessories to protect against vermin, insects, and damage in accordance with manufacturer's printed instructions.

3.2.2 Insulation on Vertical Surfaces

Provide thermal insulation on exterior of foundation walls below grade on edges of slabs-on-grade. Fasten insulation with mechanical fasteners.

3.2.3 Insulation Under Slab

Provide insulation horizontally under slab on grade for a distance of two feet from the edge of slab. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

3.2.4 Protection of Insulation

Protect insulation from damage during construction and back filling by application of protection board or a coating. Do not leave installed vertical insulation unprotected overnight. Protect installed insulation from weather, including rain and ultraviolet light, from mechanical abuse, compression, and dislocation. Install protection over entire exposed exterior insulation board.

-- End of Section --

SECTION 07 21 16

BUILDING INSULATION
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C665	(2023) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C930	(2019) Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D3833/D3833M	(1996; R 2019) Standard Test Method for Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D5359	(1998; R 2021) Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E136	(2022) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2020) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2021) National Fuel Gas Code
NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	(2010) Puncture Test of Container Board

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sound Attenuation Batt Insulation

Rigid Polyisocyanurate Board Insulation

Energy Star Label for Insulation Materials

Spray Polyurethane Foam Insulation - Thermal SPF

Vapor Retarder

Pressure Sensitive Tape

Accessories

SD-07 Certificates

Indoor Air Quality for Adhesives

SD-08 Manufacturer's Instructions

Insulation

1.3 CERTIFICATIONS

Submit required indoor air quality certifications and validations in one submittal package.

1.3.1 Insulation Products

Provide product certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification from certification body.

1.3.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.4.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.5 SAFETY PRECAUTIONS

1.5.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational

Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.5.2 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C930.

PART 2 PRODUCTS

2.1 SOUND ATTENUATION BATT INSULATION

ASTM C665, Type I, blankets without membrane coverings; Class A, membrane-faced surface with a flame spread of 25 or less, except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

Provide insulation with R-Value as indicated on drawings

2.1.1 Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

a. Fiberglass: 20 percent glass cullet complying with ASTM D5359

b. Mineral wool: 75 percent recovered materials content from slag

2.1.2 Energy Star

Provide insulation materials that are Energy Star labeled. Provide data identifying Energy Star label for insulation materials.

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.1.4 Reduced Volatile Organic Compounds (VOC) for Insulation Materials

Provide certification of indoor air quality for insulation materials.

2.2 RIGID POLYISOCRYANURATE BOARD INSULATION - EXTERIOR WALS

Rigid Polyisocyanurate Board Insulation: Cellular themal insulation with glass fiber-reinforced Polyisocyanurate closed-cell foam core and aluminum foil facing laminated to both sides: complying with FS HH-I-1972/1, Class 2; aged r-values of 7.2 and 8 at 40 and 75 degrees F (4.4 and 23.9 degrees C), respectively, and as follows:

Surface Burning Characteristics: Maximum values for flame spread and smoke developed of 20 and 150, respectively.

2.3 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E136 for blocking around chimneys and heat producing devices.

2.4 SPRAY POLYURETHANE FOAM INSULATION - THERMAL SPF

At locations indicated on Drawings.

ASTM C 1029, Type II, closed-cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

a. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 degrees F x h x sq. ft./Btu x in. at 75 degrees F.

b. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation unit installation of pipes, ducts, conduits, wiring, and electrical outlets in walls in completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.

c. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to receive insulation are masked

d. Thermal Resistance Value (R-Value) of SPF: As indicated on Drawings.

2.5 VAPOR RETARDER

b. Membrane with the following properties:

Water Vapor Permeance: ASTM E96/E96M: 1 perm

Maximum Flame Spread: ASTM E84: 25

Combustion Characteristics: Passing ASTM E136

Puncture Resistance: TAPPI T803 OM: 25

2.6 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D3833/D3833M.

2.7 ACCESSORIES

2.7.1 Adhesive

As recommended by the insulation manufacturer. Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.7.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.7.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that surfaces that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

d. Gas Fired Appliances: Clearances as required in NFPA 54.

e. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passes ASTM E136, in addition to meeting other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's

instructions. Keep material dry and free of extraneous materials. Any materials that show visual evidence of biological growth due to presence of moisture must not be installed on the building project. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical conductors, that are not installed in conduit, between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.2 Installation of Separate Vapor Retarder

Apply continuous vapor retarder as indicated. Overlap joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION 07 27 10

BUILDING AIR BARRIER SYSTEM
08/23

PART 1 GENERAL

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system. Construct the air barrier system indicated, taking responsibility for the means, methods, and workmanship of the installation of the air barrier system. The air barrier must be contiguous and connected across all surfaces of the enclosed air barrier envelope indicated. The maximum leakage requirements of individual air barrier components and materials are specified in the other specification sections covering these items.

This section also defines the maximum allowable leakage of the final air barrier system. The workmanship must be adequate to meet the maximum allowable leakage requirements of this specification. Test the assembled air barrier system to demonstrate that the building envelope is properly sealed and insulated. Passing the air barrier system leakage test and thermography test will result in system acceptance.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4541	(2022) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E96/E96M	(2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E2178	(2021a) Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials
ASTM E2357	(2018) Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2023) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Accessory

Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

1.3.2 Air Barrier Assembly

The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

1.3.3 Air Barrier Component

Pre-manufactured elements such as windows, doors, dampers and service elements that are installed in the environmental separator.

1.3.4 Air Barrier Envelope

The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

1.3.5 Air Barrier Material

A building material that is designed, tested or produced to provide the primary resistance to airflow through an air barrier assembly of a building enclosure.

1.3.6 Air Barrier System

Same as AIR BARRIER ENVELOPE.

1.3.7 Air Leakage Rate

The rate of airflow (CFM) driven through a unit surface area (sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly. (example: 0.25 CFM/sq.ft. @ 75 Pa)

1.3.8 Air Leakage

The total airflow (CFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope. (example: 6500 CFM @ 75 Pa)

1.3.9 Air Permeance

The tested rate of airflow (CFM) through a unit area (sq.ft.) of a material driven by unit static pressure difference (Pa) across the material (example: 0.004 CFM/sq.ft. @ 75 Pa) as established by ASTM E2178.

1.3.10 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. Also known as the Control Layer.

1.3.11 Vapor Permeance

Vapor permeance is separated into three classes based on the water vapor permeance of a material as tested via ASTM E96/E96M

Class III Vapor Barrier/Retarder 1.0 perm to 10 perm

1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE

Organize pre-construction conferences between the air barrier inspector and the sub-contractors involved in the construction of, or penetration of, the air barrier system to discuss where the work of each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials. Discuss the products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Air Barrier System Shop Drawings; G, Manufacturer produced warranted air barrier system

SD-03 Product Data

Air Barrier System Product Data; G

SD-04 Samples

Material Samples For Air Barrier System; G

SD-05 Design Data

Design Data And Calculations For The Air Barrier System; G

SD-06 Test Reports

Design Review Report; G

Testing and Inspection; G

SD-07 Certificates

Air Barrier Inspector; G

1.6 AIR BARRIER INSPECTOR

Employ a designated Air Barrier Inspector on this project. The Air Barrier Inspector performs a Design Review, oversees quality control testing specified in these specifications, performs quality control air barrier inspection as specified, interfaces with the designer and product manufacturer's representatives to assure installation requirements are met, and verifies that the constructed work is in accordance with both the manufacturer's recommendations for products used, the content of this specification and other Contract drawings or documents. Qualifications for the Air Barrier Inspector are as follows:

a. Training and certification as an Air Barrier Auditor from the Air Barrier Association of America (ABAA) or other third-party air barrier association.

b. Or, provide documentation in resume format that demonstrates that the individual proposed has the experience, knowledge, skills and abilities to fulfill the above stated duties as the air barrier inspector.

c. It is acceptable that this individual be employed by the firm performing the building pressurization test or another independent third-party entity, provided they meet the above requirements but must not be a member of the installing Contractor or firm.

Provide copies of Air Barrier Inspector qualifications 30 days after Notice to Proceed.

1.7 DESIGN REVIEW

Review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the construction of an effective air barrier system. Provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for a proper air barrier system. Provide copies of the Design Review Report not later than 14 days after approval of the Air Barrier Inspector Qualifications. Submit design data and calculations for the Air Barrier System for a manufacturer produced and warranted air barrier system.

PART 2 PRODUCTS

2.1 AIR BARRIER

Provide air barrier system of compatible parts from one or several manufacturers coordinated by the Contractor or provide a single warranted system provided by a primary manufacturer. The air barrier system as part of a tested exterior wall assembly must meet the conditions of acceptance as tested in accordance with NFPA 285. Materials used for roof assembly air barrier must conform to the appropriate UL and FM wind and fire requirements for the specified roof assemblies.

If a complete air barrier system from a single manufacturer is utilized, whether warranted or not warranted, the air barrier system must conform to ASTM E2357.

Materials in the following categories, as used in the air barrier system or assembly of the exterior wall system, are tested and are required to conform to ASTM E2178: Self-adhered sheet membranes, fluid applied

membranes, spray polyurethane foam, mechanically fastened commercial building wrap, factory bonded membranes to sheathing, and adhesive backed commercial building wrap and accessory products.

Other materials used as an air barrier such as concrete, glass, wood, metal or gypsum board may or may not conform to ASTM E2178 but are acceptable provided that when integrated into the air barrier system or assemblies they are not subject to material or environmental induced degradation in their final produced state once incorporated in the permanent construction.

All materials used must be identifiable through manufacturer testing data or literature to be compatible with all the attached or adjoining materials or substrates used in the system.

Provide Air Barrier System Shop Drawings, Material Samples for Air Barrier System and Air Barrier System Product Data.

PART 3 EXECUTION

3.1 QUALITY CONTROL

3.1.1 Documentation and Reporting

Document the entire installation process on daily job site reports. These reports include information on the Installer, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results.

3.1.2 Quality Control Testing And Inspection

Conduct the following tests and inspections as applicable in the presence of the Contracting Officer during installation of the air barrier system, and submit quality control reports as indicated below.

a. Provide a Daily Report of Observations with a copy to the Contracting Officer.

b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.

c. Inspect to assure structural support of the air barrier system to withstand design air pressures.

d. Inspect to assure masonry surfaces receiving air barrier materials are smooth, clean, and free of cavities, protrusions and mortar droppings, with mortar joints struck flush or as required by the manufacturer of the air barrier material.

e. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.

f. Inspect to assure substrate surfaces are properly primed, if applicable, and in accordance with manufacturer's instructions. Priming must extend at least 2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.

g. Inspect to assure laps in materials are at least a 2-inch minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.

h. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.

i. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.

j. Inspect to assure that the correct materials are installed for compatibility.

k. Inspect to assure proper transitions for change in direction and structural support at gaps.

l. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

m. Perform adhesion tests for fluid-applied and self-adhered air barrier membranes to assure that the manufacturer's specified adhesion strength properties are met. Determine the bond strength of coatings to substrate in accordance with ASTM D4541.

n. Provide cohesion tests for spray polyurethane foam (SPF).

o. Provide written test reports of all tests performed.

3.2 REPAIR AND PROTECTION

Upon completion of inspection, testing, sample removal and similar services, repair damaged construction and restore substrates, coatings and finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

-- End of Section --

SECTION 07 27 19.01

SELF-ADHERING AIR BARRIERS
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation	Accreditation
ABAA QAP	Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM D146/D146M	(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D412	(2016; R 2021) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D903	(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1876	(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4541	(2022) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E96/E96M	(2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E154/E154M	(2008a; R 2019) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E283/E283M	(2019) Standard Test Method for

	Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2023) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E2178	(2021a) Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials
ASTM E2357	(2018) Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2023) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10 BUILDING AIR BARRIER SYSTEM and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components, and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-02 Shop Drawings

Self-adhering Air Barrier Shop Drawings; G

SD-03 Product Data

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

Safety Data Sheets; G

SD-04 Samples

Self-adhering Air Barrier System Mockup; G

SD-06 Test Reports

Field Peel Adhesion Test; G

Flame Propagation of Wall Assemblies; G

Site Inspections and Testing; G

SD-08 Manufacturer's Instructions

Self-adhering Air Barrier Manufacturer's Printed Instructions; G

Primers, Adhesives, and Mastics; G

1.4 MISCELLANEOUS REQUIREMENTS

For self-adhering air barrier provide the following:

1.4.1 Shop Drawings

Submit self-adhering air barrier shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other building enclosure assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.4.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements in Part 2 of this specification. Also submit self-adhering air barrier manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

1.4.3 Mockup

Provide a self-adhering air barrier system mockup. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.4.4 Test Reports

Submit test reports indicating that field peel-adhesion tests on all materials have been performed and the changes made, if required, in order

to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight. Keep materials sealed and separated from absorptive materials, such as wood and insulation.

1.6 AIR BARRIER TESTING

Perform air barrier testing in accordance with.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications of Manufacturer

Submit documentation verifying that the manufacturer of the self-adhering air barrier is currently accredited by Air Barrier Association of America (ABAA Accreditation https://www.airbarrier.org/).

1.7.2 Qualifications of Installer

Submit documentation verifying that installers of the self-adhering air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (https://www.airbarrier.org/qap/).

1.7.3 Field Peel Adhesion Test

Perform a field peel-adhesion test on the construction mockup. Test the self-adhering air barrier for adhesion in accordance with ASTM D4541 using a Type II pull tester except use a disk that is 4 inches in diameter and cut through the membrane to separate the material attached to the dish from the surrounding material. Perform test after curing period in accordance with manufacturer's written recommendations. Record mode of failure and area which failed in accordance with ASTM D4541. Compare adhesion values with the manufacturer's established minimum values for the particular combination of material and substrate. Indicate on the inspection report whether the manufacturer's requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product and substrate combination, the inspector must record actual values.

1.8 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to

commencing work specified in this specification Section. Agenda must include, at a minimum, construction and testing of mockup, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the air barrier system.

1.9 ENVIRONMENTAL CONDITIONS

1.9.1 Temperature

Install air barrier within the range of ambient and substrate temperatures as recommended in writing by the air barrier manufacturer. Verify that the surface to receive self-adhering air barrier is dry for a minimum of 48 hours prior to the installation of the barrier. Do not apply air barrier to damp or wet substrates. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.9.2 Exposure to Weather and Ultraviolet Light

Protect air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the Government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 SELF-ADHERING AIR BARRIER

Provide minimum 0.040 inch thick self-adhering, vapor permeable, air barrier membrane consisting of a cross-laminated high density polyethylene (HDPE) film, fully coated with rubberized butyl-based or acrylic-based adhesive. Provide membrane in rolls of various widths interleaved with disposable silicone release paper. Self-adhering air barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Use regular or low temperature formulation depending on site conditions, within temperature ranges specified by manufacturer.

2.1.1 Physical Properties

a. Air Permeance (ASTM E2178): In accordance with Section 07 27 10 BUILDING AIR BARRIER SYSTEM

b. Air Leakage (ASTM E2357, ASTM E283/E283M): In accordance with Section 07 27 10 BUILDING AIR BARRIER SYSTEM and Section 01 91 19 BUILDING ENCLOSURE COMMISSIONING.

c. Tensile Strength (ASTM D412 die C modified): Not less than 400 psi.

d. Tensile Elongation (ASTM D412 die C modified): Not less than 200 percent.

e. Puncture Resistance (ASTM E154/E154M): Not less than 40 lbs.

f. Pliability (ASTM D146/D146M): Unaffected at minus 25 degrees F, 0.063 inch mandrel.

g. Lap Adhesion (ASTM D1876 modified): Not less than 4.0 lbs per inch.

h. Peel Adhesion (ASTM D903): Not less than 5.0 lbs per inch.

i. Water Vapor Permeance (Vapor Permeable Air Barrier) (ASTM E96/E96M, desiccant method B): greater than 10.0 perms.

j. Water Absorption (ASTM D570): Not to exceed 0.12 percent by weight.

k. Flame propagation of wall assemblies (NFPA 285): Pass

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended in writing by the manufacturer of the self-adhering air barrier for adequate bonding to each type of substrate. Adhesive must be butyl- or acrylic-based.

2.3 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.4 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with adjacent products that are or will be in contact with one another.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing air barrier, examine substrates, areas, and conditions under which air barrier assemblies will be applied, with Installer present, for compliance with requirements. Ensure the following conditions are met:

a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.

b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.

c. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.

d. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel adhesion test on materials to which sealants are adhered.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for air barrier application.

a. Prime masonry and concrete substrates with conditioning primer.

b. Prime gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.

c. Prime wood, metal, and painted substrates with primer.

d. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions.

3.3 INSTALLATION

3.3.1 Installation of Self-adhering Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

a. Apply primer at rate recommended by manufacturer prior to membrane installation. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.

b. When membrane is properly positioned, press into place and roll membrane with roller immediately after placement.

c. Apply membrane sheets to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.

d. Position subsequent sheets of membrane applied above so that membrane overlaps the membrane sheet below by a minimum of 2-1/2 inches, unless greater overlap is recommended by manufacturer. Roll into place with roller.

e. Make side laps a minimum of 2-1/2 inches and end laps a minimum of 5 inches, unless greater overlap is recommended by manufacturer. Roll seams with roller.

f. Roll membrane to adhere to substrate. Cover corners and joints with two layers of reinforcement by first applying a 12 inch width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection.

g. Seal around all penetrations through the air barrier resulting from pipes, vents, conduit, electrical fixtures, structural members, or other construction passing through it. Seal with termination mastic, extruded silicone sealant, membrane counterflashing or other sealing methods in accordance with manufacturer's written recommendations.

h. Continuously connect the air barrier between walls, roof, floor and below grade assemblies to form a continuous integrated air barrier system around the entire building enclosure. Extend the air barrier membrane into rough openings such as doors, windows, louvers, and other exterior penetrations. Seal edges of barrier at junctures with rough openings.

i. At changes in substrate plane, provide transition material (e.g., bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to

eliminate all sharp 90-degree inside corners and to make a smooth transition from one plane to another.

j. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.

k. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.

l. At expansion and seismic joints provide transition to the joint assemblies.

m. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.

n. At end of each working day, seal top edge of membrane to substrate with termination mastic.

o. Do not allow materials to come in contact with chemically incompatible materials.

p. Counterflash upper edge of thru-wall flashing and air barrier. Counter flashing is specified in Section 07 60 00 FLASHING AND SHEET METAL. See applicable wall-type Sections for thru-wall flashing requirements.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with the manufacturer's instructions, Section 07 27 10 BUILDING AIR BARRIER SYSTEM and this section.

a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written site inspections and testing reports to the Contracting Officer within five working days of the inspection and test being performed.

b. If inspections reveal defects, promptly remove and replace defective work at no additional expense to the Government.

3.5 FIELD PEEL ADHESION TEST

Conduct in accordance with test protocol indicated in Part 1, paragraph FIELD PEEL ADHESION TEST.

3.6 PROTECTION AND CLEANING

3.6.1 Protection

3.6.1.1 Adjacent Surfaces

Protect exposed adjacent surfaces that could be damaged by primers and adhesives associated with air barrier membrane. Provide protection during application and the remainder of construction in accordance with manufacturer's written instructions.

3.6.1.2 The Air Barrier Assembly

Protect finished portions of the air barrier assembly from damage during ongoing application and throughout the remainder of the construction period in accordance with manufacturer's written instructions. Coordinate timing of installation of materials that will cover the air barrier membrane to ensure the exposure period does not exceed that recommended by the air barrier manufacturer's written installation instructions. Remove and replace, at no additional cost to the Government, membrane products that exceed the manufacturer's allowed exposure limits.

3.6.2 Cleaning

Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and as acceptable to the primary material manufacturer.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A480/A480M	(2023a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792/A792M	(2022) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B69	(2021) Standard Specification for Rolled Zinc
ASTM B209/B209M	(2021a) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2244	(2021) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color

	Coordinates
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4586/D4586M	(2007; R 2018) Asphalt Roof Cement, Asbestos-Free
ASTM E2112	(2023) Standard Practice for Installation of Exterior Windows, Doors and Skylights

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0429	(2022) The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control and Reroofing

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1	(2019) Performance Standard for Retrofit Drains

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.2.1 General Material Requirements

All materials specified in this Section installed in conjunction with the roofing system must be provided by the roofing system manufacturer, or by a manufacturer approved by the roofing system manufacturer for use in the roofing system, and must form a part of the Warranty as required by the applicable roofing system Section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Exposed Sheet Metal Coverings; G

Expansion Joints; G

Flashing for Roof Drains; G

Base Flashing; G

Counterflashing; G

Flashing at Roof Penetrations and Equipment Supports; G

Reglets; G

Copings; G

SD-04 Samples

Finish Samples; G

SD-07 Certificates

Warranty on Finishes; G

SD-08 Manufacturer's Instructions

Instructions for Installation; G

SD-10 Operation and Maintenance Data

Cleaning and Maintenance; G

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 MATERIALS

Use any metal listed by NRCA 0429 or SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials and configurations in accordance with NRCA 0429 or SMACNA 1793 for each material, while also meeting the minimum thickness requirements specified in this Section. Different items need not be of the same metal, except that contact between dissimilar metals must be avoided.

Provide sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Provide sheet metal items with mill finish unless specified otherwise.

2.1.1 Exposed Sheet Metal Items

Provide exposed sheet metal items of the same material. Consider the following as exposed sheet metal: cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with ASTM A653/A653M, a minimum of 24 gauge, and a minimum zinc coat weighting of 90 ounces per square feet.

2.1.3 Zinc Sheet and Strip

Provide in accordance with ASTM B69, Type I, a minimum of 0.024 inch thick.

2.1.4 Steel Sheet, Aluminum Zinc-Coated

Provide in accordance with ASTM A792/A792M, a minimum of 24 gauge.

2.1.5 Stainless Steel

Provide in accordance with ASTM A480/A480M, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper, a minimum of 24 gauge.

2.1.6 Aluminum Alloy Sheet and Plate

Provide in accordance with ASTM B209/B209M anodized clear form alloy, and temper appropriate for use. Provide material not less than 0.032-in in thickness.

2.1.6.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on one side unless otherwise indicated.

a. Flashing

2.1.7 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied coil fluoropolymer color coating or approved equal siliconized polyester coating. Dry film thickness of coatings must be 0.8 to 1.3 mils. Color to be selected from manufacturer's standard range of color choices. Field applications of color coatings are prohibited and will be rejected.

2.1.7.1 Warranty on Finishes

Provide a manufacturer's warranty to repair, or replace, sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of project substantial completion. Deterioration includes the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2.1.8 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

2.1.9 Solder

Provide in accordance with ASTM B32, 95-5 tin-antimony.

2.1.10 Reglets

2.1.10.1 Polyvinyl Chloride Reglets

Provide in accordance with ASTM D1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.1.10.2 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 1/4 inch and a depth of 1-1/4 inch, as approved.

2.1.10.2.1 Caulked Reglets

Provide with rounded edges, temporary reinforcing cores, and accessories as required for securing to adjacent construction. Provide built-up mitered corner pieces for inside and outside corners.

2.1.10.2.2 Friction Reglets

Provide with flashing receiving slots not less than 5/8 inch deep, one inch jointing tongues, and upper and lower anchoring flanges installed at 24 inch maximum snap-lock type receiver.

2.1.11 Splash Pans

Provide splash pans where downspouts discharge onto roof surfaces and at

locations indicated. Unless otherwise indicated, provide pans not less than 24 inches long by 18 inches wide with metal ribs across bottoms of pans. Provide sides of pans with vertical baffles not less than one inch high in the front, and 4 inches high in the back. Ground splash pans to be precast concrete.

2.1.12 Copings

Unless otherwise indicated, provide copings in copper sheets, 8 or 10 feet long, joined by a 3/4 inch locked and soldered seam.

2.1.13 Bituminous Plastic Cement

Provide in accordance with ASTM D4586/D4586M, Type I.

2.1.14 Roofing Felt

Provide in accordance with ASTM D226/D226M Type I.

2.1.15 Asphalt Primer

Provide in accordance with ASTM D41/D41M.

2.1.16 Fasteners

Use the same metal as, or a metal compatible with the item fastened. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

3.1.2 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Pre-tin cleats for soldered seams.

3.1.3 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inches or less in thickness.

3.1.4 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5 Mechanical Fastening

3.1.5.1 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

3.1.6 Protection from Contact with Dissimilar Materials

3.1.6.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.6.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.6.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.6.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.7 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 12 feet apart.

3.1.8 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inches and not less than 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inches on center with a minimum of 2 inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.9 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inches by 8 inches or may be of the preformed single piece type. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form flashings to the required shapes before installation. Factory form corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on chimneys and short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing. Utilize two piece counterflashing components to minimize damage of counterflashing and reglets during future reroofing activities.

3.1.10 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 1/4 inch and a minimum depth of 1-1/4 inch, when installed.

3.1.10.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 18 inches, caulked full and solid with an approved compound.

3.1.10.2 Friction Reglets

Install flashing snap lock receivers at 24 inches on center maximum. When flashing has been inserted the full depth of the slot, caulk the slot, lock, and fill with sealant.

3.1.11 Polyvinyl Chloride Reglets for Temporary Construction

Rigid polyvinyl chloride reglets may be provided in lieu of metal reglets for temporary construction.

3.1.12 Gravel Stops and fascia

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascia after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascia on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inch long spaced not more than 3 inches on center, in two staggered rows.

3.1.12.1 Edge Strip

Hook the lower edge of fascia at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inches on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.1.12.2 Joints

Leave open the section ends of gravel stops and fascia 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing is not permitted. Install prefabricated aluminum gravel stops and fascia in accordance with the manufacturer's printed instructions and details.

3.1.13 Flashing for Roof Drains

Provide a 30 inches square sheet indicated. Taper insulation to drain from 24 inches out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D4586/D4586M. Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.1.14 Flashing at Wall Openings

Install pan flashing in the rough opening sill at all penetrations in the exterior wall assemblies, such as windows, louvers, storefronts and curtain walls. Pan sill flashing must have end dams at both jambs a minimum of 2 in high and a rear dam of 2 in high. Flashing must comply with ASTM E2112 and SMACNA 1793.

3.1.15 Expansion Joints

Provide expansion joints for roofs, walls, and floors as indicated. Provide.

3.1.16 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.1.17 Single Pipe Vents

Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inches roof flange in bituminous plastic cement and nailed 3 inches on center. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.18 Copings

Provide copings as indicated in the Drawings.

3.1.19 Through Wall Flashing

Provide through wall flashing as required in the applicable wall system Sections.

3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint dissimilar sheet metals in contact to separate and deter galvanic interactions.

3.2.1 Aluminum Surfaces

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

-- End of Section --

SECTION 07 61 14.00 20

STEEL STANDING SEAM ROOFING
08/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP Z359.1	(2020) The Fall Protection Code

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A182/A182M	(2023) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A500/A500M	(2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792/A792M	(2022) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2023) 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

ASTM D522/D522M	(2017) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D2247	(2015; R 2020) Standard Practice for Testing Water Resistance of Coatings in 100?Percent Relative Humidity
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E1592	(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E2140	(2001; R 2023) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM G152	(2013; R 2021) Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013; R 2021) Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

1.2 DEFINITIONS

1.2.1 Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical or hand seamers. Crimped (45 degree

bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bends), and roll and lock systems are types of field-formed seam systems.

1.2.2 Snap Together Seam

Panels so configured that the male and female portions of the seam interlock through the application of foot pressure or tamping with a mallet. Snap-on cap configurations are a type of snap together system.

1.2.3 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.4 Field-Formed

Formed to the final, less field-formed seam, profile and configuration at the site of work prior to installation.

1.2.5 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.2.6 SSMRS

Standing Seam Metal Roof System (SSMRS) is abbreviation of the entire roof system specified herein with all components and parts coming from a single manufacturer's system.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

a. Panels must be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets must be in continuous contact from eave to ridge. Individual panels of snap together type systems must be removable for replacement of damaged material.

b. There must be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel must be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes. There must be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.

c. Snap together type systems must have a capillary break and a positive side lap locking device. Field-formed seam type systems must be mechanically locked closed by the manufacturer's locking tool. The seam must include a continuous factory applied sealant when required by the manufacturer to withstand the wind loads specified.

d. Roof panel anchor clips must be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement. Panel clip spacing must be a maximum of 5 feet on-center in

the field and 30 inches on-center in the wind zone on the edge and corners.

1.3.2 Design Conditions

Design the system to resist positive and negative loads specified herein in accordance with the AISI SG03-3. Panels must support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Hydrokinetic / Hydrostatic-Head Resistance

The miminum slope for hydrokinetic roofs is 4:12. In ASHRA Climates Zones 4 and above, which have the potential for ice damming, use a minimum slope of 6:12. Slopes lower than indicated above will require a Hydrostatic roof system with a minimum of 2 inch tall seams and with no water penetration when tested according to ASTM E2140.

1.3.2.2 Wind Uplift

Wind-Uplift Resistance: Provide portable roll-forming equipment capable of producing sheet metal roofing assemblies that comply with UL 580 for Class 90 wind-uplift resistance.

Maintain UL certification of portable roll-forming equipment for duration of sheet metal roofing work.

Refer to Component and Cladding Wind Pressures and Design Criteria Schedule on Structural Drawings. Compute and apply the design uplift pressures for the roof system using a basic wind speed indicated on the Structural Drawings.

1.3.2.3 Roof Live Loads

Loads must be applied on the horizontal projection of the roof structure. The minimum roof design live load must be 20 psf.

1.3.2.4 Thermal Movement

System must be capable of withstanding thermal movement based on a temperature range of 10 degrees F below design low air temperatue degrees F and 180 degrees F.

1.3.2.5 Deflection

Panels must be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

1.3.3 Structural Performance

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) must be in accordance with ASTM E1592. Full scale testing is required to certify the adequacy of the Standing Seam Metal Roofing System.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that

will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing; G

SD-03 Product Data

Roofing Panels; G

Energy Star Label for Steel Roofing Product

Recycled Content for Steel Roofing Product

Snow / Ice Guards; G

Fall Protection System; G

Attachment Clips

Closures

Accessories

Fasteners

Sealants

Sample Warranty Certificate; G

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

SD-04 Samples

Roofing Panel

Submit a 12 inch long by full width section of typical panel.

For color selection, submit 2 by 4 inch metal samples in color, finish and texture specified. When colors are not indicated, submit samples of not less than six different manufacturer's standard colors for selection.

Accessories

Submit each type of accessory item used in the project including, but not limited to each type of anchor clip, closure, fastener, and leg clamp.

Sealants

Intermediate Support

SD-05 Design Data

Design Calculations

SD-06 Test Reports

Field Inspection; G

Submit manufacturer's technical representative's field inspection reports as specified in paragraph MANUFACTURER'S FIELD INSPECTION.

Structural Performance Tests

Submit test reports by a nationally recognized testing laboratory equipped and capable of performing the required tests herein.

Finish Tests

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained, has the specified experience, and authorized by the manufacturer to install the products specified.

Coil Stock Compatibility; G

Provide certification of coil compatibility with roll forming machinery to be used for forming panels without warping, waviness, and rippling not part of panel profile; to be done without damage, abrasion or marking of finish coating.

SD-08 Manufacturer's Instructions

Installation Manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information Card

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

Warranty

1.5 DESIGN CALCULATIONS

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate

calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph WIND UPLIFT.

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

After submittals are received and approved but before roofing and insulation work, including associated work, is preformed, the Contracting Officer will hold a preroofing conference within 45 days after Contract award to review the following:

a. The drawings and specifications and required submittals.

b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system

c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

d. Safety requirements and to establish a mutual understanding of the metal roof system contractor requirements.

The preroofing conference must be attended by the Contractor installation, roofing supplier, erector, Construction Representative, and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference must be resolved and confirmed in writing before roofing work, including associated work, is begun. Prepare written minutes of the preroofing conference and submit to the Contracting Officer.

1.6.2 Manufacturer

The SSMRS must be the product of a metal roofing industry - recognized manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve

field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative must be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative must be on-site during all roof system installation work.

1.6.4 Installer's Qualifications

The roofing system installer must be factory-trained, approved by the steel roofing system manufacturer to install the system, and must have a minimum of three years experience as an approved applicator with that manufacturer. The applicator must have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer; must be the latest design by the manufacturer; and must have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels must meet the following test requirements:

a. Formability Test: When subjected to a 180 degree bend over a 1/8 inch diameter mandrel in accordance with ASTM D522/D522M, exterior coating film may show only slight microchecking and no loss of adhesion.

b. Accelerated Weathering Test: Withstand a weathering test for a minimum of 2000 hours in accordance with ASTM G152 and ASTM G153, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument will be considered to indicate loss of adhesion.

c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating may not chalk greater than No. 8 rating when measured in accordance with ASTM D4214 test procedures.

d. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D2247 for 1000 hours, a scored panel must show no signs of blistering, cracking, creepage, or corrosion.

e. Gloss Test: The gloss of the finish must be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D523.

1.6.7 Shop Drawing Requirements

Submit roofing drawings to supplement the instructions and diagrams. Include design and erection drawings containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation must be in accordance with the manufacturer's Standard Instructions and details or the SMACNA 1793. Prior

to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

1.7 WARRANTY

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period must be not less than 20 years from the date of Government acceptance of the work. The warranty must be issued directly to the Government. The warranty must provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship must be the responsibility of the roofing system manufacturer. Repairs that become necessary because of defective materials and workmanship while roofing is under warranty must be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. In addition, provide a 2 year contractor installation warranty.

1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials must not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Replace damaged or permanently stained materials that cannot be restored to like-new condition with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

PART 2 PRODUCTS

2.1 ROOFING PANELS

Provide panels with interlocking ribs for securing adjacent sheets and with concealed clip fastening system for securing the roof covering to structural framing members. Fasteners must not penetrate the panels except

at the ridge, eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps must be predrilled or prepunched. Factory prepare ends of panels to be lapped by trimming part of seam, die-setting, or swaging ends of panels. Individual sheets must be sufficiently long to cover the entire length of any unbroken roof slope when such slope is 30 feet or less. Provide panels that extend over two or more spans when length of run exceeds 30 feet. Obtain Contracting Officer (KO) approval for sheets longer than 30 feet before submitting shop drawings. Sheets must provide not less than 12 inches of coverage (width) in place. Provide panels with a minimum corrugation height of 2.25 inches (nominal). Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Form panels from coil stock without warping, waviness or ripples not part of the panel profile, and free of damage to the finish coating system.

Provide steel roofing product that is Energy Star labeled. Provide data identifying Energy Star label for steel roofing product. Provide solar reflectance product with an initial solar reflectance greater than or equal to 0.25 and a solar reflectance greater than or equal to 0.15 three years after installation under normal conditions.

Provide commplete system comprising of standing seam roof, fascia, and soffit panels (0.040 inch flush panel, non-vented, panels with finish and color to match roof panels) as indicated on drawings, tested and warranteed as specified.

2.1.1 Material

Zinc-coated steel conforming to ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy coated steel conforming to ASTM A792/A792M, AZ 55 coating. Provide material with a minimum thickness of 0.023 inch thick (24 gage) minimum except when mid field of roof is subject to design wind uplift pressures of 60 psf or greater, entire roof system must have a minimum thickness of 0.030 inch (22 gage). Steel roofing materials must contain a minimum of 30 percent total recycled content. Provide data identifying percentage of recycled content for steel roofing product.

2.1.2 Texture

Smooth or smooth with raised intermediate ribs for added stiffness.

2.1.3 Finish

Factory color finish.

2.1.3.1 Factory Color Finish

Provide factory applied, thermally cured coating to exterior and interior of metal roof and wall panels and metal accessories. Provide exterior finish top coat of 70 percent resin polyvinylidene fluoride with not less than 1.0 mil dry film thickness. Provide exterior primer and 0.75 mil finish coat with not less than 0.25 mil dry film thickness. Interior finish must consist of 0.25 mil dry film thickness prime coat. Provide manufacturer's standard color.

2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A653/A653M, G90, Grade D (16 gage and

heavier), Grade A (18 gage and lighter); or steel conforming to ASTM A36/A36M, ASTM A1011/A1011M, or ASTM A1008/A1008M prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A1011/A1011M, or ASTM A1008/A1008M steel hot-dip galvanized in accordance with ASTM A653/A653M, G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.4 ACCESSORIES

Sheet metal flashings, gutters, downspouts, trim, moldings, closure strips, pre-formed crickets, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels must be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless steel. Metal must be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners must be as recommended by the manufacturer except that wood spacer blocks are not allowed.

2.4.1 Closures

2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures must not absorb water.

2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and headwall roof panel flashing conditions and terminations. Foam material must not absorb water.

2.4.2 Snow / Ice Guards

Provide non-corrosive metal seam clamping (non-penetrating) type snow/ice guards, secured to the clamp assembly with brackets designed to mechanically clamp over the standing seam metal roof panel ribs with integral snow clips or ice flags. Type to be either rail or two pipe system, with manufacturer's standard color finish to match roof panel. Snow/ice guard system shall be as manufactured by Albine "Two Pipe Snow Guard" or Metal Roof Innovations "S-5 ColorGuard", or approved equal

2.4.3 Fasteners

Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners must be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material must be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed

portion of fasteners or washers must be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

2.4.3.1 Screws

Not smaller than No. 14 diameter if self-tapping type and not smaller than No. 12 diameter if self-drilling and self-tapping.

2.4.3.2 Bolts

Not smaller than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.4.3.3 Automatic End-Welded Studs

Automatic end-welded studs must be shouldered type with a shank diameter of not smaller than 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.3.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools must have a shank diameter of not smaller than 0.145 inch with a shank length of not smaller than 1/2 inch for fastening to steel and not smaller than 1 inch for fastening to concrete.

2.4.3.5 Rivets

Blind rivets must be stainless steel with 1/8 inch nominal diameter shank. Rivets must be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems must have closed ends.

2.4.4 Sealants

Elastomeric type containing no oil or asphalt. Exposed sealant must cure to a rubberlike consistency. Concealed sealant must be the non-hardening type. Seam sealant must be factory-applied, non-skinning, non-drying, and must conform to the roofing manufacturer's recommendations. Silicone-based sealants must not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer.

2.4.5 GASKETS AND INSULATING COMPOUNDS

Nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds must be nonrunning after drying.

2.5 THERMAL INSULATION

Provide rigid insulation as indicated in the Drawings.

2.6 LINER PANELS

Fabricate liner panels of the same material as roof panels, and formed or patterned to prevent waviness and distortion. Liner panels must have a factory applied, one mil thick minimum painted coating on the inside face and a prime coat on the liner side.

2.7 FALL PROTECTION SYSTEM

Provide a new permanent fall protection anchorage, horizontal lifeline, or equivalent protection system conforming to ASSP Z359.1 and 29 CFR 1910.66 App C, and EM 385-1-1. The system shall be designed and installed under the supervision of a qualified person in fall protection as specified in section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and shall be identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time). Exposed structural components and hardware shall be hot dip galvanized or corrosion resistant steel conforming to ASTM A500/A500M, ASTM A36/A36M, or ASTM A182/A182M, as applicable.

PART 3 EXECUTION

Do not install building construction materials that show visible evidence of biological growth.

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

3.2.1 Cementitious Materials

Paint metal surfaces which will be in contact with mortar, concrete, or other masonry materials with one coat of alkali-resistant coating such as heavy-bodied bituminous paint.

3.2.2 Contact with Wood

Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels must be in full and firm contact with attachment clips. Where prefinished panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they must, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened.

3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints except at the

junction of ventilators, curbs, skylights, chimneys, and similar openings. Install flashing to assure positive water drainage away from roof penetrations. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels. Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment must allow roof to move independently of the structure, except at fixed points as indicated.

3.3.2 Insulation Installation

Install between covering and supporting members to present a neat appearance.

3.3.2.1 Rigid or Semi-Rigid Insulation

Install in all areas. Fasten securely without loose joints or unsightly sags.

3.3.3 Flashings

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves and rakes, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weathertightness. Details of installation which are not indicated must be in accordance with the SMACNA 1793, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.4 Flashing Fasteners

Fastener spacings must be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface and to a uniform depth to seat gasketed washers properly and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered. Do not drill through sealant tape. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners must not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

3.3.5 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live

load limits of roof construction.

3.5 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

3.6 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative must be on-site during all roofing system installation work

3.7 COMPLETED WORK

Completed work must be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.8 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.032 inch thick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated.

3.9 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. NAVFAC Specification Number:

4. Deck/Substrate Type:

5. Slopes of Deck/Roof Structure:

6. Insulation Type & Thickness:

7. Insulation Manufacturer:

8. Vapor Retarder: ( )Yes ( )No

9. Vapor Retarder Type:

10. Preformed Steel Standing Seam Roofing Description:

a. Manufacturer (Name, Address, & Phone No.):
b. Product Name: c. Width: d. Gage:
e. Base Metal: f. Method of Attachment:

11. Repair of Color Coating:

a. Coating Manufacturer (Name, Address & Phone No.):
b. Product Name:
c. Surface Preparation:
d. Recoating Formula:
e. Application Method:

12. Statement of Compliance or Exception:_____
_____
_____

13. Date Roof Completed:

14. Warranty Period: From_____ To_____

15. Roofing Contractor (Name & Address):

16. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Inspector's Signature _____ Date:

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
05/10, CHG 1: 08/13

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; do not allow firestopping material to interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	(2022) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E814	(2023a) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E1399/E1399M	(1997; R 2022) Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E1966	(2015; R 2019) Standard Test Method for Fire-Resistive Joint Systems
ASTM E2174	(2020a) Standard Practice for On-Site Inspection of Installed Firestop Systems
ASTM E2307	(2023b) Standard Test Method for

	Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E2393	(2020a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

FM GLOBAL (FM)

FM 4991	(2013) Approval of Firestop Contractors
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code

UNDERWRITERS LABORATORIES (UL)

UL 723	(2020) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1479	(2015; Reprint May 2021) Fire Tests of Through-Penetration Firestops
UL 2079	(2015; Reprint Jul 2020) Tests for Fire Resistance of Building Joint Systems
UL Fire Resistance	(2014) Fire Resistance Directory

1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Locate cast-in-place firestop devices and install in place before concrete placement. Install pipe, conduit or cable bundles through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material must be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping System; G

SD-03 Product Data

Firestopping Materials; G

SD-06 Test Reports

Inspection; G

SD-07 Certificates

Inspector Qualifications

Firestopping Materials

Installer Qualifications; G

1.5 QUALITY ASSURANCE

1.5.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer must be a trained representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. Obtain and submit installer's written certification of training, and retain proof of certification for duration of firestop installation.

1.5.2 Inspector Qualifications

The inspector must have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector must be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector must not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, submit a manufacturer's engineering judgment, derived from similar UL system designs or other tests for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

2.2 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.2.1 Fire Hazard Classification

Provide material that has a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Provide an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.2.2 Toxicity

Provide material that is nontoxic and carcinogen free to humans at all stages of application or during fire conditions and does not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

2.2.3 Fire Resistance Rating

Firestop systems must be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems must also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, must provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Provide fire resistance ratings as follows:

2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

F Rating = Rating of wall or partition being penetrated.

2.2.3.1.2 Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the Ceiling Membrane of Roof-Ceiling Assemblies

F Rating: Where the penetrating item is outside of a wall cavity the F rating must be equal to the fire resistance rating of the floor penetrated, and the T rating must be in accordance with the requirements of ICC IBC.

2.2.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SUMMARY, and gaps such as those between floor slabs and curtain walls must be Provide construction joints and gaps with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Provide curtain wall joints with firestopping materials and systems that have been tested in accordance with ASTM E2307 to meet the required fire resistance rating. Systems installed at construction joints must meet the cycling requirements of ASTM E1399/E1399M or UL 2079. Provide a minimum class II movement capability for all joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. Provide certification of compliance with UL 1479 for all intumescent firestop materials used in through penetration systems.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Cut and remove thermal insulation where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Division 23. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Seal cabling for data and communication applications with re-enterable firestopping products and devices.

3.2.3.1 Re-Enterable Devices

Provide firestopping devices that are pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf at 0 percent to 100 percent visual fill.

3.2.3.2 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts. Allow for cable moves, additions or changes. Provide devices capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

3.3 INSPECTION

For all projects, do not cover or enclose until inspection is complete and approved by the Contracting Officer. The inspector must inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit

written reports indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL listed printed numbers.

Install firestopping manufacturer's label(s) at each firestopped penetration. Labels shall be filled out and include, at the minimum, the UL listed number of the firestopping system, date installed, installer's name (the person doing the installation), and the company's name for whom the installer works.

3.3.1 Inspection Standards

Inspect all firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

3.3.2 Inspection Reports

Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
08/23

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C509	(2006; R 2021) Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C734	(2015; R 2019) Standard Test Method for Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C834	(2017; R 2023) Standard Specification for Latex Sealants
ASTM C919	(2022) Standard Practice for Use of Sealants in Acoustical Applications
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1193	(2016) Standard Guide for Use of Joint Sealants
ASTM C1311	(2022) Standard Specification for Solvent Release Sealants
ASTM C1521	(2019; R 2020) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM D217	(2021a) Standard Test Methods for Cone Penetration of Lubricating Grease
ASTM D1056	(2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1667	(2022) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2452	(2015; R 2019) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D2453	(2015; R 2020; E 2020) Standard Test

	Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants; G

Primers; G

Bond Breakers; G

Backstops; G

Caulking; G

Cleaning Solvents; G

SD-06 Test Reports

Field Adhesion; G

SD-07 Certificates

Indoor Air Quality For Interior Sealants

Indoor Air Quality For Interior Caulking

1.3 PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories. Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.4.1.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.6 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed shipping containers, with brand name, date of manufacture, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subjection to sustained temperatures exceeding 90 degrees F or lower than 0 degrees F. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

1.7 QUALITY ASSURANCE

1.7.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

1.7.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.7.3 Mock-Up

Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

1.7.4 Adhesion

Provide in accordance with ASTM C1193 or ASTM C1521.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant products that have been tested, found suitable, and documented as such by the manufacturer for the particular substrates to which they will be applied.

In areas with ambient temperatures that exceed 110 degrees F, do not use polybutene, bituminous, acrylic-latex, polyvinyl acetate latex sealants, polychloroprene (neoprene), polyvinyl chloride (PVC), and polyurethane foams, and neoprene, PVC, and styrene butadiene rubber extruded seals and closure strips due to these materials having maximum recommended surface temperature ranges from 130 to 180 degrees F.

2.1.1 Interior Sealants

Provide ASTM C834 ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following (Note, color "as selected" refers to manufacturer's full range of color options):

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface mounted equipment and fixtures, and similar items.	Match adjacent surface color.
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Match adjacent surface color.
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	N.A.
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	N.A.
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	White - paintable.
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where non-planar tile surfaces meet.	Match grout color.

LOCATION	COLOR
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	Match grout color.
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	White - paintable.

2.1.2 Exterior Sealants

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows (Note, color "as selected" refers to manufacturer's full range of color options):

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Joints between new and existing exterior masonry walls.	N.A.
c. Masonry joints where shelf angles occur.	Match adjacent surface color.
d. Joints in wash surfaces of stonework.	N.A.
e. Expansion and control joints.	Match grout color in masonry. Match adjacent surface color.
f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color.
g. Voids where items pass through exterior walls.	Match adjacent surface color.
h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match grout color.

LOCATION	COLOR
i. Metal-to-metal joints where sealant is indicated or specified.	Match metal color.
j. Joints between ends of gravel stops, fascia, copings, and adjacent walls.	Match adjacent wall surface color.

2.1.3 Floor Joint Sealants

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide location(s) and color(s) of sealant as follows (Note, color "as selected" refers to manufacturer's full range of color options):

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Gray
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Match adjacent surface color.

2.1.4 Acoustical Sealants

Rubber or polymer based acoustical sealant in accordance with ASTM C919 to have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Provide non-staining acoustical sealant with a consistency of 250 to 310 when tested in accordance with ASTM D217. Acoustical sealant must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168.

2.1.5 Preformed Sealants

Provide preformed sealants of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealants capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, sealants must be non-bleeding and have no loss of adhesion.

2.1.5.1 Tape

Tape sealant: Provide cross section dimensions of required width.

2.1.5.2 Bead

Bead sealant: Provide cross section dimensions of required width.

2.1.5.3 Foam Strip

Provide foam strip of polyurethane foam with cross section dimensions of required width. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed in accordance with manufacturer's printed instructions. Service temperature must be minus 40 to plus 275 degrees F. Install untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed onto adjacent finishes. Saturate treated strips with butylene waterproofing or impregnate with asphalt.

2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph INTERIOR SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph INTERIOR SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Rubber

Provide in accordance with ASTM D1056, Type 1, open cell, or Type 2, closed cell, Class A typical and Class B where petroleum oil or fuel resistance is required, Grade (as recommended by Manufacturer for intended use), round cross section for cellular rubber sponge backing.

2.4.2 PVC

Provide in accordance with ASTM D1667, Grade VO 12, open-cell foam, round cross section for polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Provide in accordance with ASTM C509, Option I, Type I preformed rods or tubes for synthetic rubber backing.

2.4.4 Neoprene

Provide in accordance with ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 open cell neoprene sponge Type 1, Class C, Grade

1C3 for neoprene backing.

2.4.5 Butyl Rubber Based

Provide in accordance with ASTM C1311, from a single component, with solvent release. color as selected from manufacturer's full range of color choices.

2.4.6 Silicone Rubber Base

Provide in accordance with ASTM C920, from a single component, with solvent release, Non-sag, Type 'S', Grade 'NS', Class 25. Color as selected from manufacturer's full range of color choices.

2.5 CAULKING

For interior use and only where there is little or no anticipated joint movement. Provide in accordance with ASTM D2452 and ASTM D2453, Type 'S', for oil and resin-based caulking. Provide products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum and bronze surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph INTERIOR SEALANTS above.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions and ASTM C1193, Method A or ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken.

3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical

or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

3.2.4 Wood Surfaces

Ensure wood surfaces that will be in contact with sealants are free of splinters, sawdust and other loose particles.

3.2.5 Removing Existing Hazardous Sealants

For sealants applied prior to 1979, or that have been tested and found to contain polychlorinated biphenyls (PCBs), remove and dispose of these sealants in accordance with Division 02 Existing Conditions.

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 1 inch	1/2 inch	5/8 inch
Over 1 inch	prohibited	

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.

3.4.2 Unacceptable Sealant Use

Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories, or to close gaps between walls, floors, roofs, windows, and doors, that exceed acceptable installation tolerances. Remove sealants that have been used in an unacceptable manner and correct building enclosure deficiencies to comply with contract documents requirements.

3.4.3 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant smears. Remove masking tape within 10 minutes of joint filling and tooling.

3.4.4 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

3.4.5 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

3.4.6 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

3.4.7 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so

as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.

3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's printed instructions. Allow excess sealant to cure for 24 hours then remove by wire brushing or sanding. Remove resulting debris.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C578	(2022) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2022) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM D2863	(2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	(2016) Hardware Preparation in Steel Doors and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2022) Standard for Fire Doors and Other Opening Protectives
NFPA 252	(2022) Standard Methods of Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2009) Recommended Details for Standard Steel Doors, Frames, and Accessories and Related Components
SDI/DOOR 113	(2013; R2018) Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.4	(2018) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
SDI/DOOR A250.6	(2015) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	(2017) Specifications for Standard Steel Doors and Frames
SDI/DOOR A250.11	(2012) Recommended Erection Instructions for Steel Frames

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 10C	(2016; Reprint May 2021) UL Standard for Safety Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Schedule of Doors; G

Schedule of Frames; G

SD-03 Product Data

Doors; G

Frames; G

Accessories

SD-04 Samples

Hot-Dip Zinc-Coated and Factory-Primed Finish; G

Submit manufacturer's standard colors and patterns for selection by DOR. Submit not less than two 1'-0" square samples for review.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00 DOOR HARDWARE. Undercut where indicated. Provide exterior doors with top edge closed flush and sealed to prevent water intrusion. Provide doors at 1-3/4 inch thick, unless otherwise indicated. Provide door material that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel door product. Exterior doors must be tested in accordance with Standard 10 to meet requirements of UFC 4-010-01.

Exterior door glazing shall be in accordance with Standard 10 of UFC 4-010-01 "DoD Minimum Antiterrorism Standard for Buildings."

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 1, with core construction as required by the manufacturer for interior doors, of size(s) and design(s) indicated including Schedule STC acoustic ratings. Provide Level 2 typical at all locations.

2.1.1.2 Extra Heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for interior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners must be filled with board insulation.

2.1.1.3 Maximum Duty Doors

SDI/DOOR A250.8, Level 4, physical performance Level A, Model 1 with core construction as required by the manufacturer for indicated exterior doors, of size(s) and design(s) indicated including Schedule "U" insulation value.

2.2 INSULATED STEEL DOOR SYSTEMS

Provide insulated steel doors and frames in accordance with SDI/DOOR 113 at entrances to dwelling units and where indicated. Meet energy requirements including Solar Heat Gain Coefficient (SHGC) and U-factor. Provide insulated steel doors with a core of polyurethane foam; face sheets, edges, and frames of galvanized steel not lighter than 23 gage, 16 gage, and 16 gage respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Provide to doors and frames a phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Test doors in accordance with SDI/DOOR A250.4 and meet the requirements for Level C. Prepare doors to receive specified hardware. Provide doors 1-3/4 inch thick.

2.3 ACCESSORIES

2.3.1 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors.

2.4 INSULATION CORES

Provide insulating cores at all exterior doors and other specific doors noted in the door schedule, and provide an apparent U-factor of.48 in accordance with SDI/DOOR 113 and conforming to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

2.5 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 2, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, transoms, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated. Provide frame product that uses a minimum of 25 percent recycled content.

2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.5.2 Mullions and Transom Bars

Provide mullions and transom bars of closed or tubular construction with heads and jambs butt-welded together or knock-down for field assembly. Bottom of door mullions must have adjustable floor anchors and spreader connections.

2.5.3 Stops and Beads

Provide form and loose stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.5.4 Terminated Stops

Where indicated, terminate interior door frame stops 6 inch above floor. Do not terminate stops of frames for soundproof, doors.

2.5.5 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.5.6 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated not lighter than 18 gage.

2.5.6.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111.

2.5.6.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.6 FIRE DOORS AND FRAMES

Where indicated provide fire doors and frames in accordance with NFPA 80 and this specification. Include insulated core materials in fire doors where indicated in the door schedule.

2.6.1 Labels

Provide fire doors and frames bearing the label of Underwriters

Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing must be in accordance with NFPA 252 or UL 10C. Provide labels that are metal with raised letters, bearing the name or file number of the door and frame manufacturer. Labels must be permanently affixed at the factory to frames and to the hinge edge of the door. Do not paint door and labels.

2.6.2 Astragal on Fire Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.

2.7 EXTERIOR FRAMES

Provide thermal insulation in all exterior frames. Provide frames of a minimum Level 4, with frames of a minimum thickness of 0.067 inch, 14 gage.

2.8 HARDWARE PREPARATION

Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Punch door frames, with the exception of frames that will have weatherstripping or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.9 FINISHES

2.9.1 Factory-Primed Finish

Thoroughly clean all surfaces of doors and frames then chemically treat and factory prime with a rust inhibiting coating as specified in SDI/DOOR A250.8, or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.9.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924M and ASTM A653/A653M. The coating weight must meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

2.10 FABRICATION AND WORKMANSHIP

Provide finished doors and frames that are strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Provide molded members that are clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints must be well formed and in true alignment. Conceal fastenings where practicable.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08 22 20

FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES
11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2010) Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2344/D2344M	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure

	Differences Across the Specimen
ASTM E331	(2000; R 2023) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E2074	(2000e1) Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
ASTM E2112	(2023) Standard Practice for Installation of Exterior Windows, Doors and Skylights

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	(2016) Hardware Preparation in Steel Doors and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2022) Standard for Fire Doors and Other Opening Protectives
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 241	(2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2014) Fire Resistance Directory

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meeting

Within 30 days of Contract Award, the Contracting Officer will schedule a Pre-Installation meeting. For that meeting, submit the following Shop Drawings for review and approval:

a. Doors

b. Frames

c. Door Hardware Components and Accessories

d. Weather-stripping

e. Smoke Seals

Include fabrication, installation details, schedule and location for doors, frames, hardware components and accessories, showing plans, elevations, sections, details, method of glazing within the door, construction and installation attachments to other work.

Submit manufacturer's catalog data, including material descriptions for doors, frames, and accessories, dimensions of individual components and profiles, and finishes for each type of door, frame, hardware components and accessories of size, design, and location indicated.

Submit documentation substantiating that the items provided within this section are from a manufacturer having a minimum of 10 years experience in the design and manufacture of similar products and systems.

Submit a Sample Warranty.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G
Frames; G
Door Hardware Components and Accessories; G
Weather-stripping; G
Smoke Seals; G

SD-03 Product Data

Doors; G
Frames; G
Door Hardware Components and Accessories; G
Weather-stripping; G
Smoke Seals; G
Thresholds; G
Fire Resistance Rating for Doors and Frames; G

SD-04 Samples

Product Samples; G

SD-07 Certificates

Sample Warranty; G
Warranty; G

1.4 QUALITY CONTROL

1.4.1 Product Samples

Submit two sets of color chips representing specified colors and finishes.

Submit samples of each type, consisting of FRP door corner construction,

minimum 6 inch by 6 inch legs.

Where color or texture variations are anticipated, such as anodized finishes, include two or more units in each set of samples indicating extreme limits of variations.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver FRP doors, frames, components and accessories in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage.

Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.

Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry.

Do not store materials outdoors unless approved by the Contracting Officer. Completely cover materials stored outdoors, with waterproof canvas protective covering. Tie covering securely to pallets to ensure complete weatherproofing is met. Provide sufficient ventilation to prevent condensation. Do not use polyethylene sheet as a covering.

Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

1.5.3 Handling

Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Existing Conditions

Take Field measurements prior to the preparation of drawings and fabrication.

1.7 WARRANTY

Submit sample material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard manufacturer warranty as required to comply with the specified requirements.

Furnish the manufacturer's 5 year no dollar limit for materials and installation, workmanship, and deterioration of factory-applied finishes

within specified warranty period. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the work.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide door and frame components including, but not limited to, astragals, cores, faces, stiles, rails, heads, jambs, and internal reinforcement, which are FRP structural shapes manufactured by the pultrusion process. Ensure all structural shapes are composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements in accordance with ASCE 7-16, and dimensions specified.

Ensure fiberglass reinforcements are a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

Verify resins are of isophthalic polyester with chemical formulation necessary for corrosion resistance, strength and other physical properties as required.

2.1.1 Design Requirements

2.1.1.1 Finish Surfaces

Ensure all finished surfaces of FRP items and fabrications are smooth, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to wear or weathering. All stiles, rails, heads, jambs, and internal reinforcement are to be integrally pigmented yellow .

2.1.1.2 Ultraviolet Protection

Provide documentation that all pultruded structural shapes are further protected from ultraviolet (UV) attack with:

a. Integral UV inhibitors within the resin

b. Synthetic surfacing veil to help produce a resin rich surface

c. UV resistant coating for outdoor exposures.

2.1.1.3 Flame Spread Rating

All FRP products to have a flame spread rating of 25 or less as per ASTM E84 Tunnel Test.

2.1.1.4 Structural Properties

Meet minimum longitudinal structural properties with structural shapes in the door and frame system as follows:

Tensile Strength	ASTM D638	30,000 psi
Compressive Strength	ASTM D695	30,000 psi
Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1,600,000 psi
Short Beam Shear	ASTM D2344/D2344M	4,500 psi
Impact, Notched	ASTM D256	25 ft-lb/in
Thermal Expansion	ASTM D696	.000008 in/in/F
Fire Resistance	ASTM E84	Class I

2.1.1.5 Fire Resistance Rating for Doors and Frames

Provide complete swing-type FRP doors with frames of the size, design and location indicated, including but not limited to, framing members, subframes,transom, door light, trim, and accessories.

Provide complete door hardware schedule, design and location as specified in specification Section 08 71 00 DOOR HARDWARE .

a. FRP Door

Provide and install a seamless press-molded constructed FRP door. Laminate FRP face sheets to be applied while wet and uncured to an internal door stile and rail subframe/core assembly which is pressure molded under heat. Integrally fuse the composite door panel over the entire surface area, do not adhesive-bond at the perimeter stile and rail.

Provide door stiles and rails which are high-modulus pultruded FRP square or rectangular tube subframe. Miter and join tubes internally at the corners with solid polymer blocks to yield a one piece unit. Provide a mid-rail tube across the width of the door at lockset height and additional horizontal rails where specified. Chemically weld all connections. No mechanical fastening at the tube joints is permitted.

Provide a triangular shaped 3/8 inch phenolic resin impregnated kraft paper honeycomb cell core for maximum rigidity and compressive strength. Use of polyurethane foam or balsa wood cores are not permitted.

Provide internal reinforcement composed of high-modulus pultruded tubular FRP or high-density polymer compression blocks at all hardware and corner locations. No aluminum, steel, or wood blocking for reinforcement is permitted. A minimum pull-out force strength of 900 pounds per screw is required for all hinge locations.

Door faces are to utilize a chemical resistant thermosetting polyester resin with fiberglass reinforcing layers. Provide structural reinforcement which is knitted multi-layer material with layers of unidirectional fiberglass orientated in both vertical and horizontal directions for high stiffness, impact and warp resistance. Furnish door faces as indicated by the door elevation drawings.

Ensure the exposed finish of the FRP door faces are to be an ultra-violet light stabilized marine grade Neopentyl Glychol (NPG)-isophthalic polyester gelcoat integrally molded to a 25/30 mil wet thickness.

Provide an integral heavy pultruded FRP astragal on the stile edge of the inactive leaf for double doors of the same materials as specified for door stiles and rails.

Cutouts for door lights and louvers are to be manufactured and not field fabricated. Cutouts are to be totally enclosed by internal pultruded FRP stiles and rails as specified and incorporated into the door subframe with the opening completely fused to both door faces.

b. FRP Frame

Provide FRP Door Frame utilizing a high-modulus pultruded structural FRP shape. Fabricate pultruded frame with a wall thickness of not less than 3/16 inch. Frames are to be one piece factory constructed with molded stop. Jambs and header to utilize miter corner connections chemically welded with FRP material ground for a visibly smooth frame face. Post and beam or mechanical fastened corners and joints are not acceptable. Provide sizes and shapes as detailed on the approved drawings.

Provide hardware reinforcement connections utilizing a chemical weld with FRP material at required locations. A minimum pull-out force strength of 1,100 lbs per screw is required for all hardware locations.

Frame finish is to be identical to door color and finish.

2.1.1.6 Fire-Rated Labeled FRP Door

Provide a Fire-Rated Door Assembly as indicated complying with NFPA 80 and UL Fire Resistance that are listed and labeled by a qualified testing agency , for the fire-protection ratings indicated in the door and frame schedule. Base the door testing at positive pressure according to ASTM E2074 . Provide certification for Oversized Fire-Rated Door Assembly units exceeding the size of tested assemblies, by a qualified testing agency, that the door complies with standard construction requirements for tested and labeled fire-rated door assemblies except for the size. Ensure door labels are permanently affixed at the factory to the hinge edge of the door and do not paint.

Provide and install a seamless press-molded constructed FRP door. Laminate FRP face sheets to be applied while wet and uncured to an internal door stile and rail subframe/core assembly which is pressure molded under heat. Integrally fuse the composite door panel over the entire surface area; do not adhesive-bond at the perimeter stile and rail.

Ensure door is provided with a fire resistant mineral core for maximum rigidity and compressive strength. Molding pressure and resin gel time are to be sufficient to allow for full penetration of resin into the cellular structure of the core to maximize shear and peel strengths at the door faces and core to reduce the possibility of delamination. Verify that the mineral core has been completely enclosed with an intumescent and FRP laminated edge perimeter, with the intumescent molded into the FRP door structure with a minimum 1/8 inch thick perimeter FRP edge banding prior to machining. Only Category A type door construction is permitted. Category B type construction with exposed edge intumescent components or products is prohibited.

Hardware reinforcement to be high-modulus pultruded tubular FRP or high-density polymer compressions blocks at all hardware and corner locations. No aluminum, steel, or wood blocking for reinforcement is permitted. A minimum pull-out force strength of 1,100 lbs per screw is required for all hinge locations.

Door faces are to utilize a chemical resistant thermosetting polyester resin formulated for the specified environment with a maximum flame spread of 25 in accordance with ASTM E84, and self-extinguishing in accordance with ASTM D635 with fiberglass reinforcing layers. Provide structural reinforcement of knitted multi-layer material with layers of unidirectional fiberglass orientated in both vertical and horizontal directions for high stiffness, impact and warp resistance. Furnish door faces as indicated by the door elevation drawings.

Ensure the exposed finish of the FRP door faces with an ultra-violet light stabilized marine grade Neopentyl Glychol (NPG)-isophthalic polyester gelcoat integrally molded to a 25/30 mil wet thickness.

Provide an integral heavy pultruded FRP astragal on the stile edge of the inactive leaf for double doors of the same materials as specified for door stiles and rails.

2.1.1.7 Fire Rated Labeled FRP Frame

Provide a Fire-Rated Door Frame as indicated complying with NFPA 80 that are listed and labeled by a qualified testing agency , for the fire-protection ratings indicated in the door and frame schedule. Permanently affix frame labels, at the factory, to the hinge side of the door jamb. Do not paint.

Provide a Fire-Rated Door Frame utilizing a high-modulus pultruded structural FRP shape. Fabricate pultruded frame with a wall thickness of not less than 3/16 inch. Provide one piece factory constructed frames with molded stop. Utilize miter corner door jambs and header connections chemically welded with FRP material ground for a visibly smooth frame face. Post and beam or mechanical fastened corners and joints are not acceptable. Provide sizes and shapes to be as detailed on the approved drawings.

Provide a minimum density of 25 pounds per cubic foot fire resistant composite formulated core for the specified environment with a maximum flame spread of 25 in accordance with ASTM E84, and self-extinguishing as per ASTM D635.

Frame finish is to be identical to door color and finish.

2.1.1.8 Frame Anchors

Provide anchorage devices and fasteners where necessary for fastening fabricated FRP door frame to the adjacent construction-in-place as recommended by the FRP frame manufacturer.

2.1.1.9 Jamb Anchors

Provide anchors of the material, type, number, and spacing as required by the FRP frame manufacturer.

2.1.1.10 Hardware Preparation

Provide hardware reinforcing as specified. Prepare doors and frames for hardware in accordance with the applicable requirements of the FRP door and frame manufacturer. For additional requirements refer to ANSI/BHMA A156.115.

Provide door hardware components and accessories as indicated on the drawings, including weather-stripping, smoke seals,and thresholds.

2.1.2 Performance Requirements

2.1.2.1 Air Infiltration

When tested in accordance with ASTM E283, air infiltration cannot to exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot 50 mile per hour wind.

2.1.2.2 Water Penetration

When tested in accordance with ASTM E331, no water penetration is allowed, at a pressure of 8 pounds per square foot of fixed area.

2.1.2.3 Provisions for Thermal Movement

Design doors and frames to provide for expansion and contraction of the component parts caused by an ambient temperature range of 0 to 100 degrees F causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

PART 3 EXECUTION

3.1 INSTALLATION

Conform all work to the requirements of 29 CFR 1910, 29 CFR 1926,and NFPA 241.

3.1.1 FRP Frame

Set FRP door frame plumb and true, aligned, and secured with the adjacent construction-in-place, in conformance with ASTM E2112. Anchor frame as specified and in accordance with the FRP door manufacturer's requirements.

Installation Tolerances

a. Squareness: Plus or minus 1/16 inch, measure at the door rabbet on a line 90 degrees from the jamb perpendicular to the frame head.

b. Alignment: Plus or minus 1/16 inch, measure at the jamb on a horizontal line parallel to the wall plane.

c. Twist: Plus or minus 1/16 inch, measure at the opposite face corners of the jambs on parallel lines, and perpendicular to the wall plane.

d. Plumb and True: Plus or minus 1/16 inch, measure at the jambs to the floor.

3.1.2 FRP Door

Fit and hang door in accordance with clearances specified below:

Clearance Tolerances

a. Jambs and Head: Plus 1/8 inch or minus 1/16 inch.

b. Pairs of Doors: Plus 1/8 inch or minus 1/16 inch.

c. Bottom of Door and Top of Threshold: Maximum 3/8 inch.

d. Bottom of Door and Top of finish floor (No Threshold: Maximum 3/4 inch.

3.1.3 Labeled Door and Frame

Install fire-rated door and frame, including hardware, in accordance with NFPA 101 .

3.2 ADJUSTING AND CLEANING

Check and re-adjust all operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including all FRP that is warped, bowed, or otherwise unacceptable to the Contracting Officer.

3.3 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to final completion and acceptance of the project or replace with new, as directed by the Contracting Officer. Thoroughly clean all surfaces of the door and frame prior to final completion and acceptance of the project.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Warranty

Submit the approved Warranty made out to the Government, to the Contracting Officer no later than 10 days prior to final inspection.

-- End of Section --

SECTION 08 33 23

OVERHEAD COILING DOORS
08/20, CHG 1: 02/22

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2021) Fundamentals Handbook, I-P Edition

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B29.400	(2001; (R 2008) (R 2013) (R 2018) (R 2023)) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	(2023) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip

	Galvanized Coatings
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E330/E330M	(2014; R 2021) Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM F568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)

ANSI/DASMA 108	(2017) Standard Method for Testing Sectional Garage Doors, Rolling Doors and Flexible Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 1	(2021) Motors and Generators
NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 325	(2017; Reprint Feb 2020) UL Standard for Safety Door, Drapery, Gate, Louver, and Window Operators and Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overhead Coiling Doors

Electric Door Operators

Bottom Bars

Guides

Mounting Brackets

Hood

Installation Drawings

SD-03 Product Data

Overhead Coiling Doors

Hardware

Electric Door Operators

SD-05 Design Data

Overhead Coiling Doors

Hardware

Electric Door Operators

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Warranty

1.3 QUALITY CONTROL

1.3.1 Warranty

Furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two years after completion and acceptance of the project.

Warrant that upon notification by the Government, any defects in material, workmanship, and door operation are immediately correct within the same time period covered by the guarantee, at no cost to the Government.

1.3.2 Operation And Maintenance Submittals

Submit 6 copies of the operation and maintenance manuals 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to cContract completion.

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

Electric Door Operators
Hood

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, operating procedures, and safety precautions.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in an adequately ventilated dry location that is free from dirt and dust, water, or other contaminants. Store in a manner that permits easy access for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide overhead coiling doors with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated. Doors must be spring counterbalanced, rolling type, and designed for use on exterior or interior openings, as indicated. Doors must be operated by electric-power with auxiliary hand chain operation. Doors to be surface-mounted type with guides at jambs set back a sufficient distance to provide a clear opening when door is in open position. Mount exterior doors as indicated.

2.1.1 Design Requirements

2.1.1.1 Door Detail Shop Drawings

Provide installation drawings for door assemblies which show: elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Show locations of replaceable fusible links on wiring diagrams for power, signal and controls. For motor-operated doors include supporting brackets for motors, location, type, and ratings of motors, and safety devices. Include a schedule showing the location of each door with the drawings.

2.1.2 Performance Requirements

2.1.2.1 Wind Loading

Design and fabricate door assembly to withstand the site-specific wind

loading pressure of pounds per square foot in accordace with ANSI/DASMA 108. Refer to Design Criteria and Components and Cladding Wind Pressures Schedule on the Structural Drawings. Provide test data showing compliance with ASTM E330/E330M. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested. Ensure that the complete assembly meets or exceeds the requirements of ASCE 7-16.

2.1.2.2 Operational Cycle Life

Design all portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

2.2 COMPONENTS

2.2.1 Overhead Coiling Doors

2.2.1.1 Curtain Materials and Construction

Provide curtain slats fabricated from Grade A steel sheets conforming to ASTM A653/A653M, with the additional requirement of a minimum yield point of 33,000 psi. Provide 20 gauge sheets, Grade 40 steel with galvanized steel zinc coating in conformance with ASTM A653/A653M and ASTM A924/A924M. Provide steel curtain slats containing a minimum of 20 percent recycled content. Submit data identifying percentage of recycled content for steel curtain slats.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Ensure the provided slats are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation, complying with the maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose the insulation completely within the slat faces on the interior surface of the slats.

Finish coating of door slats shall be factory applied manufacturer's premium finish (fusion bonded epoxy coating) for enhanced durability. Color as indicated on drawings, or, if not otherwise indicated, as selected from manufacturers' full range of standard available colors.

2.2.1.2 Insulated Curtains

Form curtains from manufacturer's standard shapes of interlocking slats. Supply a slat system with a minimum R-value of 4 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a core not less than 11/16 inch thick, completely enclosed within metal facings. Slat steel thickness as required by the size of the door to meet specified performance requirements. The insulated slat assembly requires a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E84.

2.2.1.3 Curtain Bottom Bar

Install curtain bottom bars as pairs of angles or using extrusions from the manufacturer's standard steel, stainless and aluminum extrusions not less

than 2.0 by 2.0 inches by 0.188 inch. Do not use aluminum on doors more than 16 feet wide. Ensure steel extrusions conform to ASTM A36/A36M. Stainless steel extrusions conforming to ASTM A666, Type 304. Aluminum extrusions conforming to ASTM B221. Galvanize angles and fasteners in accordance with ASTM A653/A653M and ASTM A924/A924M. Coat welds and abrasions with paint conforming to ASTM A780/A780M.

2.2.1.4 Vision Lites

Where indicate, provide complete manufacturer's standard vision panels assembly consisting of clear acrylic glazing panels.

2.2.1.5 Endlocks (and Windlocks)

Provide endlocks of Grade B cast steel conforming to ASTM A47/A47M, galvanized in accordance with ASTM A153/A153M. Secure locks at every other curtain slat. In addition to endlocks, exterior doors which are more than 16 feet wide or which have a design wind load of more than 20 pounds per square foot, must have windlocks of manufacturer's standard design. Windlocks must prevent curtain from leaving guide because of deflection from wind pressure or other forces.

2.2.1.6 Weather Stripping

Provide a hood baffle inside the hood that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber or equivalent. Provide guide weather stripping that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber, or equivalent.

Provide bottom bar weather-stripping that is a minimum 1/16 inch thick sheet of vinyl, neoprene rubber, or equivalent.

2.2.1.7 Locking Devices

Ensure that the slide bolt engages through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

Provide a locking device assembly which includes cylinder lock, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.2.1.8 Safety Interlock

Equip power-operated doors with a safety interlock switch to disengage power supply when the door is locked, or provide an operator with an internal lock sensing device to prevent the door opening when the door is locked.

2.2.2 Hardware

Ensure that all hardware conforms to ASTM A153/A153M, ASTM A307, and ASTM F568M.

2.2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated. Provide guides with sufficient depth or incorporate a steel locking bar to retain the curtain in place under the wind pressure

specified. Ensure curtain operates smoothly. Slot bolt holes for track adjustment. Securely attach guides to adjoining construction with not less than 3/8 inch diameter bolts, spaced near each end and not over 30 inches apart.

Ensure guides are roll-formed steel channel bolted to angle or structural grade, three angle assembly of steel to form a slot of sufficient depth to retain curtains in guides to achieve 20 psf windload standard. Guides may be provided with integral windlock bars and removable bottom bar stops.

Fabricate with structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Flare the top of inner and outer guide angles outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.

2.2.2.2 Hood

Provide a hood with a minimum 24-gauge sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. The hood encloses the curtain coil and counterbalance mechanism.

Hoods for openings more than 12 feet in width must have intermediate support brackets to prevent excessive sag. Provide a weather baffle at the lintel or inside the hood of each exterior door.

2.2.3 Counterbalancing Mechanism

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted, around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.2.4 Electric Door Operators

Provide electrical wiring and door operating controls conforming to the applicable requirements of NFPA 70 and UL 325. The door manufacturer must furnish automatic control and safety devices, including extra flexible type SO cable and spring-loaded automatic takeup reel or equivalent device, as required for proper operation of the doors. Conduit, wiring, and mounting of controls are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70, must be specifically approved by Underwriters Laboratories or an independent testing agency using equivalent standards, for the particular chemical group and the class and division of hazardous location involved.

Electric door-operator assemblies need to be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Furnish complete assemblies with electric motors and factory-prewired motor controls, starter, gear reduction units, solenoid-operated brakes, clutch, remote-control stations, manual or automatic control devices, and accessories as required for proper operation of the doors.

Design the operators so that motors may be removed without disturbing the limit-switch adjustment and affecting the emergency auxiliary operators.

Provide a manual operator of crank-gear or chain-gear mechanisms with a release clutch to permit manual operation of doors in case of power failure. Arrange the emergency manual operator so that it may be put into and out of operation from floor level, and its use does not affect the adjustment of the limit switches. Provide an electrical or mechanical device that automatically disconnects the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.2.4.1 Door-Operator Types

Option 1: Provide an operator mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

Option 2: Provide an operator mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

Option 3: Provide an operator mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.

2.2.4.2 Electric Motors

Provide motors which are the high-starting-torque, reversible, constant-duty electrical type with overload protection of sufficient torque and horsepower to move the door in either direction from any position. Ensure they produce a door-travel speed of not less than 8 nor more than 12 inches per second without exceeding the horsepower rating.

Provide motors which conform to NEMA MG 1 designation, temperature rating, service factor, enclosure type, and efficiency to the requirements specified. Motors must be suitable for operation on current of the characteristics indicated. Install motors in approved locations.

2.2.4.3 Motor Bearings

Select bearings with bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Pre-lubricate and factory seal bearings in motors less than 1/2 horsepower.

Equip motors coupled to worm-gear reduction units with either ball or roller bearings.

Equip bearings in motors 1/2 horsepower or larger with lubrication service fittings. Fit lubrication fittings with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods do not need to be lubricated for a given number of operating hours. Display this information on an appropriate tag or label on the motor with instructions for lubrication cycle maintenance.

2.2.4.4 Motor Starters, Controls, and Enclosures

Provide each door motor with: a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 24-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein. Ensure control equipment conforms to NEMA ICS 1 and NEMA ICS 2.

Provide adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position.

2.2.4.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for NEMA Type 4X.

2.2.4.6 Transformer

Provide starters with 230/460 to 115 volt control transformers with one secondary fuse when required to reduce the voltage on control circuits to 24volts or less. Provide a transformer conforming to NEMA ST 1.

2.2.4.7 Sensing-Edge Device

Provide each door with a pneumatic or electric sensing device that meets UL 325, extends the full width of the door, and is located within a U-section neoprene or rubber astragal, mounted on the bottom rail of the bottom door section. Device needs to immediately stop and reverse the door upon contact with an obstruction in the door opening or upon failure of the device or any component of the control system and cause the door to return to its user-defined open position. Any momentary door-closing circuit must be automatically locked out and the door must be operable manually or with constant pressure controls until the failure or damage has been corrected. A sensing device is not a substitute for a limit switch.

Connect sensing device to the control circuit through a retracting cord and reel.

2.2.4.8 Remote-Control Stations

Remote control stations must be at least 5 feet above the floor line, and all switches must be located so that the operator will have complete visibility of the door at all times. Provide interior remote control stations that are full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Mark buttons "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons must be of the type requiring only momentary pressure to operate. The "CLOSE" button must be of the type either requiring constant pressure to maintain the closing motion of the door or momentary pressure when installed with a monitored entrapment detection device which, upon failure of the device or any component of the control system, cause the door to return to its full open position. When the door is in motion and the "STOP" button is pressed, ensure the door stops instantly and remains in the stopped position. From the stopped position, the door may then be operated in either direction by the "OPEN" or "CLOSE" buttons. When the door is in motion, and the "CLOSE" button of the constant pressure type is released, the door must stop and remain in the stop position or reverse to the user set up position; from the stop position, the door may then be operated in either direction by the

"OPEN" or "CLOSE" buttons. Controls must be adjustable to automatically stop the doors at their fully open and closed positions. Open and closed positions must be readily adjustable.

Provide exterior control stations that are full-guarded, momentary-contact three-button standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosures, key-operated, with the same operating functions as specified herein for interior remote-control stations.

2.2.4.9 Speed-Reduction Units

Provide speed-reduction units consisting of hardened-steel worm and bronze worm gear assemblies or planetary gear reducers running in oil or grease and inside a sealed casing, coupled to the motor through a flexible coupling. Drive shafts need to rotate on ball- or roller-bearing assemblies that are integral with the unit.

Provide minimum ratings of speed reduction units in accordance with AGMA provisions for class of service.

Ground worm gears to provide accurate thread form; machine teeth for all other types of gearing. Surface harden all gears.

Provide antifriction type bearings equipped with oil seals.

2.2.4.10 Chain Drives

Provide roller chains that are a power-transmission series steel roller type conforming to ASME B29.400, with a minimum safety factor of 10 times the design load.

Heat-treat or otherwise harden roller-chain side bars, rollers, pins, and bushings.

Provide high-carbon steel chain sprockets with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.2.4.11 Brakes

Provide 360-degree shoe brakes or shoe and drum brakes. Ensure the brakes are solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.2.4.12 Clutches

Ensure clutches are friction type or adjustable centrifugal type.

2.2.4.13 Weather/Smoke Seal Sensing Edge

Provide automatic stop control by an automatic sensing switch within neoprene astragal extending the full width of door bottom bar.

Provide an electric sensing edge device. Ensure the door immediately stops downward travel when contact occurs before door fully closes. Provide a self-monitoring sensing edge connection to the motor operator.

2.2.5 Surface Finishing

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal

Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.2.5.1 Baked-Enamel or Powder-Coat Finish

Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with the coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 EXECUTION

3.1 INSTALLATION

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, ensure doors are free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the Contract Documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.2 ADJUSTING AND CLEANING

3.2.1 Acceptance Provisions

After installation, adjust the hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide a weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to the manufacturer's written instructions.

Test the door opening and closing operation when activated by controls system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset the door-closing mechanism after a successful test.

Test and make final adjustment of new doors at no additional cost to the Government.

3.2.1.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, examine, lubricate, test, and re-adjust doors as required for proper operation.

3.2.1.2 Cleaning

Clean doors in accordance with manufacturer's approved instructions.

-- End of Section --

SECTION 08 51 13

ALUMINUM WINDOWS
05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 611	(2014) Voluntary Specification for Anodized Architectural Aluminum
AAMA 907	(2015) Voluntary Specification for Corrosion Resistant Coatings on Carbon Steel Components Used in Windows, Doors and Skylights
AAMA 1503	(2009) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA/WDMA/CSA 101/I.S.2/A440	(2017) North American Fenestration Standard/Specification for Windows, Doors, and Skylights

ASTM INTERNATIONAL (ASTM)

ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E413	(2022) Classification for Rating Sound Insulation
ASTM E1332	(2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation
ASTM F2248	(2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows; G

Fabrication Drawings; G

SD-03 Product Data

Windows

Hardware

Fasteners

Accessories

Adhesives

SD-10 Operation and Maintenance Data

Windows; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Plastic Identification

1.3 QUALITY ASSURANCE

1.3.1 Qualification of Manufacturer

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of 10 years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.3.2 Shop Drawing Requirements

Take field measurements prior to preparation of drawings and fabrications. Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weatherstripping, method of attaching screens, installation details, and other related items.

1.3.3 Sample Requirements

1.3.3.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.4 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.5 PLASTIC IDENTIFICATION

Label plastic products provided to indicate their polymeric composition according to the following list. Where products are not labeled, provide product data indicating polymeric information in Operation and Maintenance Manual.

a. Type 1: Polyethylene Terephthalate (PET, PETE).

b. Type 2: High Density Polyethylene (HDPE).

c. Type 3: Vinyl (Polyvinyl Chloride or PVC).

d. Type 4: Low Density Polyethylene (LDPE).

e. Type 5: Polypropylene (PP).

f. Type 6: Polystyrene (PS).

g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.6 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

1.7 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

1.7.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA/WDMA/CSA 101/I.S.2/A440 for the window types and classification specified in this section.

1.7.2 Sound Attenuation

When tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or the following below, provide a minimum Sound Transmission Class (STC) of 35 in accordance with ASTM E90 and as determined by ASTM E413 or Outside-Indoor

Transmission Class (OITC) of 25 in accordance with ASTM E1332 and as determined by ASTM E413 with the window glazed with 1/2 inch air space between two pieces of 1/4 inch.

1.8 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOWS

Provide prime windows that comply with AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. In addition to compliance with AAMA/WDMA/CSA 101/I.S.2/A440, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of 53 when tested in accordance with AAMA 1503. Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

2.1.1 Fixed Windows

Type F-AW40.

2.1.2 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.1.3 Caulking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.2 FABRICATION

Fabrication of window units must comply with AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified. For minimum antiterrorism windows, attach glazing to its supporting frame using structural silicone sealant or adhesive glazing tape in accordance with ASTM F2248. Design sash for inside glazing and for securing glass with metal beads.

2.2.2 Fasteners

Use window manufacturer's standard for windows, trim, and accessories.

Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

2.2.3 Adhesives

Provide joint sealants as specified in Section 07 92 00 JOINT SEALANTS. For interior application of joint sealants, comply with applicable regulations regarding reduced VOC's, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.4 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation. Furnish extruded aluminum subframe receptors and subsill with each window unit.

2.2.4.1 Hardware

AAMA/WDMA/CSA 101/I.S.2/A440. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide stainless steel hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

2.2.4.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

2.2.4.3 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.5 Finishes

Comply with NAAMM's "Metal Finishes Manual" for applying and designating finishes. Exposed aluminum surfaces must be factory finished with an anodic coating. Color must be clear anodized. All windows must have the same finish.

2.2.5.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF45 and AAMA 611. Finish must be:

b. Architectural Class I (0.7 mil or thicker), designation AA-M10-C22-A41, clear (natural) anodized.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA/WDMA/CSA 101/I.S.2/A440. Do not coat surfaces in contact with sealants after installation with any type of protective material. Do not apply coatings or lacquers to surfaces to which caulking and glazing components must adhere.

3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 7/16 inch.

3.1.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Verify that products are properly installed, connected, and adjusted.

3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --

SECTION 08 60 45

TRANSLUCENT PANELS
08/20

PART 1 GENERAL

1.1 SUMMARY

Provide commercially available which satisfy all requirements contained in this section and have been verified by load testing and independent design analyses (if required) to meet specified design requirements. Provide UV-stabilized, shatterproof and energy efficient skylight systems. Provide light transmitting plastics in the manufacturing of skylights for daylighting applications. Systems must meet requirements of UFC 4-010-01.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA/WDMA/CSA 101/I.S.2/A440	(2017) North American Fenestration Standard/Specification for Windows, Doors, and Skylights

ASTM INTERNATIONAL (ASTM)

ASTM C297/C297M	(2016) Flatwise Tensile Strength of Sandwich Constructions
ASTM D572	(2004; R 2019) Rubber Deterioration by Heat and Oxygen
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D1002	(2010; R 2019) Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
ASTM D1003	(2013) Haze and Luminous Transmittance of Transparent Plastics
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D1929	(2020) Standard Test Method for Determining Ignition Temperature of

	Plastics
ASTM D2843	(2019) Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics
ASTM D3841	(2016) Standard Specification for Glass Fiber-Reinforced Polyester Plastic Panels
ASTM E72	(2022) Conducting Strength Tests of Panels for Building Construction
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E108	(2020a) Standard Test Methods for Fire Tests of Roof Coverings
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2023) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC04	(2012; R 2015) Acceptance Criteria for Sandwich Panels

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2020) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2020) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that

will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

SD-03 Product Data

Translucent Panels; G

Warranty

SD-06 Test Reports

Test Reports

SD-07 Certificates

Systems

Qualifications

1.4 QUALITY ASSURANCE

a. Provide documentation of Qualifications for the following: The manufacturer is a company specializing in the manufacture of the specified products with a minimum of 5 years documented experience. The installer has documented experience of 5 years minimum performing the work specified.

b. Before fabrication, provide a full service mock-up of complete with glass and AAMA certification label for structural purposes and NFRC temporary and Permanent Label for certification of thermal performance rating for review of skylight construction and quality of hardware operation. Glass and glaze in conformance with the applicable requirements of Section 08 81 00 GLAZING.

1.5 DELIVERY, STORAGE, AND HANDLING

Provide factory assembled system modules to the greatest extent possible. Ship panels to the jobsite in rugged shipping units, ready for erection. Affix conspicuous decals on all skylights warning individuals against sitting or stepping on the units. Store skylight panels on the long edge, several inches above the ground, blocked and under cover to prevent warping. Deliver unit skylights in manufacturer's original containers, dry, undamaged, with seals and labels intact. Deliver, store and protect all products in accordance with manufacturer's recommendations.

1.6 WARRANTY

Provide the manufacturer's complete warranty for materials, workmanship, and installation. The warranty is for 5 years from the time of project completion and with no proration. The warranty must guarantee, but not be limited to, the following:

a. No change in light transmission and color of the panels after exposure to heat of 300 degrees F for 25 minutes.

b. There is no delamination of the panel affecting appearance, performance, weatherability or structural integrity of the panels or the completed system.

c. There is no fiberbloom on the panel face.

d. Change in light transmission of no more than 6 percent in accordance with ASTM D1003, and in color (yellowing index) no more than 10 points in comparison to the original specified value over a 10 year period.

e. Provide a single source warranty for the glazing panels and the framing system. Third party warranty for the glazing panels will not be accepted.

PART 2 PRODUCTS

2.1 TRANSLUCENT PANELS

Fabricate insulated wall panels of panels conforming to the specified requirements and other appropriate lab test specified criteria, weighing not less than 8 ounces/square foot. Submit certified Test Reports from independent testing laboratory for each type and class of panel system. Reports must verify that the material meets specified performance requirements. Previously completed test reports will be acceptable if they are current and indicative of products used on this project. Where a Class A, B or C roof is part of the project, provide a listing certificate for roof covering systems category certifying that the product complies with the safety standards of ASTM E108 and ICC IBC. Size and color of wall panels as indicated.

2.2 GLASS-FIBER PANELS

Provide glass-fiber reinforced polyester panels conforming to ASTM D3841, Class A and to the requirements of AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.1 Weatherability

Provide the exposed faces of fiberglass sandwich type panels with a permanent glass veil erosion barrier embedded integrally to provide maximum long term resistance to reinforcing fiber exposure. The exterior face sheet must be uniform in strength and resistant to penetration by pencil point.

2.2.2 Non Combustible Grid Core

Use 6063-T6 aluminum I-beams with provisions for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material. I-beam width no less than 7/16 inch. Machine I-beam grid to tolerances of not greater than plus or minus 0.002 inch for flat panels. Panels must withstand 1200 degrees F fire for a minimum of one hour without collapse or exterior flaming.

2.2.3 Adhesive

Use heat and pressure resin-type laminate adhesive engineered for structural sandwich panel use; which passes testing requirements specified by the International Conference of Building Officials' "Acceptance Criteria for Sandwich Panel Adhesive". Provide with the following minimum strength:

a. Tensile Strength of 750 psi in accordance with ASTM C297/C297M after two exposures to six cycles each of the aging conditions prescribed in ASTM D1037.

b. Shear Strength, after exposure to five separate aging conditions in accordance with ASTM D1002:

(1) 540 psi at 50 percent relative humidity and 73 degrees F.

(2) 800 psi under accelerated aging in accordance with ASTM D1037 at room temperature.

(3) 250 psi under accelerated aging in accordance with ASTM D1037 at 182 degrees F.

(4) 1400 psi after 500 hour Oxygen Bomb in accordance with ASTM D572.

(5) 100 psi at 182 degrees F.

2.2.4 Panel Construction

Provide panels consisting of fiberglass faces laminated to an aluminum I-beam grid core and deflecting no more than 1.9 inches at 30 psf in 10 feet in accordance with ASTM E72, without a supporting frame. Include manufacturing facilities, sandwich panel components and production sandwich panels in the quality control inspections and required testing, conducted at least once each year, for conformance with ICC-ES AC04 or equivalent.

2.3 THERMOPLASTIC POLYCARBONATE PANELS

Manufacture systems from translucent polycarbonate panels designed for architectural applications. Provide panels consisting of a polycarbonate resin with a permanent, co-extruded, ultra-violet protective layer; co-extruded by the manufacturer during the original extrusion of the panel a permanent part of the exterior and interior layers. Pot-applied coatings or films of dissimilar materials are unacceptable. Provide panel width not to exceed 2 feet to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Meet the following manufacturing requirements:

a. Extruded in one single formable length. Transverse sections are unacceptable. Manufacture the panels with upstands which are integral to the unit, and with the upstands 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of upstands or standing seam is unacceptable.

b. Provide dry glazed profiles mullions, using no sealant, welding, adhesives or gaskets; thermally break mullions continuous for panel length.

c. For structural performance, the use of adhesives, plastic or sonic welding or sealant is not allowed.

d. For longevity, the minimum ratio of panel weight to thickness must be 0.5 psf for 0.4 inch thick panel.

e. Extruded panel includes integral extruded multi-cells, and truss-like structural core for resistance to buckling. Interconnect the panel's

exterior skins and space apart by supporting ribs, perpendicular to the skins, at a spacing not to exceed 0.16 inches (truss-like construction). In addition, divide the space between the two exterior skins in a cross section by multiple parallel intermediate surfaces, at a spacing not to exceed 0.16 inches.

f. Interior flame spread classification is Class I in accordance with ASTM E84.

g. Smoke density no greater than 70 in accordance with ASTM D2843.

h. The exterior and interior faces must be an approved light transmitting panel with a CC1 fire rating classification in accordance with ASTM D635.

i. Self-ignition greater than 1058 degrees F in accordance with ASTM D1929.

j. Fire rated roof assembly translucent panels must be successfully evaluated for fire from exterior exposure in accordance with ASTM E108 to meet Class A rating. Provide panel listed by an independent recognized listing laboratory.

2.4 COMMON PANEL REQUIREMENTS

2.4.1 Appearance

Provide face sheets uniform in color to prevent splotchy appearance and completely free of ridges and wrinkles which prevent proper surface contact. Clusters of air bubbles/pinholes which collect moisture and dirt are not acceptable.

2.4.2 Panel Fabrication

Panel construction must meet the following requirements:

a. Light transmission 20 percent; color White.

b. Assembled panel thickness 2-3/4 inches.

c. Grid size as indicated on Drawings. If not indicated 12 inch x 24 inch; Shoji.

2.4.3 Thermal Performance

Provide non-residential insulated wall panels (including frames and glass) certified by the National Fenestration Rating Council with a whole-unit Solar Heat Gain Coefficient (SHGC) maximum of .028 determined according to NFRC 200 procedures and a U-factor maximum of 0.23 Btu/hr-ft2-F in accordance with NFRC 100.

2.4.4 Condensation Index Rating

The condensation index rating must be 45 as determined using National Fenestration Rating Council approved software THERM.

2.5 TRANSLUCENT PANEL SYSTEMS

Submit manufacturer's certificate that the systems meet or exceed specified requirements. Provide systems evaluated and listed (the whole translucent panel as a unit, not just a glazing material in the unit) by the recognized

building code authorities: ICC and SBCCI-Public Safety Testing and Evaluation Services Inc. Product ratings determined using NFRC 100 and NFRC 200 must be authorized for certification and properly labeled by the manufacturer. Provide translucent panel systems meeting the following requirements:

a. Integral perimeter framing system assembly by the manufacturer.

b. Exterior panel faces white in color. Interior panel faces white in color.

c. Air infiltration at 1.57 psf less than 0.04 cfm/ft^2 and at 6.24 psf less than 0.07 cfm/ft^2 in accordance with ASTM E283.

d. Water penetration at test pressure of 15 psf equals zero in accordance with ASTM E331.

e. Manufacturer is responsible for maximum system deflection, in accordance with the applicable building code, and without damage to system performance. Calculate deflection in accordance with engineering principles.

f. Incorporate weepage elements within the perimeter framework of the glazing system for drainage of any condensation or water penetration.

g. System must accommodate movement within the system; movement between the system and perimeter framing components; dynamic loading and release of loads; and deflection of supporting members. Achieve this without damage to system or components, deterioration of weather seals and fenestration properties specified.

h. Exposed aluminum color must be a shade selected from the manufacturer's standard range. Provide corrosion resistant superior-performance organic finish in accordance with AAMA 2605.

i. Provide a system requiring no scheduled recoating to maintain its performance or for UV resistance.

j. Design criteria:

(1) Wind Load refer to Design Criteria and Components and Cladding Wind Pressures Schedule on Structural Drawings; snow load.

k. Use 6063-T6 and 6063-T5 extruded aluminum; all fasteners of stainless steel or plated steel.

2.6 FLEXIBLE SEALING TAPE

Provide manufacturer's standard pre-applied sealing tape to closure system at the factory under controlled conditions.

PART 3 EXECUTION

3.1 EXAMINATION

Field verify all submitted opening sizes, dimensions and tolerances; preparation of openings includes isolating dissimilar materials from aluminum system to avoid damage by electrolysis. The installer must examine area of installation to verify readiness of site conditions and to

notify the Contractor about any defects requiring correction. Verify when structural support is ready to receive all specified work and to convene a pre-installation conference, if approved by the Contracting Officer, including the Contractor, wall panel installer and all parties directly affecting and affected by the specified work. Do not install any materials that show visual evidence of biological growth due to the presence of moisture. Do not commence work until conditions are satisfactory.

3.2 ERECTION

Erect translucent wall panel system in accordance with the approved shop drawings supplied by the manufacturer. Submit drawings showing fabrication details, materials, dimensions, installation methods, anchors, and relationship to adjacent construction. Fasten and seal in accordance with the manufacturer's shop drawings. Remove all panel, after other trades have completed work on adjacent materials. Carefully inspect and adjust panel installation as necessary to ensure proper installation and weather-tight conditions. provide all staging, lifts and hoists required for the complete installation and field measuring. Install system clean of dirt, debris or staining and thoroughly examined for removal of all protective material prior to final inspection of the designated work area.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
02/16, CHG 4: 02/22

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2021) Butts and Hinges
ANSI/BHMA A156.3	(2020) Exit Devices
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.5	(2020) Cylinder and Input Devices for Locks
ANSI/BHMA A156.6	(2021) Architectural Door Trim
ANSI/BHMA A156.7	(2016) Template Hinge Dimensions
ANSI/BHMA A156.8	(2021) Door Controls - Overhead Stops and Holders
ANSI/BHMA A156.13	(2022) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.15	(2021) Release Devices Closer Holder, Electromagnetic and Electromechanical
ANSI/BHMA A156.16	(2023) Auxiliary Hardware
ANSI/BHMA A156.18	(2020) Materials and Finishes
ANSI/BHMA A156.19	(2013) Power Assist & Low Energy Power Operated Doors
ANSI/BHMA A156.21	(2019) Thresholds
ANSI/BHMA A156.22	(2021) Gasketing
ANSI/BHMA A156.23	(2010) Electromagnetic Locks
ANSI/BHMA A156.24	(2012) Delayed Egress Locking Systems

ANSI/BHMA A156.25	(2013) Electrified Locking Devices
ANSI/BHMA A156.26	(2012) Continuous Hinges
ANSI/BHMA A156.31	(2013) Electric Strikes and Frame Mounted Actuators
ANSI/BHMA A156.36	(2010) Auxiliary Locks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 80	(2022) Standard for Fire Doors and Other Opening Protectives
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 252	(2022) Standard Methods of Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2023) Specifications for Standard Steel Doors and Frames

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(updated continuously online) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Manufacturer's Detail Drawings; G

Verification of Existing Conditions; G

Hardware Schedule; G

Keying System; G

SD-03 Product Data

Hardware Items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G

SD-11 Closeout Submittals

Key Bitting

1.3 SHOP DRAWINGS

Submit manufacturer's detail drawings indicating all hardware assembly components and interface with adjacent construction. Indicate power components and wiring coordination for electrified hardware. Base shop drawings on verified field measurements and include verification of existing conditions.

1.4 PRODUCT DATA

Indicate fire-ratings at applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.5 HARDWARE SCHEDULE

Provide Hardware Item List and Hardware Schedule containing the following information, and additional information as needed to identify the complete make up of each hardware set and its application to each opening:

1.5.1 Hardware Item List:

a. Hardware Type

b. Item Number

c. Quantity

d. Size(s)

e. Reference Publication / Type Number

f. Manufacturer's Name / Catalog Number

g. Key Control Symbols

h. UL Mark (If fire rated and listed)

i. BHMA Finish(es)

j. Remarks

1.5.2 Hardware Schedule

a. Hardware Set Number

b. Opening Number(s)

c. Opening Description (single/double leaf, hand, size, door/frame material)

d. Fire Rating

e. Sound Rating

f. Hardware Items

g. Quantity

h. Size

i. BHMA Finish

j. Remarks

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 KEY BITTING CHART REQUIREMENTS

1.6.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (e.g. AA1 and AA2).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.7 QUALITY ASSURANCE

1.7.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.7.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware Subcontractor, using Activity and Base Locksmith must meet to discuss and coordinate key requirements for the facility.

1.8 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown on hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware applied to metal or to prefinished doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark is visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Coordinate electrified door hardware components with corresponding components specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.1 Hinges

Provide in accordance with ANSI/BHMA A156.1. Provide hinges that are 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins are non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu of ball bearing hinges.

2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26.

2.3.3 Locks and Latches

a. At exterior locations provide locksets of full stainless steel type 302 or 304 construction including fronts, strike, escutcheons, knobs, bolts and all interior working parts. Marine Grade I, fully non-ferrous.

2.3.3.1 Mortise Locks and Latches

Provide in accordance with ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.3.2 Auxiliary Locks

Provide in accordance with ANSI/BHMA A156.36, Grade 1.

2.3.3.3 Combination Locks

Heavy-duty, mechanical combination lockset with five push buttons, standard sized knobs, 3/4 inch deadlocking latch, 2-3/4 inch backset. Locks to operate by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob operates the latch. Provide a keyed cylinder on the interior to permit setting the combination. Provide a keyed removable core cylinder on the exterior to permit bypassing the combination.

2.3.4 Exit Devices

Provide in accordance with ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms.

2.3.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with six pin tumblers. Provide cylinders from the products of one manufacturer, and provide cores from the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Push Button Mechanisms

Provide in accordance with ANSI/BHMA A156.5, Grade 1.

2.3.7 Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.7.1 Electric Strikes and Frame Mounted Actuators

Provide in accordance with ANSI/BHMA A156.31, Grade 1. Provide electric strikes and actuators as required to meet operational requirements. Provide electric strikes that remain secure during power failure. Provide a separate power supply for electric strikes, other locking devices and ancillary parts. Provide strikes and actuators with a minimum opening force of 2300 pounds.

Provide facility interface devices that use direct current (dc) power to energize the solenoids. Provide electric strikes and actuators that incorporate end-of-line resistors to facilitate line supervision by the system. If not incorporated into the electric strike or local controller, provide metal oxide resistors (MOVs) to protect the controller from reverse

current surges.

2.3.7.1.1 Solenoid

Provide actuating solenoid for strikes and actuators that are rated for continuous duty, cannot dissipate more than 12 Watts and must operate on 12 or 24 Volts dc. Inrush current cannot exceed 1 ampere and the holding current cannot be greater than 500 milliamperes. Actuating solenoid must move from fully secure to fully open positions in less than 500 milliseconds.

2.3.7.1.2 Signal Switches

Provide strikes and actuators with signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. Signal switches must report a forced entry to the system.

2.3.7.1.3 Tamper Resistance

Provide strike guards that prevent tampering with the latch bolt of the locking hardware or the latch bolt keeper of the electric strike. Strike guards to bolt through the door using tamper resistant screws. Provide strike guards made of 1/8 inch thick brass and that are 11-1/14 inch high by 1-5/8 inch wide, with a minimum 5/32 inch wide offset.

2.3.7.1.4 Coordination

Provide electric strikes and actuators of a size, weight and profile compatible with each specified door frame. Field verify installation clearances prior to procurement.

2.3.7.1.5 Mounting Method

Provide electric strikes and actuators suitable for use with single and double doors, with mortise or rim type hardware specified, and for right or left hand mounting as specified. In double door installations, locate the lock in the active leaf and monitor the fixed leaf.

2.3.7.2 Electrified Mortise Locks

Provide in accordance with ANSI/BHMA A156.25, Grade 1. Provide electrified mortise locks that remain secure during power failure. Provide facility interface devices that use dc power to energize solenoids. Provide solenoids, resisters, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

2.3.7.2.1 Power Transfer Hinges

Provide power transfer hinges with each electrified lock that route power and monitoring signals from the lockset to the door frame. Coordinate power transfer hinges with door frames.

2.3.7.3 Card Readers and Keypad Access Control Hardware

Coordinate access control hardware with corresponding devices and systems specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.7.4 Release Devices

In accordance with ANSI/BHMA A156.15, Grade 1.

2.3.7.4.1 Release Devices

Provide wall mounted Electromagnetic release devices connected to fire and smoke detecting devices.

2.3.7.5 Power Assist and Low Energy Power Operated Doors

Provide in accordance with ANSI/BHMA A156.19, Grade 1.

2.3.7.6 Electromagnetic Locks

Provide in accordance with ANSI/BHMA A156.23, Grade 1. Provide electromagnetic locks that do not contain any moving parts and depend solely upon electromagnetism to secure a portal by generating at least 1200 pounds of holding force. The lock must interface with the local processors without external, internal or functional alteration of the local processor. The electromagnetic lock must incorporate an end of line resistor to facilitate line supervision by the system. Provide metal-oxide resistors (MOVs) to protect controllers from reverse current surges, if not incorporated into the electromagnetic lock or local controller.

2.3.7.6.1 Armature

Provide electromagnetic locks with internal circuitry to eliminate residual magnetism and inductive kickback. Provide atuating armature that operates on 12 or 24 Volts dc and cannot dissipate more than 12 Watts. Holding current must be less than 500 milliamperes. Actuating armature must take less than 300 milliseconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

2.3.7.6.2 Tamper Resistance

Provide lock mechanism encased in hardened guard barriers to deter forced entry.

2.3.7.6.3 Mounting Method

Provide electromagnetic lock suitable for use with single and double door with mortise or rim type hardware and compatible with right or left hand mounting.

2.3.7.7 Delayed Egress Locking System

Provide in accordance with ANSI/BHMA A156.24, Grade 1.

2.3.8 Keying System

Provide a grand master keying system Provide construction interchangeable cores.

2.3.9 Lock Trim

Provide cast, forged, or heavy wrought construction and commercial plain design for lock trim.

2.3.9.1 Lever Handles

Provide lever handles where indicated in the Hardware Schedule. Provide in accordance with ANSI/BHMA A156.3 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.10 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish 4 great grand master keys, 12 master keys, 15 construction master keys, and 4 control keys for removable cores. Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

2.3.11 Door Bolts

Provide in accordance with ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except at doors having metal thresholds. Provide automatic latching flush bolts in accordance with ANSI/BHMA A156.3, Type 25.

2.3.12 Closers

Provide in accordance with ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's printed recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.12.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation in locations that will be visible after installation.

2.3.13 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

2.3.14 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

2.3.14.1 Sizes of Armor Mop and Kick Plates

2 inch less than door width for single doors; 1 inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors . Provide a minimum 36 inch armor plates for flush doors and completely cover lower panels of panel doors, except UL listed armor plates on fire doors. Provide 10 inch mop plates.

2.3.15 Door Stops and Silencers

Provide in accordance with ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.16 Thresholds

Provide in accordance with ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.17 Weatherstripping Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weatherstripped doors not to exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weatherstripping with one of the following: Silicone rubber, or polyurethane inserts. Provide clear anodized aluminum.

2.3.17.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.3.17.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

2.3.17.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

2.3.18 Lightproofing and Soundproofing Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide adjustable doorstops at heads,jambs and automatic door bottoms in accordance with the hardware set, of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed cell sponge gasket. Provide door bottoms with adjustable operating rod and silicone rubber or closed cell sponge neoprene gasket. Provide doorstops that are mitered at corners. Provide type and function designation where specified in paragraph HARDWARE SETS.

2.3.19 Rain Drips

Provide in accordance with ANSI/BHMA A156.22. Provide extruded aluminum rain drips, not less than 0.08 inch thick, clear anodized finish. Provide the manufacturer's full range of color choices to the Contracting Officer for color selection. Provide rain drips with a 4 inch overlap on each side of each exterior door that is not protected by an awning, roof, eave or other horizontal projection. Set drips in sealant and fasten with stainless steel screws.

2.3.19.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.19.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection. Align bottom with door frame rabbet.

2.3.20 Auxiliary Hardware (Other than locks)

Provide in accordance with ANSI/BHMA A156.16, Grade 1.

2.3.21 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, as required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of type, quality, size, and quantity appropriate to the specific application. Fastener finish to match hardware. Provide stainless steel or nonferrous metal fasteners in locations exposed to weather. Verify metals in contact with one another are compatible and will avoid galvanic corrosion when exposed to weather.

2.5 FINISHES

Provide in accordance with ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers, and except BHMA 652 finish (satin chromium plated) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph HARDWARE SETS. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

2.6 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with ANSI/BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

PART 3 EXECUTION

3.1 INSTALLATION

Provide hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weatherstripping Installation

Provide full contact, weathertight seals that allow operation of doors without binding the weatherstripping.

3.1.1.1 Stop Applied Weatherstripping

Fasten in place with color matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weatherstripping

Provide interlocking, self adjusting type on heads and jambs and flexible hook type at sills. Nail weatherstripping to door 1 inch on center and to heads and jambs at 4 inch on center.

3.1.1.3 Spring Tension Type Weatherstripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze. Provide stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

3.1.2 Lightproofing and Soundproofing Installation

Provide as specified for stop applied weatherstripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves. For aluminum thresholds placed on top of concrete surfaces, coat the underside surfaces that are in contact with the concrete with fluid applied waterproofing as a separation measure prior to placement.

3.2 FIRE DOORS AND EXIT DOORS

Provide hardware in accordance with NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, and NFPA 252 for fire tests of door assemblies.

3.3 HARDWARE LOCATIONS

Provide in accordance with SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Provide complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality

A. Basis of Design Manufacturer's Abbreviations used in schedule:

1. Cores - BE - BEST
2. BA - BEA Inc
3. DO - Dorma
4. HA - Hager
5. KA - KABA-MAS
6. ME - Medeco
7. PE - Pemko
8. RO - Rockwood
9. SU - Securitron
10. VD - Von Duprin

Hardware Sets

Set #1

-- End of Section --

SECTION 08 91 00

METAL WALL LOUVERS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 500-L	(2015) Laboratory Methods of Testing Louvers for Rating
AMCA 511	(2010; R 2016) Certified Ratings Program for Air Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall Louvers

SD-03 Product Data

Metal Wall Louvers

SD-04 Samples

Wall Louver Samples; G

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers must be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 COLOR SAMPLES

Colors of finishes for wall louver samples must closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Wind driven rain resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers must bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating must show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Formed Metal Louvers

Formed of aluminum sheet not less than 0.08 inch thick.

2.2.3 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions where indicated and for all louvers more than 5 feet in width at not more than 5 feet on centers. Provide mullion covers on both faces of joints between louvers.

2.2.4 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Exposed aluminum surfaces must be factory finished with an organic coating. Color must be as indicated. All louvers must have the same finish.

2.4.1.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a baked enamel finish conforming to AAMA 2603, with total dry film thickness not less than 0.8 mil , color as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD
02/10, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2022) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2014; E 2015) Nonstructural Steel Framing Members
ASTM C754	(2020) Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C841	(2023) Installation of Interior Lathing and Furring
ASTM C847	(2014a) Standard Specification for Metal Lath

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM EMLA 920	(2009) Guide Specifications for Metal Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Support Systems

Submit for the erection of metal framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

SD-03 Product Data

Metal Support Systems

Recycled Content for Metal Support Systems

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations permitting easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating.

Provide metal support systems containing a minimum of 20 percent recycled content. Provide data identifying percentage of recycled content for metal support systems.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, and ASTM C847.

2.1.1.2 Non-load Bearing Wall Framing

NAAMM EMLA 920.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C645.

2.1.2.2 Non-load Bearing Wall Framing and Furring

ASTM C645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

2.1.2.3 Furring Structural Steel Columns

ASTM C645. Steel (furring) clips and support angles listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

2.1.2.4 Z-Furring Channels with Wall Insulation

Not lighter than 26 gage galvanized steel, Z-shaped, with 1-1/4 inch and 3/4 inch flanges and depth as required by the insulation thickness provided.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Lath

3.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, except as indicated otherwise.

3.1.1.2 Non-load Bearing Wall Framing

NAAMM EMLA 920, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.2 Systems for Attachment of Gypsum Wallboard

3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.2.2 Non-load Bearing Wall Framing and Furring

ASTM C754, except as indicated otherwise.

3.1.2.3 Furring Structural Steel Columns

Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns in accordance with the UL Fire Resistance, design number(s) indicated .

3.1.2.4 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches o.c.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/4 inch in 8 feet from a straight line;

c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/8 inch in 8 feet from a straight line;

c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD
08/16, CHG 4: 02/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C475/C475M	(2017; R 2022) Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C840	(2020) Standard Specification for Application and Finishing of Gypsum Board
ASTM C954	(2022) Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C1002	(2022) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	(2019) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1396/C1396M	(2017) Standard Specification for Gypsum Board
ASTM C1766	(2015; R2019) Standard Specification for Factory-Laminated Gypsum Panel Products
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D3273	(2021) Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM E336	(2023) Standard Test Method for Measurement of Airborne Sound Attenuation

between Rooms in Buildings

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2016) Application and Finishing of Gypsum Panel Products
GA 600	(2015) Fire Resistance Design Manual Sound Control

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2022) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious Backer Units

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

Gypsum Board

Recycled Content for Gypsum Board

Recycled Content for Paper Facing and Gypsum Cores

VOC Content of Joint Compound

SD-06 Test Reports

ASTM E90 Factory Test Report;

ASTM E336 Field Test Report;

SD-07 Certificates

Asbestos Free Materials;

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

Indoor Air Quality for Gypsum Board

SD-08 Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Manufacturer Maintenance Instructions

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Ceiling and Wall Systems

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.3.1.2 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.4.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range.

Do not store gypsum wallboard with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives. Do not use materials that have visible moisture or biological growth.

1.4.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

1.6 SCHEDULING

The gypsum wallboard must be taped, finished and primed before the installation of the highly-emitting materials, or installed after the installation and ventilation period of the highly-emitting materials.

Commence application only after the area scheduled for gypsum board work is completely weathertight. The heating, ventilating, and air-conditioning systems must be complete and in operation prior to application of the gypsum board. If the mechanical system cannot be activated before gypsum board is begun, the gypsum board work may proceed in accordance with an approved plan to maintain the environmental conditions specified below. Apply gypsum board prior to the installation of finish flooring and acoustic ceiling.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not expose the gypsum board to excessive sunlight prior to gypsum board application. Maintain a continuous uniform temperature of not less than 50 degrees F and not more than 80 degrees F for at least one week prior to the application of gypsum board work, while the gypsum board application is being done, and for at least one week after the gypsum board is set. Shield air supply and distribution devices to prevent any uneven flow of air across the plastered surfaces. Provide ventilation to exhaust moist air to the outside during gypsum board application, set, and until gypsum board jointing is dry. In glazed areas, keep windows open top and bottom

or side to side 3 to 4 inches. Reduce openings in cold weather to prevent freezing of joint compound when applied. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 20 degrees F or more, screen openings with cheesecloth or similar materials. Avoid rapid drying. During periods of low indoor humidity, provide minimum air circulation following gypsum boarding and until gypsum board jointing complete and is dry.

1.8 FIRE RESISTIVE CONSTRUCTION

Comply with specified fire-rated assemblies for design numbers indicated per UL Fire Resistance or FM APP GUIDE.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only. Submit Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

ASTM C1396/C1396M. Gypsum board must contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Provide data identifying percentage of recycled content for gypsum board. Paper facings must contain a minimum of 100 percent recycled paper content. Gypsum cores must contain a minimum of 95 percent post-industrial recycled gypsum content. Provide data identifying percentage of recycled content for paper facing and gypsum cores. Provide gypsum wall board and panels meeting the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification or validation of indoor air quality for gypsum board.

2.1.1.1 Regular

48 inch wide, 1/2, 5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inch wide, 1/2, 5/8 inch thick, tapered edges.

2.1.1.3 Mold Resistant / Anti-Microbial Gypsum

ASTM D3273. 48 inch wide, 1/2, 5/8 inch thick, tapered edges. This product must be used on the interior face of all exterior metal stud walls.

2.1.2 Gypsum Backing Board

ASTM C1396/C1396M, gypsum backing board must be used as a base in a multilayer system.

2.1.2.1 Regular

48 inch wide, 1/2, 5/8 inch thick, square edges.

2.1.2.2 Foil-Backed

48 inch wide, 1/2, 5/8 inch thick, square edges.

2.1.2.3 Type X (Special Fire-Resistant)

48 inch wide, 1/2, 5/8 inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.3.1 Regular

48 inch wide, 1/2, 5/8 inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inch wide, 1/2, 5/8 inch thick, tapered edges.

2.1.4 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C1178/C1178M

2.1.4.1 Regular

48 inch wide, 1/2, 5/8 inch thick, square edges.

2.1.4.2 Type X (Special Fire-Resistant)

48 inch wide, 1/2, 5/8 inch thick, square edges.

2.1.5 Factory-Laminated Gypsum Board (Where sound rated assemblies are indicated on Drawings)

ASTM C1766, regular or Type X, 48 inch wide 1/2, 5/8 inch thick, sound dampening gypsum panel products composed of factory-laminated gypsum panels laminated into a composite panel.

2.1.6 Joint Treatment Materials

ASTM C475/C475M. Product must be low emitting VOC types with VOC limits not exceeding 50 g/L. Provide data identifying VOC content of joint compound. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds must be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.6.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.6.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.6.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.6.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.6.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.7 Fasteners

2.1.7.1 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.8 Accessories

ASTM C1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges must be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.9 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over glass mat covered or reinforced gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

2.1.10 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Building Construction Materials

Do not install building construction materials that show visual evidence of

biological growth.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. Install 5/8 inch gypsum or 1/2 inch ceiling board over framing at 24 inch on center. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.2 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C840, System IX or GA 216.

3.2.3 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board or water-resistant gypsum backing board in accordance with ASTM C840, System X or GA 216.

3.2.4 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C840, System XI or GA 216.

3.2.5 Floating Interior Angles

Minimize framing by floating corners with single studs and drywall clips. Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with ASTM C840, System XII or GA 216, for single-ply and two-ply applications of gypsum board to wood framing.

3.2.6 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216.

Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use self-adhering fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.3.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.4.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat.

3.5 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resistance for the Design Number(s) indicated, or GA 600 for the File Number(s) indicated. Joints of fire-rated gypsum board enclosures must be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.6 SOUND RATED ASSEMBLIES

When sound rated assemblies are required, provide materials and application methods, including panels, insulation, types and spacing of fasteners, wall and ceiling framing in accordance with the contract document and the description of the assembly in the ASTM E90 Factory Test Report. Seal partitions continuously with acoustical foam or sealant (both sides) and finished to match wall wherever it abuts another element such as the floor, ceiling, wall, column, mullion, or another system or assembly.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.8 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

3.9 SOUND RATED ASSEMBLY FIELD TESTING

Provide third party testing of sound rated assemblies tested in accordance with ASTM E336. Provide the ASTM E336 Field Test Report verifying that the installed assemblies perform no less than five ASTC rating points below the ASTM E90 Factory Test Report. Examine, modify adjust, and retest any installation not meeting the STC Rating until compliance is obtained.

-- End of Section --

SECTION 09 30 10

CERAMIC TILING
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108/A118/A136.1	(2019) American National Standard Specifications for theInstallation of Ceramic Tile
ANSI A137.1	(2019) American National Standards Specifications for Ceramic Tile

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2023) Standard Specification for Concrete Aggregates
ASTM C144	(2018) Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C206	(2014; R 2022) Standard Specification for Finishing Hydrated Lime
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C648	(2020) Standard Test Method for Breaking Strength of Ceramic Tile
ASTM C1026	(2013; R 2018) Standard Test Method for Measuring the Resistance of Ceramic and Glass Tile to Freeze-Thaw Cycling
ASTM C1027	(2009; R 2017) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor

Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36 (2013) Adhesives for Commercial Use

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk (2017) Handbook for Ceramic, Glass, and Stone Tile Installation

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

SD-03 Product Data

Porcelain Tile

Glazed Ceramic Wall Tile

Transition Strips

Setting-Bed

Mortar, Grout, and Adhesive

Glass-Mat Gypsum Water-Resistant Backing Board; G

Waterproof Membrane

Crack Isolation Membrane

SD-04 Samples

Tile

Accessories

Transition Strips

Grout

SD-08 Manufacturer's Instructions

Manufacturer's Approved Cleaning Instructions

SD-10 Operation and Maintenance Data

Porcelain Tile; G

Glazed Ceramic Wall Tile; G

Transition Strips; G

1.3 CERTIFICATIONS

1.4 QUALITY ASSURANCE

Provide installers having a minimum of two years of experience with a company specializing in performing the type of work described. Each type and color of tile to be provided from a single source. Each type and color of mortar, adhesive, and grout to be provided from the same source.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship tiles in sealed packages and clearly marked with the grade, type of tile, producer identification, and country of origin. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions. Store and handle tiles per manufacturer's instructions for gauged porcelain tile and gauged porcelain tile panels/slabs.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.7 WARRANTY

Provide manufacturer's warranty to repair or replace defective tiling materials and workmanship, including tile, mortar and grout products and installation as a system, for a period of one year from date of final acceptance of the work.

1.8 EXTRA MATERIALS

Supply an extra 2 percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Provide tiles that comply with ANSI A137.1 and are standard grade tiles. Provide a minimum breaking strength of 125 lbs. for wall tile and 250 lbs. for floor tile in accordance with ASTM C648. Provide exterior building tile for cold climate projects that is approved by the manufacturer for exterior use when tested in accordance with ASTM C1026. Provide floor tiles with a minimum wet dynamic coefficient of friction (DCOF) value of 0.42 when tested in accordance with ANSI A137.1 requirements. Provide glazed floor tile with a Class IV-Commercial classification as rated by the manufacturer when tested in accordance with ASTM C1027 for visible abrasion resistance as related to foot traffic. For materials like tile, accessories,

and transition strips submit samples of sufficient size to show color range, pattern, type and joints.

Submit manufacturers' descriptive product data for each type of ceramic, quarry and glass tiling indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of ceramic, quarry and glass tiling indicated in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Porcelain Tile

Provide unglazed through body (surface color and pattern go all the way through the tile body), porcelain tile and cove base and trim pieces. Provide nominal tile size(s) as indicated on Drawings.

2.1.2 Glazed Ceramic Wall Tile

Provide glazed ceramic wall tile as indicated on Drawings.

2.1.3 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile.

2.2 SETTING-BED

Submit manufacturer's catalog data. Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C33/C33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C150/C150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C206 for hydrated lime, Type S or ASTM C207, Type S.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of

SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. For products located on the interior of the building (inside of the weatherproofing system. Provide bond coat, mortar, and grout supplied from the same manufacturer.

2.4.1 Latex-Portland Cement Mortar

TCNA Hdbk.

2.4.2 Ceramic Tile Grout

TCNA Hdbk; petroleum-free and plastic-free high-performance cement grout (latex-portland cement grout).

2.4.3 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Provide sealant that does not change the color or alter the appearance of the grout. Refer to Section 07 92 00 JOINT SEALANTS.

Provide sealants used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. For products located on the interior of the building (inside of the weatherproofing system).

2.5 SUBSTRATES

2.5.1 Glass-Mat Gypsum Water-Resistant Backing Board
Provide glass-mat water-resistant backing board, for use as tile substrate as indicated, in accordance with ASTM C1178/C1178M. Provide 1/2 inch thick glass-mat water-resistant backing board.

2.6 MISCELLANEOUS TRIMS

2.6.1 Transition Strips

Provide as indicated on Drawings.

2.7 WATERPROOF MEMBRANE

2.7.1 General

Manufacturer's standard product that complies with ANSI A108/A118/A136.1 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.7.2 Chlorinated-Polyethylene Shower Waterproof Membrane

Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.040 inch nominal thickness.

2.8 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers..

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex-Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer. Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern elevations and floor plans. Submit manufacturer's preprinted installation instructions.

Do not install building construction materials that show visual evidence of biological growth.

3.3 INSTALLATION OF SUBSTRATES

3.3.1 Glass-Mat Water-Resistant Backing Board

Install in accordance with manufacturer's written instructions.

3.4 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, method and with grout joints as recommended by the manufacturer for the type of tile.

3.4.1 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.5 INSTALLATION OF MISCELLANEOUS TRIMS

3.5.1 Transition Strips

Install transition strips where indicated, in a manner similar to that of the ceramic tile floor and as recommended by the manufacturer. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.5.2 Metal Trims

Install trim where indicated. Embed anchoring leg in setting mortar in accordance with manufacturer's instructions. During grouting of tile joints, immediately wipe grout from finish surface.

3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C423	(2023) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2022) Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C834	(2017; R 2023) Standard Specification for Latex Sealants
ASTM E413	(2022) Classification for Rating Sound Insulation
ASTM E580/E580M	(2022) Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
ASTM E795	(2023) Standard Practices for Mounting Test Specimens During Sound Absorption Tests
ASTM E1111/E1111M	(2014; R 2022) Standard Test Method for Measuring the Interzone Attenuation of Open Office Components
ASTM E1264	(2023) Standard Classification for Acoustical Ceiling Products
ASTM E1414/E1414M	(2021a) Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E1477	(1998; R 2022a) Standard Test Method for

Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2023) Structural Engineering

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings

SD-03 Product Data

Acoustical Ceiling Systems

Acoustical Performance

SD-04 Samples

Acoustical Units

Acoustical Ceiling Tiles

1.3 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.5 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship including but not limited to, sagging and warping of panels and rusting and of grid systems, for a period of 1 year from date of final

acceptance of the work.

1.7 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. Provide the unit size, texture, finish, and color as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to provide I-P RLF, then provide I-P products for other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills. Coordinate the entire ceiling system with other details, like the location of access panels and ceiling penetrations, for instance, shown on the drawings. Submit drawings showing the the location, extent and details of acoustical treatment including suspension system, method of anchoring and fastening, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

2.1.1 Acoustical Performance

2.1.1.1 Ceiling Sound Transmission

Provide ceiling systems with the specified Ceiling Attenuation Class (CAC) ratings as determined in accordance with ASTM E1414/E1414M and ASTM E413. Provide sound attenuators over light fixtures, air terminals and other ceiling penetrations, provide acoustical blanket insulation on top of the ceiling or adjacent to partitions to provide lightweight acoustical plenum barriers above partitions as required to achieve the specified CAC ratings. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

2.1.1.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423. Determine Articulation Class (AC) in accordance with ASTM E1111/E1111M.

2.1.2 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 test method.

2.2 ACOUSTICAL UNITS

Submit samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

2.2.1 Humidity Resistant Composition Units

2.2.1.1 Type

Non-asbestos mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant material and having a factory applied white paint finish. Provide panels that do not sag or warp under conditions of heat, high humidity or chemical fumes.

2.2.1.2 Flame Spread

Class: A, 25 or less

2.2.1.3 Pattern

As indicatred on drawings

2.2.1.4 Minimum NRC

0.75 when tested on Mounting Type E-400 of ASTM E795.

2.2.1.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.2.1.6 Nominal Size

24 by 24 inch

2.2.1.7 Edge Detail

Square

2.2.1.8 Finish

Factory-applied standard finish. See paragraph COLORS AND PATTERNS.

2.3 SUSPENSION SYSTEM

Provide as indicated suspension system conforming to ASTM C635/C635M for intermediate-duty systems. Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less than 15/16 inch. Provide mitered corners. Provide a suspension system with a maximum deflection of 1/360 of the span length capable of supporting the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Conform seismic details to the guidance in UFC 3-301-01, ASTM E580/E580M, and as indicated on Drawings.

Provide Suspension System containing a minimum of 15 percent recycled content.

2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.11 inch in diameter.

2.5 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.6 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

2.7 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Splay (slope or slant) hangers around obstructions, offsetting the resulting horizontal force by bracing, countersplaying, or other acceptable

means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Acoustical Sealant

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

-- End of Section --

SECTION 09 65 00

RESILIENT FLOORING
08/10, CHG 3: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4078	(2002; R 2015) Water Emulsion Floor Polish
ASTM F710	(2021) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F1066	(2004; R 2014; E 2014) Standard Specification for Vinyl Composition Floor Tile
ASTM F1482	(2021) Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F1861	(2021) Standard Specification for Resilient Wall Base
ASTM F1869	(2022) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S"

classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories; G

SD-03 Product Data

Resilient Flooring and Accessories; G

Adhesives

Vinyl Composition Tile

Wall Base

SD-04 Samples

Resilient Flooring and Accessories; G

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests; G

SD-08 Manufacturer's Instructions

Surface Preparation; G
Installation; G

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories; G

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including. Do not store exposed rubber surface materials in occupied spaces.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the

flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.5 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.7 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles and 5 square feet for each 1000 square feet of sheet flooring installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE

Conform to ASTM F1066 Class 1, (solid color tile), Composition 1, asbestos-free, 12 inch square and 1/8 inch thick. Provide color and pattern uniformly distributed throughout the thickness of the tile.

2.2 WALL BASE

Conform to ASTM F1861, Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber), Style A (straight). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide preformed corners in matching height, shape, and color.

2.3 MOULDING

Provide tapered mouldings of vinyl and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.4 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either

emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36.

2.5 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

2.6 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.7 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings. Provide floor patterns as specified on the drawings. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring

product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 GENERAL INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

3.5 PLACING VINYL COMPOSITION TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.6 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.7 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.8 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number

of coats and type of polish and finish in accordance with manufacturer's written instructions.

3.9 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 65 30

RESILIENT BASE AND ACCESORIES
08/10, CHG 3: 08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM F1861	(2021) Standard Specification for Resilient Wall Base

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall Base; G

SD-03 Product Data

Adhesives
Wall Base

SD-04 Samples

Wall Base; G

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests; G

SD-08 Manufacturer's Instructions

Surface Preparation; G
Installation; G

SD-10 Operation and Maintenance Data

Wall Base; G

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including. Do not store exposed rubber surface materials in occupied spaces.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.5 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.7 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles and 5 square feet for each 1000 square feet of sheet flooring installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 WALL BASE

Conform to ASTM F1861, Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber), Style A (straight). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide preformed corners in matching height, shape, and color. Refer to Finish Plan and Schedule for product information.

2.2 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36.

2.3 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.4 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for Wall Base as indicated on the drawings. Provide floor patterns as specified on the drawings. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 GENERAL INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

3.3 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.4 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and finish in accordance with manufacturer's written instructions.

3.5 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
02/21

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.1.1.1 Exterior Painting

Includes new surfaces of the building and appurtenances.

1.1.1.2 Interior Painting

Includes new surfaces of the building and appurtenances as indicated. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.1.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, anodized aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.1.3 Mechanical and Electrical Painting

Includes field coating of interior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.1.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes.

1.1.4 Exterior Painting of Site Work Items

Field coat the following items:

	New Surfaces	Existing Surfaces
a.	Steel Doors and Frames	N.A.
b.	Exposed Structural Steel	N.A.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100 (2017; Suppl 2020) Documentation of the Threshold Limit Values and Biological Exposure Indices

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1 (2020) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D523 (2014; R 2018) Standard Test Method for Specular Gloss

ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4444	(2013; R 2018) Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters
ASTM D6386	(2016a) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F1869	(2023) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

Intelligence Bulletin 65	(2013) Occupational Exposure to Carbon Nanotubes and Nanofibers

MASTER PAINTERS INSTITUTE (MPI)

MPI 3	(2016) Primer, Alkali Resistant, Water Based
MPI 4	(2016) Interior/Exterior Latex Block Filler
MPI 9	(2016) Alkyd, Exterior Gloss (MPI Gloss Level 6)
MPI 10	(2016) Latex, Exterior Flat (MPI Gloss Level 1)
MPI 11	(2016) Latex, Exterior Semi-Gloss, MPI Gloss Level 5
MPI 44	(2016) Latex, Interior, (MPI Gloss Level 2)
MPI 50	(2015) Primer Sealer, Latex, Interior
MPI 52	(2016) Latex, Interior, (MPI Gloss Level 3)
MPI 54	(2016) Latex, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 72	(2016) Polyurethane, Two-Component, Pigmented, Gloss (MPI Gloss Level 6-7)
MPI 77	(2015) Epoxy, Gloss
MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal
MPI 94	(2016) Alkyd, Exterior, Semi-Gloss (MPI Gloss Level 5)

MPI 95	(2015) Primer, Quick Dry, for Aluminum
MPI 101	(2016) Primer, Epoxy, Anti-Corrosive, for Metal
MPI 107	(2016) Primer, Rust-Inhibitive, Water Based
MPI 108	(2015) Epoxy, High Build, Low Gloss
MPI 119	(2016) Latex, Exterior, Gloss (MPI Gloss Level 6)
MPI 134	(2015) Primer, Galvanized, Water Based
MPI 138	(2016) Latex, Interior, High Performance Architectural, (MPI Gloss Level 2)
MPI 139	(2016) Latex, Interior, High Performance Architectural, (MPI Gloss Level 3)
MPI 141	(2016) Latex, Interior, High Performance Architectural, Semi-Gloss (MPI Gloss Level 5)
MPI 144	(2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 2)
MPI 145	(2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 3)
MPI 146	(2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 4)
MPI 147	(May 2016) Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (MPI Gloss Level 5)
MPI 149	(2016) Primer Sealer, Interior, Institutional Low Odor/VOC
MPI 161	(2016) Light Industrial Coating, Exterior, Water Based (MPI Gloss Level 3)
MPI 163	(2016) Light Industrial Coating, Exterior, Water Based, Semi-Gloss (MPI Gloss Level 5)
MPI 164	(2016) Light Industrial Coating, Exterior, Water Based, Gloss (MPI Gloss Level 6)
MPI 214	(2016) Latex, Exterior (MPI Gloss Level 2)
MPI ASM	(2019) Architectural Painting Specification Manual
MPI GPS-1-14	(2014) Green Performance Standard GPS-1-14
MPI GPS-2-14	(2014) Green Performance Standard GPS-2-14
MPI MRM	(2015) Maintenance Repainting Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC Glossary	(2011) SSPC Protective Coatings Glossary
SSPC Guide 6	(2021) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC Guide 7	(2015) Guide to the Disposal of Lead-Contaminated Surface Preparation Debris
SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC QP 1	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components)
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 2	(2018) Hand Tool Cleaning
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 10/NACE No. 2	(2015) Near-White Blast Cleaning
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC-SP WJ-1/NACE WJ-1	(2012) Clean to Bare Substrate, Waterjet Cleaning of Metals
SSPC-SP WJ-2/NACE WJ-2	(2012) Very Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-3/NACE WJ-3	(2012) Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-4/NACE WJ-4	(2012) Light Cleaning, Waterjet Cleaning of Metals

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(2018) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

1.3 DEFINITIONS

1.3.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third-party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.3.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing must be accomplished by an MPI testing lab.

1.3.3 Coating

SSPC Glossary; (1) A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer; (2) Generic term for paint, lacquer, enamel.

1.3.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.3.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five levels are generically defined under the Assessment sections in the MPI MRM, MPI Maintenance Repainting Manual.

1.3.6 EXT

MPI short term designation for an exterior coating system.

1.3.7 INT

MPI short term designation for an interior coating system.

1.3.8 Loose Paint

Paint or coating that can be removed with a dull putty knife.

1.3.9 mil / mils

The English measurement for 0.001 in or one one-thousandth of an inch.

1.3.10 MPI Gloss Levels

MPI system of defining gloss. Seven gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degree angle	Units at 80 degree angle
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.3.11 MPI System Number

The MPI coating system number in each MPI Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

1.3.12 Paint

SSPC Glossary; (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material.

1.3.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.3.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

1.4 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including carpets, textiles, unprimed gypsum wallboard, acoustical ceiling panels,.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping Identification

SD-03 Product Data

Coating; G

Product Data Sheets

SD-04 Samples

Color; G

SD-07 Certificates

Qualification Testing laboratory for coatings; G

Indoor Air Quality for Paints and Primers

Indoor Air Quality for Consolidated Latex Paints

SD-08 Manufacturer's Instructions

Application Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings, Data Package 1; G

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

1.6.1.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.6.1.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.1.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.1.4 Asbestos Content

Provide asbestos-free materials.

1.6.1.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.6.1.6 Silica

Provide abrasive blast media containing no free crystalline silica.

1.6.1.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6.1.8 Carbon Based Fibers / Tubes

Materials must not contain carbon based fibers such as carbon nanotubes or carbon nanofibers. Intelligence Bulletin 65 ranks toxicity of carbon nanotubes on a par with asbestos.

1.6.2 Coating Contractor's Qualification

Submit the name, address, telephone number, and e-mail address of the Contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully

performed surface preparation and application of coatings on on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address and telephone number of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.6.3 SSPC QP 1 Certification

Contractors that perform surface preparation or coating application on steel substrates must be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to Contract award, and must remain certified while accomplishing any surface preparation or coating application. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the Contracting Officer of any change in Contractor certification status. Notify the Contracting Officer of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

1.6.4 Approved Products List

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of Contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire Contract and each coating system is to be from a single manufacturer. Provide all coats on a particular substrate from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

1.6.5 Paints and Coatings Indoor Air Quality Certifications

Provide paint and coating products certified to meet indoor air quality requirements by MPI GPS-1-14, MPI GPS-2-14 or provide certification by other third-party programs. Provide current product certification documentation from certification body.

Provide certification of Indoor Air Quality for Paints and Primers.

Provide certification of Indoor Air Quality for Consolidated Latex Paints. Submit required indoor air quality certifications in one submittal package.

1.6.6 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURE. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing as specified in the paragraph TESTING PROCEDURE at no cost to the Government.

1.6.6.1 Sampling Procedure

Select paint at random from the products that have been delivered to the job site for sample testing. The Contractor must provide one quart samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE.

1.6.6.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph QUALIFICATION TESTING laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If MPI is chosen to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.7 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the Contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 5 gallons. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain

products with materials that have a high capacity to absorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.8 SAFETY AND HEALTH

Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100, threshold limit values.

d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in Section 02 83 00 LEAD REMEDIATION. Additional guidance is given in SSPC Guide 6 and SSPC Guide 7. Refer to drawings for list of hazardous materials located on this project. Coordinate paint preparation activities with this specification section.

Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.9 ENVIRONMENTAL REQUIREMENTS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Do not, under any circumstances, violate the manufacturer's application recommendations.

1.9.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit Product Data Sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems. Submit Manufacturer's Instructions on Mixing: Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

2.2 COLOR SELECTION OF FINISH COATS

Provide colors of finish coats as indicated or specified. Allow Contracting Officer to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors are approximately the colors indicated and the product conforms to specified requirements.

Provide color, texture, and pattern of wall coating systems as indicated. Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated. Submit color stencil codes. Tint each coat progressively darker to enable confirmation of the number of coats.

2.3 CONCRETE FLOOR SURFACE SEALER

Clear concrete water based, wet look, floor sealer system in conformance with MPI ASM, No. 99.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, reinstall removed items by workmen skilled in the trades. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or

surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas. Refer to MPI ASM and MPI MRM for additional more specific substrate preparation requirements.

3.2.1 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

3.3 PREPARATION OF METAL SURFACES

3.3.1 New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC 7/NACE No.4; Water jetting to SSPC-SP WJ-4/NACE WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Protect shop-coated ferrous surfaces from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3 / SSPC-SP WJ-3/NACE WJ-3SSPC SP 10/NACE No. 2 / SSPC-SP WJ-2/NACE WJ-2.

3.3.2 Final Ferrous Surface Condition:

3.3.2.1 Tool Cleaned Surfaces

Comply with SSPC SP 2 and SSPC SP 3. Use as a visual reference, photographs in SSPC VIS 3 for the appearance of cleaned surfaces.

3.3.2.2 Abrasive Blast Cleaned Surfaces

Comply with SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. Use as a visual reference, photographs in SSPC VIS 1 for the appearance of cleaned surfaces.

3.3.2.3 Waterjet Cleaned Surfaces

Comply with SSPC-SP WJ-1/NACE WJ-1, SSPC-SP WJ-2/NACE WJ-2, SSPC-SP WJ-3/NACE WJ-3 or SSPC-SP WJ-4/NACE WJ-4. Use as a visual reference, photographs in SSPC VIS 4/NACE VIS 7 for the appearance of cleaned surfaces.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, or non-alkaline detergent solution in accordance with SSPC SP 1. Completely remove coating by brush-off abrasive blast if the galvanized metal has been passivated or stabilized. Do not "passivate" or "stabilize" new galvanized steel to be coated. If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC-SP WJ-3/NACE WJ-3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC-SP WJ-3/NACE WJ-3 degree of cleanliness. Spot abrasive blast rusted areas as described for steel in SSPC SP 6/NACE No.3, and waterjet to SSPC-SP WJ-3/NACE WJ-3 to remove existing coating.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Allow concrete, stucco and masonry surfaces to cure at least 30 days before painting, and concrete slab on grade to cure at least 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturer's recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

3.4.2.1 Surface Cleaning

Verify that plaster and stucco surfaces are free from loose matter and that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint is water-based.

3.4.2.2 Repair of Minor Defects

Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

3.4.2.3 Allowable Moisture Content

Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263. Verify that new plaster to be coated has a maximum moisture content of 8 percent, when measured in accordance with ASTM D4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Surface Cleaning: Clean wood surfaces of foreign matter. Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.3.6 APPLICATION

3.6.1 Coating Application

a. Comply with applicable federal, state and local laws enacted to ensure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

b. At the time of application, paint must show no signs of deterioration. Maintain uniform suspension of pigments during application.

c. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Use rollers for applying paints and enamels of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

d. Only apply paints, except water-thinned types, to surfaces that are completely free of moisture as determined by sight or touch.

e. Thoroughly work coating materials into joints, crevices, and open spaces. Pay special attention to ensure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

f. Apply each coat of paint so that dry film is of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Completely hide all blemishes.

g. Touch up damaged coatings before applying subsequent coats. Broom clean and clear dust from interior areas before and during the application of coating material.

g. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel (MPI 9) applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. h. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel (MPI 9) applied to a minimum dry film thickness of 1.0 mil or two component gloss polyurethane (MPI 72) in exterior applications.i. Provide labeling on the surfaces of all feed and cross mains to show the pipe function such as "Sprinkler System", "Fire Department Connection", "Standpipe". For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 in in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75 in in height and visible from the floor.j. All fire suppression system valves must be marked with permanent tags indicating normally open or normally closed.k. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

l. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Cover each preceding coat or surface completely by ensuring visually perceptible difference in shades of successive coats.

m. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

n. Thermosetting Paints: Apply topcoats over thermosetting paints (epoxies and urethanes) within the overcoat window recommended by the manufacturer.

o. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than one pint of suitable thinner per gallon. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.6.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table for Exterior Applications	
MPI Division	Substrate Application
MPI Division 3	REfer to Section 07 19 00 Water Repellents
MPI Division 4	Refer to Section 07 19 00 Water Repellents
MPI Division 5	Exterior Metal, Ferrous and Non-Ferrous Paint Table
MPI Division 6	Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
MPI Division 9	Exterior Stucco Paint Table
MPI Division 10	Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table

Table for Interior Applications	
MPI Division	Substrate Application
MPI Division 3	Interior Concrete Paint Table
MPI Division 5	Interior Metal, Ferrous and Non-Ferrous Paint Table
MPI Division 6	Interior Wood Paint Table
MPI Division 9	Gypsum Board, Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness, where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat unspecified surfaces the same as surfaces having similar conditions of exposure.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in MPI Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer to steel surfaces on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat. Overcoat these items with the specified ferrous-metal primer prior to application of finish coats.

e. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in MPI Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in MPI Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after

erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101ASME A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 FIRE WALL MARKING AND IDENTIFICATION

For other than existing assemblies where there is an accessible concealed floor/ceiling or attic space, fire walls, fire barriers, smoke barriers, and smoke partitions must be permanently identified with an ink roller system within 15 feet of end of each wall, and at intervals not exceeding 30 feet measured horizontally along the wall. Include lettering not less than 3 inches in height with a minimum of 3/8 inch stroke in contrasting color. Identify the fire resistive rating as applicable.

3.12 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, contact local recyclers to reclaim the materials. Set aside extra paint for future color matches or reuse by the Government. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

3.14 PAINT TABLES

All DFT's are minimum values. Use only materials with a MPI GPS-1-14 green check mark having a minimum MPI "Environmentally Friendly" E2 or E3 rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.14.1 Exterior Paint Tables

3.14.1.1 MPI Division 3: Exterior Concrete Paint Table

A. Concrete; No Table Refer to Section 07 19 00 Water Repellents.

(1) New concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs

Latex					
New and uncoated existing	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI EXT 3.1A-G1 (Flat)	MPI REX 3.1A-G1 (Flat)	MPI 3	MPI 10	MPI 10	3.5 mils
MPI EXT 3.1A-G2 (Velvet)	MPI REX 3.1A-G2 (Velvet)	MPI 3	MPI 214	MPI 214	3.5 mils
MPI EXT 3.1A-G5 (Semigloss)	MPI REX 3.1A-G5 (Semigloss)	MPI 3	MPI 11	MPI 11	3.5 mils
MPI EXT 3.1A-G6 (Gloss)	MPI REX 3.1A-G6 (Gloss)	MPI 3	MPI 119	MPI 119	3.5 mils
Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.					

3.14.1.2 MPI Division 5: Exterior Metal, Ferrous and Non-Ferrous Paint Table

A. Steel / Ferrous Surfaces

(1) New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3

Option 1: Alkyd					
New	Existing, uncoated	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.1D-G5 (Semigloss)	MPI REX 5.1D-G5 (Semigloss)	MPI 79	MPI 94	MPI 94	5.25 mils
MPI EXT 5.1D-G6 (Gloss)	MPI REX 5.1D-G6 (Gloss)	MPI 79	MPI 9	MPI 9	5.25 mils
Topcoat: Coating to match adjacent surfaces.					

Option 2: Pigmented Polyurethane

Existing, previously coated with epoxy	Primer	Intermediate	Topcoat	System DFT
MPI REX 5.1H-G6 (Gloss)	MPI 101	MPI 108	MPI 72	8.5 mils
Topcoat: Coating to match adjacent surfaces.				

B. Exterior Galvanized Surfaces (only where designated as "painted" on Drawings.

(1) New Galvanized surfaces

Waterborne Primer / Latex				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.3H-G1 (Flat)	MPI 134	MPI 10	MPI 10	4.5 mils
EXT 5.3H-G5 (Semigloss)	MPI 134	MPI 11	MPI 11	4.5 mils
MPI EXT 5.3H-G6 (Gloss)	MPI 134	MPI 119	MPI 119	4.5 mils
Topcoat: Coating to match adjacent surfaces.				

Waterborne Primer / Waterborne Light Industrial Coating				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.3J-G5 (Semigloss)	MPI 134	MPI 163	MPI 163	4.5 mils
MPI EXT 5.3J-G6 (Gloss)	MPI 134	MPI 164	MPI 164	4.5 mils
Topcoat: Coating to match adjacent surfaces.				

Epoxy Primer / Waterborne Light Industrial Coating				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.3K-G5 (Semigloss)	MPI 101	MPI 163	MPI 163	5 mils

MPI EXT 5.3K-G6 (Gloss)	MPI 101	MPI 164	MPI 164	5 mils
Topcoat: Coating to match adjacent surfaces.				

Option 1: Pigmented Polyurethane				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.3L-G6 (Gloss)	MPI 101	N/A	MPI 72	5 mils
Topcoat: Coating to match adjacent surfaces.				

C. Exterior Surfaces, Other Metals (Non-Ferrous) - Only where designated as "Painted" on Drawings.

(1) Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment

Waterborne Light Industrial Coating				
New Galvanized Surfaces	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.4F-G5 (Semigloss)	MPI 95	MPI 163	MPI 163	5 mils
MPI EXT 5.4F-G6 (Gloss)	MPI 95	MPI 164	MPI 164	5 mils
Topcoat: Coating to match adjacent surfaces.				

(2) Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports,exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

Waterborne Light Industrial Coating				
New	Primer	Intermediate	Topcoat	System DFT
MPI EXT 5.1C-G3(Eggshell)	MPI 79	MPI 161	MPI 161	5 mils

MPI EXT 5.1C-G5(Semigloss)	MPI 79	MPI 163	MPI 163	5 mils
MPI EXT 5.1C-G6(Gloss)	MPI 79	MPI 164	MPI 164	5 mils
Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.				

3.14.2 Interior Paint Tables

3.14.2.1 MPI Division 3: Interior Concrete Paint Table

A. New Concrete, vertical surfaces, not specified otherwise

Institutional Low Odor / Low VOC Latex					
New, uncoated Existing	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 3.1M-G2 (Flat)	MPI RIN 3.1L-G2 (Flat)	MPI 149	MPI 144	MPI 144	4 mils
MPI INT 3.1M-G3 (Eggshell)	MPI RIN 3.1L-G3 (Eggshell)	MPI 149	MPI 145	MPI 145	4 mils
MPI INT 3.1M-G4 (satin)	MPI RIN 3.1L-G4	MPI 149	MPI 146	MPI 146	4 mils
MPI INT 3.1M-G5 (Semigloss)	MPI RIN 3.1L-G5 (Semigloss)	MPI 149	MPI 147	MPI 147	4 mils
Topcoat: Coating to match adjacent surfaces.					

E. New concrete floors:

Epoxy					
New, uncoated Existing	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 3.2C-G6 (Gloss)	MPI RIN 3.2C-G6 (Gloss)	MPI 77	MPI 77	MPI 77	5 mils
Note: Primer may be reduced for penetration per manufacturer's instructions.					

3.14.2.2 MPI Division 4: Interior Concrete Masonry Units Paint Table

A. New Concrete Masonry

Institutional Low Odor / Low VOC Latex					
New, uncoated Existing	Filler	Primer	Intermediate	Topcoat	System DFT
MPI INT 4.2E-G2 (Flat)	MPI 4	N/A	MPI 144	MPI 144	4 mils
MPI INT 4.2E-G3 (Eggshell)	MPI 4	N/A	MPI 145	MPI 145	4 mils
MPI INT 4.2E-G4 (Satin)	MPI 4	N/A	MPI 146	MPI 146	4 mils
MPI INT 4.2E-G5 (Semigloss)	MPI 4	N/A	MPI 147	MPI 147	4 mils
Fill all holes in masonry surface					

3.14.2.3 MPI Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table - Only where designated as "Painted" on Drawings.

A. Interior New and Existing, previously painted not otherwise specified

Latex					
New	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 9.2A-G2 (Flat)	RIN 9.2A-G2 (Flat)	MPI 50	MPI 44	MPI 44	4 mils
MPI INT 9.2A-G3 (Eggshell)	RIN 9.2A-G3 (Eggshell)	MPI 50	MPI 52	MPI 52	4 mils
MPI INT 9.2A-G5 (Semigloss)	RIN 9.2A-G5 (Semigloss)	MPI 50	MPI 54	MPI 54	4 mils
Topcoat: Coating to match adjacent surfaces.					

High Performance Architectural Latex - High Traffic Areas					
New	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 9.2B-G2 (Flat)	MPI RIN 9.2B-G2 (Flat)	MPI 50	MPI 138	MPI 138	4 mils
MPI INT 9.2B-G3 (Eggshell)	MPI RIN 9.2B-G3 (Eggshell)	MPI 50	MPI 139	MPI 139	4 mils

MPI INT 9.2B-G5 (Semigloss)	MPI RIN 9.2B-G5 (Semigloss)	MPI 50	MPI 141	MPI 141	4 mils
Topcoat: Coating to match adjacent surfaces.					

-- End of Section --

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS
11/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

MASTER PAINTERS INSTITUTE (MPI)

MPI ASM	(2019) Architectural Painting Specification Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment List; G

SD-03 Product Data

Epoxy Coatings; G
Polyurethane Coatings; G

SD-04 Samples

Color Chips

SD-07 Certificates

Epoxy Coatings
Polyurethane Coatings; G
Manufacturer's Printed Instructions

1.3 QUALITY CONTROL

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

Submit an equipment list consisting of a list of proposed equipment to be used in performance of construction work.

Submit three color chips 3-inch by 4-inch or manufacture's pull-down of each finish color and gloss as scheduled.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver special coating materials to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Store special coating materials in tightly closed containers in a covered, well-ventilated area where they are not exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Store solvents, thinners, and equipment cleaners with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Submit manufacturer's catalog data including manufacturer's name and identification. Include detailed data analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Also provide manufacturer's data concerning application, thinning, and average coverage per gallon

2.2 MATERIALS

2.2.1 Epoxy Coatings

Conform to MPI ASM, No. 116 for epoxy coatings and epoxy block filler, as modified.

Resins for finish coats are based on a polyamide-cured, epoxy-resin material. Apply finish coats with a dry-film thickness of not less than 4 mils per coat. Finish color and gloss are as indicated.

2.2.1.1 Concrete Surface Coatings

Apply a epoxy coating system in conformance with MPI ASM, No. 77 for vertical concrete surfaces. Apply an epoxy slip-resistant deck coating system in conformance with MPI ASM, No. 82. Apply a prime coat to fill concrete surface pores with a total dry-film thickness of not less than 2 mils.

2.2.1.2 Masonry Surfaces Coatings

Apply a Water-Based Epoxy Coating System in conformance with MPI ASM, No. 115 . Apply a block filler to fill surface pores with a total dry-film thickness of not less than 7 mils.

2.2.1.3 Ferrous and Galvanized Metal Surface Coatings

Coatings on ferrous and galvanized metal surfaces consist of a prime coat and not less than two finish coats. Comply with MPI ASM, No. 101 for an epoxy zinc primer with a metallic-zinc pigment for the substrate to be

coated and the end use of the coated surface. Ensure resin solids and zinc pigment are not less than 80 percent of the total weight of the coating material. Apply prime coat with a total dry-film thickness of not less than 4 mils. Provide an epoxy-based finished coat as specified.

2.2.2 Polyurethane Coatings

Ensure polyurethane coatings conform to MPI ASM for each substrate indicated.

Resins for finish coats are based on a two-part, prepolymer, catalytic-cured, polyurethane material. Apply catalytic-cured coatings with a total dry-film thickness of not less than 10 mils per coat. Indicate finish color and gloss on the schedules.

2.2.2.1 Concrete Surface Coatings

Apply a polyurethane, pigmented coating system in conformance with MPI ASM, No. 72 and MPI ASM, No. 80 . Ensure the prime coat fills surface pores with a total dry-film thickness of not less than 2 mils. Finish coats are polyurethane-based material as specified

Clear concrete water based floor sealer system in conformance with MPI ASM, No. 99.

2.2.2.2 Masonry Surface Coatings

Apply a polyurethane, clear, two-component coating system in conformance with MPI ASM, No. 78. Apply block filler to fill surface pores with a total dry-film thickness of not less than 7 mils. Finish coats are polyurethane-based material as specified.

2.2.2.3 Ferrous and Galvanized Metal Surface Coatings

Apply a polyurethane, pigmented coating system in conformance with MPI ASM, No. 72, MPI ASM, No. 77, and MPI ASM, No. 101 . Apply a prime coat with a dry-film thickness of not less than 2 mils. Finish coats are polyurethane-based material as specified.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surface Preparation

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Leave clean building materials and equipment with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by the Contracting Officer, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching with water and placing them in a covered metal container

3.1.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Clean application equipment promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

3.1.2.1 Protection

A. PROTECTION: Protect work of other trades, whether to be coated or not, against damage by coating work. Correct any damage by cleaning, repairing or replacing, and refinishing, as acceptable to Architect. Provide signs, barricades, etc. as required to protect new Textured Acrylic Coating work from damage by others (see Section 1.07-B of this Division for protection times)

B. AFTER COMPLETION of work of all other trades, remove all protection materials (including other trades' if provided by them) and clean/touch up as necessary to restore coating work to new and unblemished condition.

3.1.3 Concrete Surfaces

Conform to MPI ASM for substrates indicated. Remove plates, machined surfaces, and similar items already in place that are not to be coated. Provide surface-applied protection before surface preparation and coating where removal is impractical or impossible. After completing coating operations, reinstall items that were removed.

Clean dirt, oil, grease, and incompatible paints from substrates to ensure bonding. Coordination of shop-applied prime coats with high-performance coatings is critical. Remove incompatible primers. Reprime substrate with compatible primers as required to produce coating systems indicated.

3.1.3.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk. Maximum allowable moisture content of concrete is 12 percent. Measure moisture content with an electronic moisture meter.

Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 inch to 12 inch.

Comply with SSPC 7/NACE No.4 (NACE No. 4), "Brush-Off Blast Cleaning" for abrasive cleaning.

3.1.3.2 Clay Masonry Substrates

Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.

Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 inch to 12 inch.

3.1.3.3 Steel Substrates

Remove rust and loose mill scale. Clean using methods recommended in writing by coating manufacturer. Conform to SSPC 7/NACE No.4 for blast cleaning.

3.1.3.4 Galvanized-Metal Substrates

Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.1.4 Coating Material Preparation

Mix and prepare coating materials in accordance with the coating manufacturer's printed instructions for applying the particular material and coat. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker are allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

3.1.4.1 Thinning

Thinning is done in accordance with coating manufacturer's printed directions for the particular material and coat.

3.1.4.2 Tinting

Ensure prime and intermediate coats of paint are slightly different tints from the finish coat to facilitate identification of each coat. Tinting is done by the coating manufacturer and clearly identified as to color and coat.

3.2 APPLICATION

Do not perform exterior painting in damp or rainy weather. Interior painting is not allowed until the building is enclosed and has thoroughly dried out. Painting is not allowed below 50 degrees F or above 95 degrees F. Apply paint in accordance with the coating manufacturer's recommendations, and as specified.

Ensure coating application is done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Sand and dust surfaces between

coatings, as required, to produce a surface free of visible defects. Lightly sand high gloss coatings and clear finishes between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections are not acceptable. Remove defective coating applications and re-coat as directed.

Ensure coating lines such as wainscots are sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Ensure surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, meet the dry-film thickness not less than specified.

3.2.1 Brush Application

Use clean, proper size brushes for high-quality application of the specified coating materials. Brush out slow-dry coatings. Brush out quick-dry coatings only enough to spread out evenly.

3.2.2 Roller Application

Use clean roller covers of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.

Ensure roller application is equivalent in all respects to the same coats applied by high-quality brush application.

3.2.3 Spray Application

Do not allow spray application of coatings.Spray application equipment is limited to airless-spray equipment and electrostatic-spray equipment. Ensure equipment is clean and operated by workmen skilled in high quality application of coating materials.

Cover surfaces adjacent to sprayed areas to prevent damage from overspray, coating rebound, and spray drift.

APPLICATION:

A. After proper preparation of various wall assemblies as described in section 3.1. Apply coating materials in accordance with the manufacturer's instructions and recommendations as required to achieve the appearance of the approved samples and achieve performance standards as specified herein. Coating materials shall be used as a system that may include primers or under coatings as required by the manufacturer's installation directions.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Test

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

3.3.2 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

-- End of Section --

SECTION 10 14 00.10

EXTERIOR SIGNAGE
08/17, CHG 1: 11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2019) Recommended Practices for Resistance Welding
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A1011/A1011M	(2023) 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
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for

	Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D3841	(2016) Standard Specification for Glass Fiber-Reinforced Polyester Plastic Panels
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3611	(2011; Rev E; Stabilized (S) 2011) Plastic Sheet, Polycarbonate General Purpose

1.2 GENERAL REQUIREMENTS

All exterior signage must be provided by a single manufacturer. Exterior signage must be of the design, detail, sizes, types, and message content shown on the drawings, must conform to the requirements specified, and must be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet must include sign location, sign type, and message. Signs must be complete with lettering, framing as detailed, and related components for a complete installation. Each sample must consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.2.1 Wind Load Requirements

Exterior signage must be designed to withstand windloads indicated on Structural Drawings. Submit design analysis and supporting calculations performed in support of specified signage.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings must have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs must be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When

used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

SD-03 Product Data

Modular Exterior Signage System

Installation

Exterior Signage; G

Wind Load Requirements

SD-04 Samples

Exterior Signage; G

SD-10 Operation and Maintenance Data

Protection and Cleaning; G

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment must essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials must be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period must be provided.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage must consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage must be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.2 DIMENSIONAL BUILDING LETTERS

2.2.1 Fabrication

Letters must be fabricated from cast aluminum 0.125 inch aluminum sheet or extruded aluminum . Letters must be cleaned by chemical etching or cleaned

ultrasonically in a special degreasing bath. Letters must be packaged for protection until installation.

2.2.2 Typeface

Typeface must be ARIAL or as indicated.

2.2.3 Size

Letter size must be 12" or as indicated.

2.2.4 Finish

Baked enamel or two-component acrylic polyurethane finish must be provided.

2.2.5 Mounting

Threaded studs of number and size as recommended by manufacturer, must be used for concealed anchorage. Letters, studs, and sleeves must be of the same material. Supply templates for mounting.Provide solid backup behind wall panels on outside face of metal studs.

2.3 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products must conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions must be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products must conform to AWS C1.1M/C1.1.

2.4 ORGANIC COATING

Clean, prime and give surfaces a semi-gloss baked enamel or two-component acrylic polyurethane finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

2.5 STEEL PRODUCTS

Structural steel products must conform to ASTM A36/A36M. Sheet and strip steel products must conform to ASTM A1011/A1011M. Welding for steel products must conform to AWS D1.2/D1.2M.

2.6 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting must be 5 to 7 year premium type and must be in accordance with the flammability requirements of ASTM E84 and must be a minimum 0.003 inch film thickness. Film must include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.7 FIBER-REINFORCED POLYESTER (FRP) PANELS

Fiber-reinforced polyester (FRP) must be in accordance with ASTM D3841, Type II, Grade 1, Class 124.

2.8 ACRYLIC SHEET

Acrylic sheet must be in accordance with the flammability requirements of ASTM E84 and must conform to ANSI Z97.1.

2.9 POLYCARBONATE SHEET

Polycarbonate sheet must conform to SAE AMS3611.

2.10 ANCHORS AND FASTENERS

Exposed anchor and fastener materials must be compatible with metal to which applied and must match in color and finish and must be non-rusting, non-corroding, and non-staining. Exposed fasteners must be tamper-proof.

2.11 SHOP FABRICATION AND MANUFACTURE

2.11.1 Factory Workmanship

Work must be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled must be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Welding to or on structural steel must be in accordance with AWS D1.1/D1.1M. Welding must be continuous along the entire area of contact. Exposed welds must be ground smooth. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practical. Items specified to be galvanized must be by hot-dip process after fabrication if practical. Galvanization must be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet must be in accordance with ASTM A924/A924M. Joints exposed to the weather must be formed to exclude water. Drainage and weep holes must be included as required to prevent condensation buildup.

2.11.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.11.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, must be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete must not be painted. Upon completion of work, damaged surfaces must be recoated.

2.12 COLOR, FINISH, AND CONTRAST

Color must be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. Circuits installed underground must conform to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Steel conduits installed underground and illuminated signage mounted directly on buildings must be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs must be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces must not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials must be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work must be protected against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering must be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions must include simplified diagrams for the equipment as installed. Signs must be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames must be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass must be protected from paint. Finish must be free of scratches or other blemishes.

-- End of Section --

SECTION 10 28 13

TOILET ACCESSORIES
08/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-1691	(1994; Rev F) Construction and Material Schedule for Military Medical and Dental Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Product Schedule; G

Submit product Schedule indicating types, quantities, sizes, and installation locations by room for each toilet accessory item required. Identify locations using room designations indicated on the drawings.

SD-03 Product Data

Item A5030 Bench, Stall, Shower, Built In; G

Item A5080 Dispenser, Paper Towel, SS, Surface Mounted; G

Item A5109 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, W/C Accessible; G

Item A5110 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, Shower Use; G

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G

Item A5140 Hook, Garment, Security; G

Item A5170 Rod, Shower Curtain, 1 inch Diameter, W/Curtain & Hooks; G

Item A5195 Dispenser, Toilet Tissue, SS, 1-Roll, Surface Mntd; G

Item A5202 Soap Dispenser, wall-mount; G

Item A5205 Mirror, SS, Surface Mounted; G

Item A5209 Toilet Seat Cover Dispenser, Surface Mntd; G

Soap Dispenser, Wall-mount vertical type, SS, 1200ml minimum capacity, corrosion-resistant valve; G

Mirror, Electro-copper plated plate glass, SS frame, 24" x 36"; G

Combination Paper Towel Dispenser / Waste Receptacle, 400 C-fold - single fold or quarter fold, key lock for towel door; G

Toilet Seat Cover Dispenser, Surface-mount, SS, 250 capacity; G

Submit catalog numbers, literature, data sheets, construction details, profiles, anchoring and mounting requirements and other pertinent data for each toilet accessory item to evaluate function, materials, dimensions and appearance.

Accessory Items

SD-07 Certificates

Baby Changing Stations

SD-10 Operation and Maintenance Data

Item A5030 Bench, Stall, Shower, Built In; G

Item A5080 Dispenser, Paper Towel, SS, Surface Mounted; G

Item A5109 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, W/C Accessible; G

Item A5110 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, Shower Use; G

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G

Item A5140 Hook, Garment, Security; G

Item A5170 Rod, Shower Curtain, 1 inch Diameter, W/Curtain & Hooks; G

Item A5195 Dispenser, Toilet Tissue, SS, 1-Roll, Surface Mntd; G

Item A5207 Combination Towel Bar, SS, Surface Mntd; G

Item L1200 Cabinet, Specimen, Pass Thru, CRS; G

Soap Dispenser, Wall-mount vertical type, SS, 1200ml minimum capacity, corrosion-resistant valve;

Mirror, Electro-copper plated plate glass, SS frame, 24" x 36";

Combination Paper Towel Dispenser / Waste Receptacle, 400 C-fold - single fold or quarter fold, key lock for towel door;

Toilet Seat Cover Dispenser, Surface-mount, SS, 250 capacity; G

Submit Data Package 1 for each toilet accessory item in accordance

with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of one year from date of final acceptance of the work..

PART 2 PRODUCTS

2.1 ACCESSORY ITEMS

Provide toilet accessories where indicated in accordance with Contractor-provided product schedule. Conform to the requirements for accessory items specified herein which are based on MIL-STD-1691 Joint Schedule Numbers (JSN). Refer to Restroom Accessories Schedule on Drawings for Accessory Abbreviations.

Provide stainless steel products listed herein manufactured from materials containing a minimum of 50 percent recycled content.

2.1.1 Anchors and Fasteners

Provide corrosion-resistant anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory. Provide fasteners proposed for use for each type of wall construction and mounting.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.1.3 Item A5030 Bench, Stall, Shower, Built-In

Wall mounted shower seat. Frame made of 18 gauge stainless steel with satin finish. Seat made of one piece of 1/2 inch thick nonporous solid phenolic with slots to permit water to drain, secured to frame with stainless steel carriage bolts and acorn nuts. Mounting hardware included. Seat to support a minimum static load of 250 pounds. Hinge seat to fold up when not in use. Seat complies with ADA guidelines.

Approximate size: 34 inches wide by 22 inches deep by 1/2 inch thick.

2.1.4 Item A5080 Dispenser, Paper Towel, SS, Surface Mounted

Surface mounted unit constructed of stainless steel with satin finish, welded construction, and have full length piano hinge, tumbler lock, refill indicator. Unit has smooth corners, free of burrs and sharp edges. Unit has a capacity of 400 single fold paper towels.

Approximate size: 11 inches wide by 8 inches high by 6 inches deep.

2.1.5 Item A5109 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, W/C Accessible

Grab bar of 1-1/4 inch diameter satin finish stainless steel with peened gripping surface for use in toilet stall/room. Snap-on flange covers for concealed mounting are stainless steel and equipped with two screw holes for attachment to wall. Grab bars designed to meet and exceed ADA requirements for structural strength. Grab bars designed to withstand loads of 900 pounds when properly installed. Clearance from wall to grab bar is 1-1/2 inches to meet ADA and ANSI codes.

2.1.6 Item A5110 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, Shower Use

Grab bar of 1-1/4 inch diameter satin finish stainless steel with peened gripping surface. Snap-on flange covers for concealed mounting stainless steel. Bent ends of tubing pass through the flanges and are Heliarc welded for maximum strength. Grab bars designed to meet and exceed ADA requirements for structural strength. Grab bars designed to withstand loads of 900 pounds when properly installed. Clearance from wall to grab bar is 1-1/2 inches to meet ADA and ANSI codes.

2.1.7 Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mounted

Surface mounted mop/broom holder with shelf made of 18 gauge stainless steel with all exposed surfaces in satin finish. Unit has shelf 8 inches deep with shelf support brackets of satin finish stainless steel welded to mounting base, and a minimum of 3 hooks/3 holders. Mop holders have spring-loaded rubber cams and hold mop or broom handle with a diameter between 5/8 inch and 1 inch.

Approximate size: 36 inches wide by 8 inches deep.

2.1.8 Item A5140 Hook, Garment, Security

Surface mounted safety hook made of stainless steel and secured to wall with tamper resistant mounting screws, exposed mounting. Mounting hardware to be included. Hook designed to snap down when it exceeds load limit.

2.1.9 Item A5170 Rod, Shower Curtain, 1 Inch Diameter, W/Curtain & Hooks

Shower Curtain Rod with concealed mounting. Shower curtain rod made of satin finish stainless steel, 1 inch diameter, with flanges included, and have white vinyl shower curtain, 72 inches high, and stainless steel curtain hooks. Shower curtain has corrosion resistant grommets, reinforced heading, and treated with antibacterial and flame retardant agents. Shower hooks are stainless steel. Length as indicated on drawings.

2.1.10 Item A5195 Dispenser, Toilet Tissue, SS, 1-Roll, Surface Mounted

Concealed surface mounted single roll toilet tissue dispenser of satin finish stainless steel. Spindle to be free-spinning for non-controlled

delivery, chrome-plated high impact resistant plastic and equipped with heavy-duty internal spring. Unit accommodates standard core toilet paper roll up to 5-1/2 inches diameter. Mounting hardware included.

Approximate size: 7-3/4 inches wide by 2 inches high by 4 inches deep.

2.1.11 Item A5202 Soap Dispenser, wall-mount

Vertical type, SS, 1200ml minimum capacity, corrosion-resistant valve.

Approximate size of shelf: 18 inches wide by 5 inches deep.

2.1.12 Item A5205 Mirror

Electro-copper plated plate glass, SS frame, 24" x 36".

2.1.13 Item A5207 Combination Towel Dispenser / Waste Receptacle, SS, Surface Mounted,

400 C-fold - single fold or quarter fold, key lock for towel door.

2.1.14 Item A5209 Toilet Seat Cover Dispenser, Surface Mounted

SS Dispenser with 250 capacity.

Approximate size: 13 inches wide by 12 inches high by 6 inches deep.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone sealantsealant specified in Section 07 92 00 JOINT SEALANTS) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with corrosion-resistant fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood

studs, or to backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --

SECTION 10 44 16

FIRE EXTINGUISHERS
11/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	(2021) Fire Code
NFPA 10	(2022; ERTA 1 2021) Standard for Portable Fire Extinguishers
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 505	(2018) Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.157	(2003) Portable Fire Extinguishers

UNDERWRITERS LABORATORIES (UL)

UL 299	(2012; May 2021) Dry Chemical Fire Extinguishers

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Extinguishers

Accessories

Cabinets

Wall Brackets

Schedule

SD-03 Product Data

Fire Extinguishers

Accessories

Cabinets

Wall Brackets

Replacement Parts List

SD-07 Certificates

Fire Extinguishers Certifications

Manufacturer's Warranty with Inspection Tag

1.3 DELIVERY, STORAGE, AND HANDLING

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

Provide portable fire extinguishers in compliance with NFPA 505 for all ancillary vehicles where Fire Safety Standard for Powered Industrial Trucks, including type designations, special conditions relating to areas of use, conversions, maintenance, or specific operations apply.

1.4 WARRANTY

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than five (5) years after completion.

Submit the manufacturer's warranty with inspection tag.

1.5 PROJECT SCHEDULE

For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details performed in the factory and product data for the following items: Fire Extinguishers; Accessories, cabinets, and Wall Brackets.

2.1 SYSTEM DESCRIPTION

2.1.1 Types

Submit fire extinguishers certifications showing compliance with local codes and regulations.

Provide fire extinguishers conforming to NFPA 10. Provide quantity and placement in compliance with the applicable sections of NFPA 1, NFPA 101, and 29 CFR 1910.157.

Provide dry chemical type fire extinguishers compliant with UL 299.

2.1.2 Material

Provide corrosion-resistant steel extinguisher shell.

2.1.3 Size

Dimension cabinets to accommodate the specified fire extinguisher.

2.1.4 Accessories

2.2 EQUIPMENT

2.2.1 Cabinets

2.2.1.1 Material

Provide corrosion-resistant steel cabinets.

2.2.1.2 Type

Provided cabinet type for walls as scheduled on Drawings.

2.2.1.3 Size

Dimension cabinets to accommodate the specified fire extinguishers.

2.2.2 Wall Brackets

Provide spring-clip fire extinguisher wall brackets.

Provide wall bracket and accessories as approved.

2.2.2.1 Identification

Provide lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by the drawings.

Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

Orientation: Vertical.

PART 3 EXECUTION

3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

Comply with the manufacturer's recommendations for all installations.

3.2 PROTECTION

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Submit replacement parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

SECTION 10 51 13

PPE LOCKERS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2023) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B456	(2017; R 2022) Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486	(Rev J) Lockers, Clothing, Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Types; G

Location; G

Installation

SD-03 Product Data

Material

Locking Devices

Handles

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips; G

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color indicated.

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

PART 2 PRODUCTS

2.1 TYPES

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

2.1.1 Single-tier Lockers

Single-tier lockers must be as follows:

Type STC-2: Four-tier locker 12 inches wide, 18 inches deep, and 72 inches high, attached to 6-inch high closed base

2.1.2 Double-Tier

Double-tier lockers must be as follows:

Double-tier locker 24 inches wide, 20 inches deep, and 72 inches high, attached to 6-inch high legs

2.2 MATERIAL

2.2.1 Steel Sheet (Perforated Sides and Doors)

ASTM A1008/A1008M, commercial quality, minimized spangle material. Prepare material surfaces for baked enamel finishing in accordance with FS AA-L-00486. Fabricate locker bodies from not less than 0.0239-inch thick steel sheet.

2.2.2 Chromium Coating

Nickel and chromium electrodeposited on the specified base metal. Conform to ASTM B456, SC-3, as applicable to the base metal.

2.2.3 Finish

FS AA-L-00486.

2.2.3.1 Color

Four-Tier Personal Lockers: As selected.
Double-Tier PPE Lockers: As selected.

2.3 COMPONENTS

2.3.1 Built-In Locks

FS AA-L-00486. Provide locking devices as a padlock eye in the door latching mechanism.

2.3.2 Coat Hooks

FS AA-L-00486, chromium plated.

2.3.3 Door Handles

FS AA-L-00486. Provide zinc alloy or steel handles with a chromium coating.

2.3.4 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

2.3.4.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0787 inch thick steel sheet. A full height piano hinge may be provided if standard with the manufacturer. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

2.3.4.2 Latching Mechanisms

FS AA-L-00486.

2.3.5 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0787 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

2.3.6 Silencers

FS AA-L-00486.

2.3.7 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0239 inch thick steel sheet.

2.3.8 Sloping Locker Tops

Provide sloping locker tops in addition to the locker-section flat tops. Sloping tops must be continuous in length. Provide fillers or closures at the exposed end of sloping tops. Fabricate sloping tops from not less than 0.0478-inch thick steel sheet.

2.3.9 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

2.3.10 Base Panels

FS AA-L-00486.

2.3.11 Legs

Provide lockers without legs, as indicated.

2.3.12 Number Plates

FS AA-L-00486. Aluminum . Provide consecutive numbers from starting at 100.

2.3.13 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall and base with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively as indicated .

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

SECTION 13 34 19

METAL BUILDING SYSTEMS
08/20, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual
AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2007) Standard Definitions for Use in the Design of Steel Structures
AISI D100	(2017) Cold-Formed Steel Design Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc

	Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A500/A500M	(2023) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501/A501M	(2021) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A529/A529M	(2019) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A606/A606M	(2023) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A755/A755M	(2018) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes
ASTM A1008/A1008M	(2023) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2023) 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
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B695	(2021) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C273/C273M	(2020) Standard Test Method for Shear Properties of Sandwich Core Materials
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C991	(2023) Flexible Glass Fiber Insulation for Metal Buildings
ASTM C1289	(2023a) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D522/D522M	(2017) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D822	(2013; R 2018) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2022) Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1056	(2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2002; R 2013) Effect of Household

	Chemicals on Clear and Pigmented Organic Finishes
ASTM D1621	(2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D1622/D1622M	(2014) Apparent Density of Rigid Cellular Plastics
ASTM D1667	(2022) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2021) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2015; R 2020) Standard Practice for Testing Water Resistance of Coatings in 100?Percent Relative Humidity
ASTM D2794	(1993; R 2019) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D6226	(2021) Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM DEFONLINE	(2008) ASTM Online Dictionary of Engineering Science and Technology
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2022a; E 2023) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E119	(2022) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E136	(2022) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C
ASTM E331	(2000; R 2023) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by

	Uniform Static Air Pressure Difference
ASTM E1592	(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E1646	(1995; R 2018) Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Air Pressure Difference
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2014) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
ASTM G152	(2013; R 2021) Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013; R 2021) Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2018) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2022) Standard for Fire Doors and Other Opening Protectives
NFPA 252	(2022) Standard Methods of Fire Tests of Door Assemblies

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan	(2020) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15	(1999; E 2004) Steel Joist Shop Primer/Metal Building Primer
SSPC Painting Manual	(2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1
SSPC SP 2	(2018) Hand Tool Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety -- Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023) Structural Engineering
UFC 4-010-01	(2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(updated continuously online) Building Materials Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Design Parameters

Design and construct pre-engineered metal buildings of size, shape, height, fenestration, siting, and configuration indicated. Coordinate site utility services, accessibility requirements, vehicular and pedestrian access, mechanical, electrical, plumbing and fire protection requirements, interior construction and finishes, and such other items as may be necessary for a complete, functional building.

1.2.2 Structural Performance

Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within the limits and conditions indicated.

1.2.2.1 Engineering

Design metal building systems conforming to procedures described in MBMA MBSM.

1.2.2.2 Design Loads

Design and construct to the requirements of UFC 3-301-01, Structural Engineering, and for the loads as indicated in the Design Criteria Schedule on the Structural Drawings (Sheet S-001).

1.2.3 Anti-terrorism Requirements

Design metal building systems to comply with the requirements of UFC 4-010-01.

1.2.4 Water Penetration for Metal Roof Panels

No water penetration when tested according to ASTM E1646 at test-pressure difference of 2.86 lbf/sq.ft. .

1.2.5 Water Penetration for Metal Wall Panels

No water penetration when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq.ft. and not more than 12 lbf/sq. ft.

1.2.6 Wind-Uplift Resistance

Design for wind-uplift resistance as indicated in the Design Criteria Schedule on the Structural Drawings (Sheet S-001) and in accordance with UFC 3-301-01.

1.2.7 Story Drift and Deflections

Design structure to limit story drift and structural member deflections as indicated in the Structural Design Criteria on the Structural Drawings (Sheet S-001) and in accordance with UFC 3-301-01.

1.2.8 Erection Plan

Provide plans and a written erection/lifting procedure with required plans clearly showing the intended sequence and method of erection in accordance with EM 385-1-1 "Safety - Safety and Health Requirements". Indicate required crane lifting requirements, temporary support structures, member size and locations of braced or guyed temporary supports, and locations of bracing or guys anchor points. Clearly define the required framing sequence and conditions necessary to ensure the structure is maintained in a properly braced and stable condition throughout the complete erection process.

1.3 DEFINITIONS

a. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to end wall (outside face of end-wall girt) for end bays.

b. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).

c. Eave Height: Vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and

wall.

d. Terminology Standard: Refer to MBMA "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SYSTEM DESCRIPTION

General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, Mechanical Platform, cold-formed steel (CFS) load-bearing exterior perimeter walls, interior partitions, and accessories complying with requirements indicated.

Provide metal building system of size and with spacing, slopes, and spans indicated.

1.4.1 Primary Frame Type

a. Rigid Modular: Solid-member, structural-framing system with interior columns.1.4.2 Fixed End-Wall Framing

Provide manufacturer's standard fixed end wall, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.

1.4.3 Secondary Frame Type

Provide manufacturer's purlins, studs, and joists and exterior-framed (bypass) girts (exept where required to be partially inset).

1.4.4 Eave Height

Eave height must be, as indicated by nominal height on Drawings.

1.4.5 Bay Spacings

Bay Spacing must be As indicated on Drawings.

1.4.6 Roof Slopes

Roof slopes must be as indicated on the Architectural Drawings.

1.4.7 Roof System

Provide manufacturer's standard standing-seam metal roof panels - refer to roof system as indicated on Drawings for insulation requirements.

1.4.8 Exterior Wall System

Provide factory-assembled, CFS stud walls, insulated metal wall panels complete with vapor barrier conforming to ASTM E96/E96M or, where required, an exterior wall system complying with UFC 4-010-01 and these specifications for the project location and site characteristics.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Qualifications; G

SD-02 Shop Drawings

Detail Drawings; G

Erection Plan; G

SD-03 Product Data

Manufacturer's Catalog Data; G

SD-04 Samples

Coil Stock, 12 inches long by the actual panel width; GRoof Panels, 12 inches long by actual panel width; G

Wall Panels, 12 inches long by actual panel width; G

Fasteners; G

Metal Closure Strips 10 inches long of each type; G

Manufacturer's Color Charts and Chips, 4 by 4 inches; G

SD-05 Design Data

Manufacturer's Descriptive and Technical Literature; G

Manufacturer's Building Design Analysis; G

Lateral Force Calculations; G

SD-06 Test Reports

Test Reports; G

Coatings and Base Metals; G

Factory Color Finish Performance Requirements; G

SD-07 Certificates

System Components; G

Coil Stock Certificates; G

Galvanizing Repair Paint; G

Qualification of Manufacturer; G

Qualification of Erector; G

SD-08 Manufacturer's Instructions

Installation of Roof and Wall panels; G

Shipping, Handling, and Storage; G

SD-11 Closeout Submittals

Manufacturer's Warranty; G

Contractor's Warranty for Installation; G

1.6 QUALITY ASSURANCE

1.6.1 Pre-Erection Conference

After submittals are received and approved but before metal building system work, including associated work, is performed, the Contracting Officer will hold a pre-erection conference to review the following:

a. The detail drawings, specifications, and manufacturer's descriptive and technical literature.

b. Finalize construction schedule and verify availability of materials, erector's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to metal building system erection, including, but not limited to: qualification of manufacturer, qualification of erector, manufacturer's catalog data, manufacturer's building design analysis,lateral force calculations, written instructions and test reports. Lateral force calculations must include all analysis and confirmation of system components required to transfer lateral forces to the foundation.

d. Support conditions for compliance with requirements, including alignment between and erection of structural members.

e. Flashing, special roofing and siding details, roof and wall penetrations, openings, and condition of other construction that will affect the metal building system, including coatings and base metals, factory color finish performance requirements, system components, and coil stock certificates.

f. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.

g. Temporary protection requirements for metal panel assembly during and after installation.

h. Samples of wall panels, and galvanizing repair paint.

1.6.1.1 Pre-Roofing and Siding Installation Conference

After structural framing system erection and approval but before roofing,

siding work, including associated work, is performed; the Contracting Officer will hold a pre-roofing and siding conference to review the following:

a. Examine purlins, sub-girts and formed shapes conditions for compliance with requirements, including flatness and attachment to structural members.

b. Review structural limitations of purlins, sub-girts and formed shapes during construction and after roofing and siding.

c. Review flashings, special roof and wall details, roof drainage, roof and wall penetrations, roof equipment curbs, and condition of other construction that will affect the metal building system.

d. Review temporary protection requirements for metal roof and wall panels' assembly during and after installation.

e. Review roof and wall observation and repair procedures after metal building system erection.

1.6.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products, erection of structural framing and installation of wall panels in the geographical area where construction will take place.

1.6.3 Manufacturer's Qualifications

Metal building system manufacturer must have a minimum of five years experience as a qualified manufacturer and a member of MBMA of metal building systems and accessory products.

Provide engineering services by an authorized currently licensed engineer in the geographical area where construction will take place, having a minimum of four years experience as an engineer knowledgeable in building design analysis, protocols and procedures for the "Metal Building Systems Manual" (MBMA MBSM); ASCE 7-16, the building code in the geographic area where the construction will take place and ASTM E1592. Provide certified engineering calculations using the products submitted for:

a. Roof and Wall Wind Loads with basic wind speed, exposure category, co efficients, risk category, designate type of facility, negative pressures for each zone, methods and requirements of attachment.

b. Roof Dead and Live Loads

c. Collateral Loads

d. Foundation Loads

e. Roof Snow Load

f. Seismic Loads

1.6.4 Qualification of Erection Contractor

An experienced erector who has specialized in erecting and installing work

similar in material, design, and extent to that indicated for this Project and must be approved and certified by the metal building system manufacturer.

1.6.5 Single Source

Obtain primary and secondary components and structural framing members, each type of metal roof, wall and liner panel assemblies, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6.6 Welding

Qualify procedures and personnel according to AWS A5.1/A5.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.

1.6.7 Structural Steel

Comply with AISC 325, AISC 360, for design requirements and allowable stresses.

1.6.8 Cold-Formed Steel

Comply with AISC/AISI 121 and AISI D100 for design requirements and allowable stresses.

1.6.9 Fire-Resistance Ratings

Where indicated, provide metal panels identical to those of assemblies tested for fire resistance in accordance with ASTM E119, as certified by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL Bld Mat Dir or from the listings of another qualified testing agency. Combustion Characteristics must conform to ASTM E136.

1.6.10 Surface-Burning Characteristics

Provide metal panels having insulation and vapor barrier material with the following surface-burning characteristics as determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency showing:

a. Flame-Spread Index: 25 or less.

b. Smoke-Developed Index: 450 or less.

1.6.11 Fabrication

Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles with dimensional and structural requirements. Provide metal panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Aluminum and aluminum-alloy sheet and plate must conform to ASTM B209. Fabricate metal panel side laps with factory-installed captive gaskets or separator

strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal building system manufacturer for application, but not less than thickness of metal being secured.

1.6.12 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.7 SHIPPING, HANDLING AND STORAGE

1.7.1 Delivery

Package and deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

1.7.2 Storage

Stack and store metal panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Store in a manner to prevent bending, warping, twisting, and surface damage. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage. Retain strippable protective covering on metal panel for entire period up to metal panel installation.

1.7.3 Protection of Materials

Protect foam-plastic insulation as follows:

a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to project site before installation time.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction to minimize ultraviolet exposure.

1.8 PROJECT CONDITIONS

1.8.1 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing panel system or building.

1.8.2 Field Measurements

1.8.2.1 Established Dimensions for Foundations

Comply with established dimensions on approved anchor-bolt plans, established foundation dimensions, and proceed with fabricating structural framing. Do not proceed without verifying field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.8.2.2 Established Dimensions for Metal Panels

Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8.2.3 Verification Record

Verify locations of all framing and opening dimensions by field measurements before metal panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

Coordinate final design and placement of foundation between structural engineer of record, geotechnical engineer, MBMA and Contractor. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in section on CAST-IN-PLACE CONCRETE.

Coordinate installation of fire suppression system equipment supports piping and supports and accessories, which are specified in Division 21 - FIRE SUPPRESSION.

Coordinate installation of plumbing system equipment supports piping and supports and accessories, which are specified in Division 22 - PLUMBING.

Coordinate installation of HVAC system equipment supports ductwork and supports piping and supports and accessories, which are specified in Division 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

Coordinate installation of equipment supports and roof penetrations, which are specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY

1.10.1 Building System Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal building system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government. The warranty must provide that if within the warranty period, the metal building system shows evidence of deterioration resulting from defective materials or workmanship, correcting of any defects is the responsibility of the metal building system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal building system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and will not void the warranty.

1.10.2 Roof System Weather-Tightness Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the roof panel system shows evidence of corrosion, perforation, rupture, lost of weather-tightness or excess weathering due to deterioration of the panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal building system manufacturer.

Repairs that become necessary because of defective materials and workmanship while roof panel system is under warranty are to be performed within 48 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform temporary repairs within 48 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty. Immediate follow-up and completion of permanent repairs must be performed within 30 days from date of notification.

1.10.3 Wall Panel Finish Warranty

Furnish manufacturer's no-dollar-limit warranty for the metal panel system. The warranty period is to be no less than 20 years from the date of acceptance of the work and be issued directly to the Government.

The warranty is to provide that if within the warranty period the metal panel system shows evidence of checking, delaminating cracking, peeling, chalk in excess of a numerical rating of eight, as determined by ASTM D4214 test procedures; or change colors in excess of five CIE or Hunter units in accordance with ASTM D2244 or excess weathering due to deterioration of the panel system resulting from defective materials and finish or correction of the defective workmanship is to be the responsibility of the metal building

system manufacturer.

Liability under this warranty is exclusively limited to replacing the defective coated materials.

Repairs that become necessary because of defective materials and workmanship while roof and wall panel system is under warranty are to be performed within 32 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 32 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAMING MATERIALS

2.1.1 Steel Shapes and Plates

Wide flange and WT shapes: ASTM A992/A992M; ASTM A572/A572M or ASTM A529/A529M. Angles, Channels and Plates: ASTM A36/A36M, ASTM A572/A572M or ASTM A529/A529M.

2.1.2 Steel Pipe

ASTM A36/A36M, ASTM A53/A53M, ASTM A572/A572M or ASTM A529/A529M.

2.1.3 Cold-Formed and Hot Formed Hollow Structural Sections

Cold formed: ASTM A500/A500M or ASTM B221, ASTM B221M. Hot-formed: ASTM A501/A501M.

2.1.4 Structural-Steel Sheet

Hot-rolled, ASTM A1011/A1011M or cold-rolled, ASTM A1008/A1008M.

2.1.5 Metallic-Coated Steel Sheet

ASTM A653/A653M, ASTM A606/A606M.

2.1.6 Metallic-Coated Steel Sheet Pre-painted with Coil Stock Coating

Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755/A755M.

a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, and ASTM A123/A123M.

2.1.7 High-Strength Bolts, Nuts, and Washers

ASTM F3125/F3125M, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436/F436M hardened carbon-steel washers.

Finish: Hot-dip zinc coating, ASTM A153/A153M.

Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, heavy-hex-head steel structural bolts with spline.

Finish: Mechanically deposited zinc coating, ASTM B695.

2.1.8 Anchor Rods

ASTM F1554.

a. Configuration: Straight or headed, minimum 3/4 inch diameter, minimum 24 inch embedment.

b. Nuts: ASTM A563 heavy hex carbon steel.

c. Plate Washers: ASTM A36/A36M carbon steel.

d. Washers: ASTM F436/F436M hardened carbon steel.

e. Finish: Hot-dip zinc coating, ASTM A153/A153M.

2.1.9 Threaded Rods

Manufacturer's standard.

a. Nuts: ASTM A563MASTM A563 heavy hex carbon steel.

b. Washers: ASTM A36/A36M carbon steel.

c. Finish: Hot-dip zinc coating, ASTM A153/A153M or Mechanically deposited zinc coating, ASTM B695.

2.1.10 Primer

SSPC-Paint 20 or SSPC Paint 29, (zinc-rich primer).

2.2 FABRICATION

2.2.1 General

Comply with MBMA MBSM - "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

2.3 STRUCTURAL FRAMING

2.3.1 General

Clean all framing members to remove loose rust and mill scale. Provide 1 shop coat of primer to an average dry film thickness of 1 mil according to SSPC SP 2. Balance of painting and coating procedures must conform to SSPC Paint 15 and SSPC Painting Manual.

2.3.2 Primary Framing

Manufacturer's standard structural primary framing system includes transverse and lean-to frames; rafter, rakes, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing designed to withstand required loads and specified requirements. Provide frames with attachment plates, bearing plates, and splice members. Provide frame span and spacing indicated.

Shop fabricate framing components by welding or by using high-strength bolts to the indicated size and section with base-plates, bearing plates, stiffeners, and other items required. Cut, form, punch, drill, and weld framing for bolted field erection.

a. Rigid Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Manufacturer to provide interior steel columns as required - refer to Drawings for additional information.

b. Frame Configuration: Single gable.

c. Exterior Column Type: Uniform depth at gable ends and interior. Tapered at eave ends and at corners.

d. Rafter Type: Tapered.

e. Mechanical Platform Framing: Uniform depths or tapered.

2.3.3 Secondary Framing

Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, studs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated.

Shop fabricate framing components by roll-forming or break-forming to the indicated size and section with base-plates, bearing plates, stiffeners, and other plates required for erection. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

a. Purlins: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; minimum depth as required to comply with system performance requirements .

b. Girts: C or Z-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange minimum depth as required to comply with system performance requirements .

c. Eave Struts: Unequal-flange, C-shaped sections; fabricated from steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.

d. Flange Bracing: Structural-steel angles or cold-formed structural tubing to stiffen primary frame flanges.

e. Sag Bracing: Structural-steel angles.

f. Base or Sill Angles: Zinc-coated (galvanized) steel sheet.

g. Purlin and Girt Clips: Steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.

h. Secondary End-Wall Framing: Manufacturer's standard sections (girts, studs, and tracks) fabricated from zinc-coated (galvanized) steel sheet .

i. Framing for Openings: Channel shapes; fabricated cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.

j. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

2.3.4 Bracing

Provide adjustable wind bracing as follows:

a. Rods: ASTM A36/A36M; ASTM A572/A572M; or ASTM A529/A529M threaded a minimum of 8 inches at each end.

b. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.

c. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

d. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through roof deck or through roof x-bracing.

e. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

2.4 PANEL MATERIALS

Steel Sheet

Roll-form steel roof and wall panels to the specified profile, with fy = 24 gauge and minimum depth as indicated. Steel sheets must contain a minimum recycled content of 25 percent. Provide data identifying percentage of recycled content for steel sheet materials. Material must be plumb and true, and within the tolerances listed:

a. Galvanized Steel Sheet conforming to ASTM A653/A653M and AISI D100.

b. Individual panels to have continuous length to cover the entire length of any unbroken roof slope or wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide wall panels with thermal expansion and contraction consistent with the type of system specified;

Metal wall panel profile to be a 2-1/2 inch high box rib, 12 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.Metal wall panel profile to be box rib.

2.4.1 Foam-Insulation Core Metal Wall Panel

Provide factory-formed steel panel assembly fabricated from two sheets of metal with modified polyisocyanurate or polyurethane foam insulation core foamed-in-place during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.

a. Closed-Cell Content: 90 percent when tested according to ASTM D6226,

ASTM C1289.

b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D1622/D1622M.

c. Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.

d. Shear Strength: 26 psi when tested according to ASTM C273/C273M.

2.4.2 Insulated Panel Construction

Shop fabricate or field assemble insulated panel construction with specified exterior and interior steel sheet in accordance with manufacturer's printed instructions.

Insulation to be glass-fiber-ASTM C991 conforming to ASTM C553 and ASTM C612 of thickness and density as required for the geographical area where construction will take place.

Insulation fasteners to be adhesively attached, plate welded to projecting spindle anchors; capable of holding insulation of thickness indicated, secured in position with self-locking washer and complying with the following requirements:

a. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

c. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

d. Anchor adhesive to be a product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

2.4.3 Finish

All panels are to receive a factory-applied polyvinylidene fluoride of Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 0.05 mils for a total

dry film thickness of 1.00 plus 0.10 mils. This finish coat must be oven-cured.

d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash-coat must be oven-cured.

e. Color: The exterior finish chosen from the manufacturer's color charts and chips.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

Chalking: ASTM DEFONLINE
Color Change and Conformity: ASTM D2244
Weatherometer: ASTM G152, ASTM G153 and ASTM D822
Humidity: ASTM D2247 and ASTM D714
Salt Spray: ASTM B117
Chemical Pollution: ASTM D1308
Gloss at 60 degrees: ASTM D523
Pencil Hardness: ASTM D3363
Reverse Impact: ASTM D2794
Flexibility: ASTM D522/D522M
Abrasion: ASTM D968
Flame Spread: ASTM E84

2.5 MISCELLANEOUS METAL FRAMING

2.5.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.5.2 Fasteners for Miscellaneous Metal Framing

Refer to the following paragraph FASTENERS.

2.6 FASTENERS

2.6.1 General

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7-16 requirements.

2.6.2 Exposed Fasteners

Fasteners for metal panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.6.3 Screws

Screws to be corrosion resistant coated steel, aluminum or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.6.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.6.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A653/A653M or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.7 FRAMES AND MATERIALS FOR OPENINGS

2.7.1 Doors

Fire-Rated and Non-Fire-Rated Door Assemblies conforming with NFPA 80 and based on testing according to NFPA 252 as specified in Division 08 - OPENINGS unless otherwise indicated.

2.8 ACCESSORIES

2.8.1 General

All accessories to be compatible with the metal panels; sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.8.2 Roof and Wall Accessories and Specialties

Equipment supports, roof hatches, dropout-type heat and smoke vents, hatch-type heat and smoke vents, gravity and roof ridge ventilators, wall louvers and other miscellaneous roof and wall equipment or penetrations conforming to AAMA, ASTM, and UL as specified in Division 07 unless otherwise indicated.

2.8.3 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D1056 and ASTM D1667; extruded or molded to the configuration of the specified metal panel and in lengths supplied by the metal panel manufacturer.

2.8.4 Metal Closure Strips

Factory fabricated closure strips to be the same material, thickness, color, finish and profile of the specified wall panel.

2.6.6 Joint Sealants

2.8.5 Sealants

Sealants are to be an approved gun type for use in hand or air-pressure caulking guns at temperatures above 40 degrees F(or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.8.6 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.8.7 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C920, Type II. Color to match panel colors.

2.8.8 Tape Sealant

Pressure sensitive, 100 percent solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the metal panel manufacturer.

2.9 SHEET METAL FLASHING AND TRIM

2.9.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.10 FINISHES

2.10.1 General

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

2.10.2 Appearance of Finished Work

Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable

variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

Before erection proceeds, examine with the erector present, the concrete foundation dimensions, concrete and masonry bearing surfaces, anchor bolt size and placement, survey slab elevation, locations of bearing plates, and other embedments to receive structural framing with the metal building manufacturer's templates and drawings before erecting any steel components for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Examine primary and secondary framing to verify that rafters, purlins, angles, channels, and other structural and metal panel support members and anchorages have been installed within alignment tolerances required by metal building manufacturer, UL, ASTM, ASCE 7-16 and as required by the building code for the geographical area where construction will take place.

Examine roughing-in for components and systems penetrating metal roof or wall panels to verify actual locations of penetrations relative to seam locations of metal panels before metal roof or wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Erector, listing conditions detrimental to performance of the Work.

Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Provide temporary shoring, guys, braces, and other supports during erection to keep the structural framing secure, plumb, and in alignment against temporary construction loading or loads equal in intensity of the building design loads. Remove temporary support systems when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment and performance.

Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous support members or anchorage for the metal roof or wall panels, doors, windows, roof curbs, ventilators and louvers according to metal building manufacturer's written instructions.

3.3 ERECTION OF STRUCTURAL FRAMING

Erect metal building system according to manufacturer's written erection instructions, approved shop drawings and other erection documents in accordance with MBMA MBSM - "Metal Building Systems Manual".

Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer and the Contracting Officer.

Set structural framing accurately in locations and to elevations indicated and according to AISC 325 specifications. Maintain structural stability of frame during erection.

Clean and roughen concrete bearing surfaces prior to setting plates. Clean bottom surface of plates. Place non-shrink grout between the concrete bearing surfaces and the column base plates, as indicated on the Structural Drawings and in accordance with AISC 360 and UFC 3-301-01.

Align and adjust structural framing before permanent bolt-up and connections. Perform necessary adjustments and alignment to compensate for changes or discrepancies in elevations.

Maintain erection tolerances of structural framing in accordance with AISC 360.

3.4 METAL WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.5 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place in accordance with NRCA RoofMan and MBMA MBSM.

Erect roofing system in accordance with the approved erection drawings, the printed instructions and safety precautions of the metal building manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Do not install bent, chipped, or defective sheets.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake and eave overhang.

Work must allow for thermal movement of the roofing, movement of the

building structure, and provide permanent freedom from noise due to wind pressure.

Field cutting metal roof panels by torch is not permitted.

Roofing sheets must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; the side laps of standard exterior corrugated sheets must be not less than 2-1/2 corrugations.

Do not permit storage, walking, wheeling, or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of roof construction.

3.6 METAL PANEL FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.7 FLASHING, TRIM AND CLOSURE INSTALLATION

a. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

b. Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.8 DOOR AND FRAME INSTALLATION

Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each door frame with elastomeric sealant compatible with metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.9 WINDOW INSTALLATION

Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fastened in place according to manufacturer's written instructions. Coordinate installation with metal panel flashings and other components. Caulk and seal perimeter of each window frame with elastomeric sealant compatible with for metal panels. Comply with installation requirements in Division 08 - OPENINGS.

3.10 ACCESSORY INSTALLATION

3.10.1 General

Install accessories with positive anchorage to building and weather-tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

3.10.2 Dissimilar Metals

Where dissimilar metals contact one another or corrosive substrates are present, protect against galvanic action by painting dissimilar metal surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each surface, or by other permanent separation techniques as recommended by the metal building manufacturer.

3.10.3 Gutters and Downspouts

Comply with performance requirements, manufacturer's written installation instructions, and install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA 1793 recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.10.4 Insulation

Comply with performance requirements and manufacturer's written installation instructions. Install insulation concurrently with metal panel installation, in thickness indicated to cover entire roof and wall area, as specified in Division 07 - THERMAL AND MOISTURE PROTECTION.

3.10.5 Roof and Wall Accessories and Specialties

Install roof and wall accessories and specialties complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports as specified in Division 07 - THERMAL AND MOISTURE PROTECTION, unless otherwise indicated.

3.11 CLEAN-UP AND PROTECTION

3.11.1 Structural Framing

Clean all exposed structural framing at completion of installation. Remove metal shavings, filings, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.2 Metal Panels

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove protective coverings/films, grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

3.11.3 Touch-Up Painting

After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories. Clean and touch-up paint with manufacturer's touch-up paint.

3.12 WASTE MANAGEMENT

Dispose of construction waste in accordance with the requirements of Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

3.13 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Perform special inspections and testing for seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.14 WARRANTY

3.14.1 Manufacturer's Warranty

Submit all manufacturers' signed warranties to Contracting Officer prior to final commissioning and acceptance.

3.14.2 Contractor's Warranty For Installation

Submit warranty for installation to the Contracting Officer prior to final commissioning and acceptance.

3.14.3 Contractor's No Penal Sum Warranty

CONTRACTOR'S NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM

FACILITY DESCRIPTION:_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____
ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____
ADDRESS:_____

POINT OF CONTACT:_____
_
TELEPHONE NUMBER:_____

CONTRACTOR'S NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY [_____] FOR A PERIOD OF TWENTY 20 YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:

FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM.

ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE MUST BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY MUST BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER.

THIS WARRANTY COVERS THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON [_____] AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(continued)

THE CONTRACTOR HEREBY SUPPLEMENTS THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH IS SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR IS ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL,INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, GUTTERS AND DOWNSPOUTS; OR CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING SIDING.

6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND BUILDING SYSTEM DEFICIENCIES MUST BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, MUST BE INITIATED IMMEDIATELY; A WRITTEN PLAN MUST BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSMR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT MUST BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED

CONTRACTOR'S NO PENAL SUM WARRANTY
FOR
METAL BUILDING SYSTEM
(Exclusions from Coverage Continued)

POST A FRAMED COPY OF THIS WARRANTY IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 13 48 73

SEISMIC CONTROL FOR MISCELLANEOUS EQUIPMENT
05/22

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 355.2	(2007) Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
ACI 355.4	(2011) Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4) and Commentary

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A500/A500M	(2023) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A603	(2019) Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM E488/E488M	(2022) Standard Test Methods for Strength of Anchors in Concrete Elements
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156	(2012) Acceptable Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components
ICC-ES AC23	(2012; R 2016) Acceptance Criteria for Sprayed Fire-resistant Materials (SFRMs), Intumescent Fire-resistant Coatings and Mastic Fire-resistant Coatings Used to Protect Structural Steel Members

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA-4	(2004) Metal Framing Standards Publication

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023) Structural Engineering
UFC 4-010-01	(2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)

VISCMA 412	(2014) Installing Seismic Restraints for Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures, described in this section and on the drawings, of the miscellaneous equipment and systems listed below, in accordance with UFC 3-301-01 and additional data furnished by the Contracting Officer. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. Where there is a conflict between the specifications and the drawings, the specifications will take precedence. Accomplish resistance to lateral forces induced by earthquakes without consideration

of friction resulting from gravity loads.

1.2.2 Miscellaneous Equipment and Systems

Provide bracing and attachment for the following miscellaneous equipment and components developed by the Contractor in accordance with the requirements of this specification:

Equipment/Components with Ip = 1.0
Storage cabinets
Ornamentations
Storage Racks
Shelving
Partitions
Stacks
Pole or frame supported equipment
Storage tanks for water and oil

1.2.3 Contractor Designed Bracing

Submit copies of the design calculations with the drawings. Calculations must be approved, certified, stamped and signed by a registered Professional Structural Engineer. Calculations must verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-301-01, UFC 4-010-01 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes must be accomplished without consideration of friction resulting from gravity loads. UFC 3-301-01 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas must be required. Loadings determined using UFC 3-301-01 are based on strength design; therefore, AISC 325 Specifications must be used for the design. The bracing for the equipment designated in paragraph 1.2.2 must be developed by the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing; G

Resilient Vibration Isolation Devices; G

Equipment Requirements; G

SD-03 Product Data

Bracing; G

Equipment Requirements; G

Anchor Bolts; G

Vibration Isolators; G

Snubbers; G

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Anchor Bolts; G

SD-07 Certificates

ICC ES AC156 Shake Table Test; G

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings of bracing along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed in Paragraph 1.2.2. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. Provide calculations and drawings that are stamped by a registered structural engineer, and that verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static seismic loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility sufficient to be used for the installation. Equipment must be rigidly or flexibly mounted as indicated in the specifications and/or drawings depending on vibration isolation requirements as follows below. Roof mounted equipment both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for seismic restraint and wind loads.

2.1.1 Rigidly (Base and Suspended) Mounted Equipment

Equipment furnished under this contract must be rigidly mounted using cast-in-place anchor bolts to anchor them or post-installed anchors that are qualified for earthquake loading in accordance with ACI 355.2 and ACI 355.4. Anchor bolts must conform to ASTM F1554-07ae1. For any rigid equipment which is rigidly anchored, provide flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions. Suspended equipment bracing attachments should be located just above the center of gravity to minimize swinging.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/4 inch. Equipment flexibly mounted on vibration isolators must have a bumper restraint or

snubber in each horizontal direction and vertical restraints must be provided where require to resist overturning. Isolator housing and restraints must be constructed of ductile materials. A viscoelastic pad or similar material of appropriate thickness must be used between the bumper and components to limit the impact load. Restraints must be designed to resist the calculated horizontal lateral and vertical forces.

Spring vibration isolators must be seismically rated, restrained isolators for equipment subject to load variations and large external forces. The seismically rated housing must be sized to meet or exceed the force requirements applicable to the project and meet the required isolation criteria. Spring vibration isolator manufacturer's will be a member of VISCMA. Design force, Fp, must be doubled for vibration isolators with an air gap greater than 0.25 inches as specified in ASCE 7-16, Chapter 13.

2.2 BOLTS AND NUTS

Hex head bolts, and heavy hexagon nuts must be ASTM A325 or ASTM A490 bolts and ASTM A563 nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground or exposed to weather.

2.3 SWAY BRACING

Material used for members listed in this section and on the drawings, must be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A36/A36M.

b. Wire rope, ASTM A603.

c. Tubes, ASTM A500/A500M, Grade B.

d. Pipes, ASTM A53/A53M, Grade B.

e. Angles, ASTM A36/A36M.

f. Channels (Struts) with in-turned lips and associated hardware for fastening to channels at random points conforming to MFMA-4.

PART 3 EXECUTION

3.1 BRACING

Provide bracing conforming to the arrangements shown. Install cables at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 412.

3.2 BUILDING DRIFT

Do not attach sway braces for equipment to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Bracing must be capable of accommodating building drift due to seismic displacements.

3.3 ANCHOR BOLTS

3.3.1 General

Submit copies of test results to verify the adequacy of the specific anchor

and application, as specified.

Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices allowing adequate edge distance and embedment depth for restraint anchor bolts. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Install neoprene grommet washers or till the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inches.

3.3.2 Cast-In-Place

Use templates to locate cast-in-place bolts accurately and securely in formwork. Provide anchor bolts with an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads must either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths. Use templates to locate cast-in-place bolts accurately and securely in formwork.

3.3.3 Drilled-In Anchor Bolts

Drill holes with rotary impact hammer drills. Drill bits must be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the drawings, all holes must be drilled perpendicular to the concrete surface. Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the COR if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Perform anchor installation in accordance with manufacturer instructions. For Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10 percent of the specified torque, 100 percent of the specified torque must be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor must be removed and replaced unless otherwise directed by the Engineer.

For Cartridge Injection Adhesive Anchors where approved for seismic application, clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive must be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed. For Capsule Anchors where approved for seismic application, perform drilling and setting operations in accordance

with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors must be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.3.4 Anchor Bolt Testing

Test in place expansion and chemically bonded anchors not more than in accordance with manufacturer approval reports hours after installation of the anchor, conducted by an independent testing agency; testing must be performed on random anchor bolts as described below.

3.3.4.1 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque must equal the minimum required installation torque as required by the bolt manufacturer. Calibrate torque wrenches at the beginning of each day the torque tests are performed. Recalibrate torque wrenches for each bolt diameter whenever tests are run on bolts of various diameters. Apply torque between 20 and 100 percent of wrench capacity. Reach the test torque within one half turn of the nut, except for 3/8 inch sleeve anchors which must reach their torque by one quarter turn of the nut. If any anchor fails the test, test similar anchors not previously tested until 20 consecutive anchors pass. Failed anchors must be retightened and retested to the specified torque; if the anchor still fails the test it must be replaced.

3.3.4.2 Pullout Testing

Test expansion and chemically bonded anchors by applying a pullout load using a hydraulic ram attached to the anchor bolt. Testing must be done in accordance with ASTM E488/E488M or ICC-ES AC23. At least 5 percent of the anchors per day must be tested. Apply the load to the anchor without removing the nut; when that is not possible, the nut must be removed and a threaded coupler must be installed of the same tightness as the original nut. Check the test setup to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus must be at least 1.5 times the embedment length away from the bolt being tested. Load each tested anchor to 1 times the design tension value for the anchor. The anchor must have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested must be tested until 10 consecutive anchors pass. Failed anchors must be retightened and retested to the specified load; if the anchor still fails the test it must be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, select anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations that follow the same procedure as in paragraph ANCHOR BOLTS, except use an equipment weight equal to five times the actual equipment weight.

3.4.1 Spring-Type Vibration Devices

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/2 inch. Equipment flexibly mounted on vibration isolators must have a bumper restraint or snubber in each horizontal direction and vertical restraints must be provided where required to resist overturning. Isolator housing and restraints must be constructed of ductile materials. A viscoelastic pad or similar material of appropriate thickness must be used between the bumper and components to limit the impact load. Restraints must be designed to resist the calculated horizontal lateral and vertical forces.

Spring vibration isolators must be seismically rated, restrained isolators for equipment subject to load variations and large external forces. The seismically rated housing must be sized to meet or exceed the force requirements applicable to the project and meet the required isolation criteria. Spring vibration isolator manufacturers will be a member of VISCMA.

3.4.2 Multidirectional Seismic Snubbers

Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment. Use snubbers that provide 1/4 inch free vertical and horizontal movement from the static deflection point. Provide snubber medium consisting of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 EQUIPMENT SWAY BRACING

3.5.1 Suspended Equipment

Provide equipment sway bracing for items supported from floor, overhead floor or roof structural systems. Provide braces that consist of angles, rods, wire rope, bars, channels (struts) or pipes arranged as shown in bracing submittals and secured at both ends with not less than 1/2 inch bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-301-01 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with UFC 3-301-01 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.5.2 Floor or Pad Mounted Equipment

3.5.2.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Provide the number and installation of bolts to resist shear forces in accordance with paragraph ANCHOR BOLTS.

3.5.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the

resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

3.6 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Equipment and components designated as Designated Seismic Systems required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise.

Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches x 7 inches with red letters 1 inch in height on a white background stating "Certified Equipment." The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.7 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS AND EQUIPMENT

Perform special inspections for seismic-resisting systems, equipment and components designated seismic systems and equipment per ICC IBC 1705.12.4; and storage racks per ICC IBC 1705.12.7. Periodic special inspections will be conducted on miscellaneous equipment as required by Section 1705.12 of the International Building Code and paragraph 2-2.4.3 of UFC 3-301-01. Provide a Statement of Special Inspections and Final Report in accordance with paragraph 2-2.4.3 of UFC 3-301-01.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
11/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1/CSA 4.1	(2017) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3/CSA 4.3	(2019) Gas-Fired Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
ANSI Z21.22/CSA 4.4	(2015) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	(2012; R 2017) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.6.1M	(1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2019) Standard for Floor and Trench Drains
ASME A112.6.4	(2003: R 2012) Roof, Deck and Balcony Drains
ASME A112.14.1	(2003; R 2017) Backwater Valves
ASME A112.19.2/CSA B45.1	(2018; ERTA 2018) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.36.2M	(1991; R 2017) Cleanouts
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.12	(2019) Cast Iron Threaded Drainage Fittings
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2011) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
ASME B16.29	(2017) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.50	(2013) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B16.51	(2013) Copper and Copper Alloy Press-Connect Pressure Fittings
ASME B31.1	(2018) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME CSD-1	(2016) Control and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2016) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1018	(2001) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002
ASSE 1019	(2011; R 2016) Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2017) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(2010; Addenda 2011) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2015) Grooved and Shouldered Joints
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C652	(2011) Disinfection of Water-Storage Facilities

AWWA C700	(2015) Cold-Water Meters - Displacement Type, Metal Alloy Main Case
AWWA C701	(2015) Cold-Water Meters - Turbine Type for Customer Service

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	(2016) Specification for Brazing Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A74	(20207) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	(2018) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2014) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2019) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A518/A518M	(1999; R 2018) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A733	(2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A888	(2020) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal

ASTM B42	(2015a) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	(2014) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B88	(2016) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2018) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B306	(2013) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C564	(2014) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1053	(2000; R 2010) Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2235	(2004; R 2016) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D2239	(2012) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2015) Standard Specification for Threaded

	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2657	(2007; R 2015) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D2661	(2014; E 2018) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2672	(2014) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D2683	(2014) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2737	(2012a) Polyethylene (PE) Plastic Tubing
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D2846/D2846M	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D2996	(2017) Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D3035	(2015) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

ASTM D3122	(1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D3138	(2004; R 2016) Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D4101	(2017) Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F409	(2017) Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F437	(2015) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	(2017) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441/F441M	(2015) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442/F442M	(2013; E 2013) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F477	(2014) Standard Specification for

	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F493	(2014) Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F628	(2012; E 2013; E 2016; E 2018) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F877	(2020) Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
ASTM F891	(2016) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F1290	(2019) Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F1760	(2016) Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F2389	(2019) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2018) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2012) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(2016; 14/17) Copper Tube Handbook

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117	(2005b) Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings 4 Install On CU Tubing

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities

ICC IPC	(2018) International Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	(2014) American National Standard for Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(2017) Steel Pipeline Flanges
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2017; Errata 1 2017) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2014) Class 3000 Steel Pipe Unions Socket Welding and Threaded
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends
MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NACE INTERNATIONAL (NACE)

NACE SP0169	(2013) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2018) Motors and Generators

NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2018) National Fuel Gas Code
NFPA 90A	(2018) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 372	(2016) Drinking Water System Components - Lead Content
NSF/ANSI 14	(2019) Plastics Piping System Components and Related Materials
NSF/ANSI 61	(2019) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man	(2016) Firestopping: Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	(2009) Hose Clamp Specifications

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523	(1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 141.80	National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets

Flush Valve Urinals

Wall Hung Lavatories

Countertop Lavatories

Service Sinks

Water Heaters; G

Backflow Prevention Assemblies; GWelding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; G

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the RPM, FEAD CM or Engineer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the RPM, FEAD CM or Engineer. For Navy owned property, references to the "owner" shall be interpreted to mean the RPM, FEAD CM or Engineer. For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the RPM, FEAD CM or Engineer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and

welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The RPM, FEAD CM or Engineer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the RPM, FEAD CM or Engineer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Cement pipe shall contain recycled content as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Provide data identifying percentage of recycled content for steel pipe. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet

NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces. Cast-iron pipe shall contain a minimum of 95 percent recycled content. Provide data identifying percentage of recycled content for cast iron pipe. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

f. Solder Material: Solder metal shall conform to ASTM B32.

g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.

lj. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

k. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.

l. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D3138.

m. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D2235.

n. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

o. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F493.

p. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

q. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D3122.

t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.51 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

r. Copper tubing shall conform to ASTM B88, Type K, L or M.

s. Heat-fusion joints for polypropylene piping: ASTM F2389.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B370.

c. Asphalt Roof Cement: ASTM D2822/D2822M.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78

Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key

handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.4 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.5 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 1.6 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees

and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat .

Water flushing volume of the water closet and flush valve combination shall not exceed 1.28 gallons per flush. Provide a dual-flush water closet and flush valve combination that will also provide a second flushing water volume not to exceed 1.28 gallons per flush.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.2 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, ,wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.5 gallons per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.3 Wall Hung Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, ,straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

2.4.4 Countertop Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, ,self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

2.4.5 Service Sinks

ASME A112.19.2/CSA B45.1, white vitreous china with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 0.75 inch external hose threads.

2.4.6 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.7 Emergency Eyewash and Shower

ANSI/ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.4.8 Emergency Eye and Face Wash

ANSI/ISEA Z358.1, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 3 gpm of aerated water at 30 psig flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum. Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

2.6.3 Floor Sinks

Floor sinks shall be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, ABS sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.4 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular

and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.6.5 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.6.4, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III in PART 3 of this Section for each type of water heater specified. Plastic materials

polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure.

2.8.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1/CSA 4.1 when input is 75,000 BTU per hour or less or ANSI Z21.10.3/CSA 4.3 for heaters with input greater than 75,000 BTU per hour. Provide Energy Star labeled gas storage water heater. Provide data identifying Energy Star label for gas storage water heater.

2.9 PUMPS

2.9.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be close-coupled with an overhung impeller, or supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

2.10 DOMESTIC WATER SERVICE METER

The requirements for metering and submetering are specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

2.11 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26

05 00.00 20 COMMON WORK RESULTS FOR ELECTRICAL. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 05 00.00 20 COMMON WORK RESULTS FOR ELECTRICAL.

2.12 MISCELLANEOUS PIPING ITEMS

2.12.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.12.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.12.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.12.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.12.3 Pipe Hangers (Supports)

Provide MSS SP-58 Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.12.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.12.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

a. Identification of the sensor and its operation with written description.

b. Range of the sensor.

c. Battery replacement schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping

at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or

with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

The RPM, FEAD, CM or Engineer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.5 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

d. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.2.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.2.7 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method in accordance with ASTM D2657 and ASTM F1290. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

3.1.2.8 Polypropylene Pipe

Joints for polypropylene pipe and fittings shall be made by heat fusion welding socket-type or butt-fusion type fittings and shall comply with ASTM F2389.

3.1.2.9 Other Joint Methods

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space

between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be

installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Supports

3.1.6.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when

operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.6.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE)

or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.6.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.7 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.8 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron or plastic.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas Water Heater

Installation shall conform to NFPA 54 for gas fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.2.6 Direct Fired and Domestic Water Heaters

Notify the RPM, FEAD, CM or Engineer when any direct fired domestic water heater over 400,000 BTU/hour is operational and ready to be inspected and certified.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid

interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the flushometer stop .

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed

at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 20 percent of the lowest equipment rpm.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the RPM, FEAD CM or Engineer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

Color	System	Item	Location
Red	Fire Protection	All	All

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.8.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test,

the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate

personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the

systems.

3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.12 TABLES

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS

It #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI	X	X	X	X	X		
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for	X		X	X			
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X		

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
It #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X		
10	Steel pipe, seamless galvanized, ASTM A53/A53M, Type S, Grade B	X			X	X		
11	Seamless red brass pipe, ASTM B43				X	X		X
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X		X
13	Cast copper alloy solder joint pressure fittings, ASME B16.18for use with Item 14				X	X		X
14	Seamless copper pipe, ASTM B42						X	X
15	Cast bronze threaded fittings, ASME B16.15				X	X		
16	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X	X		X
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X		X
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X		X

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS

It #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
19	Acrylonitrile-Butad (ABS) plastic drain, waste, and vent pipe and fittings ASTM D2661, ASTM F628	X	X	X	X	X	X	
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760	X	X	X	X	X	X	X
21	Process glass pipe and fittings, ASTM C1053						X	
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A518/A518M		X			X	X	
23	Polypropylene (PP) waste pipe and fittings, ASTM D4101						X	
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D2996						X	

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
G - Condensate Drain Aboveground

* - Hard Temper

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
1	Malleable-iron threaded fittings:				
	a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
4	Steel pipe:				
	a. Seamless, galvanized, ASTM A53/A53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A53/A53M, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B42	X	X		X
8	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter	X			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D3035	X			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F441/F441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437, for use with Items 20, and 21	X	X		X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438 for use with Items 20, 21, and 22	X	X		X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2464	X			X
30	Joints for IPS PVC pipe using solvent cement, ASTM D2672	X			X
31	Polypropylene (PP) plastic pipe and fittings; ASTM F2389	X	X		X
32	Steel pipeline flanges, MSS SP-44	X	X		

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A733	X	X	X	
37	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F877	X	X		X
38	Press Fittings	X	X		
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Compressed Air Lubricated D - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Gas	4,000 (btu/h)/gal and 2 gal max.	200,000 Btu/h min.	ANSI Z21.10.3	ET = 80 percent SL = (Q/800+110x(V^^1/2))

TERMS:

EF = Energy factor, minimum overall efficiency.
ET = Minimum thermal efficiency with 70 degrees F delta T.
SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements.
V = Rated storage volume in gallons
Q = Nameplate input rate in Btu/h

-- End of Section --

SECTION 26 05 00.00 20

COMMON WORK RESULTS FOR ELECTRICAL
08/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	(1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2009) Accessible and Usable Buildings and Facilities

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2015) American National Standard for Electrical Metallic Tubing (EMT)

ANSI Z535.1	(2017) Safety Colors
ANSI/NEMA OS 1	(2013) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA FU 1	(2012) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(2014) Dry-Type Transformers for General Applications
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2015) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2016) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code
NFPA 70E	(2018; TIA 18-1; TIA 81-2) Standard for Electrical Safety in the Workplace

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jan 2020) UL Standard for Safety Flexible Metal Conduit
UL 5	(2016) UL Standard for Safety Surface Metal Raceways and Fittings

UL 5A	(2015) Nonmetallic Surface Raceways and Fittings
UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 20	(2010; Reprint Feb 2012) General-Use Snap Switches
UL 198M	(2018) UL Standard for Mine-Duty Fuses
UL 360	(2013; Reprint Nov 2018) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 498	(2017; Reprint Jan 2020) UL Standard for Safety Attachment Plugs and Receptacles
UL 506	(2017) UL Standard for Safety Specialty Transformers
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint Nov 2014) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint Nov 2018) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 797	(2007; Reprint Mar 2017) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL 870	(2016; Reprint Mar 2019) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1561	(2011; Reprint Jun 2015) Dry-Type General Purpose and Power Transformers
UL 4248-1	(2017) UL Standard for Safety Fuseholders - Part 1: General Requirements
UL 4248-12	(2018) UL Standard for Safety Fuseholders - Part 12: Class R

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 150 mph wind loading in accordance with ASCE 7-16.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Marking Strips; G

SD-03 Product Data

Conduits and Raceways; G

Wire and Cable; G

Splices and Connectors; G

Switches; G

Receptacles; G

Outlet Boxes, Pull Boxes and Junction Boxes; G

Circuit Breakers; G

Panelboards; G

Dry-Type Distribution Transformers; G

Device Plates; G

SD-06 Test Reports

Continuity Test; G

Phase-Rotation Tests; G

Insulation Resistance Test; G

600-Volt Wiring Test; G

Transformer Tests; G

Ground-Fault Receptacle Test; G

Insulation-Resistance Test; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.4 QUALITY CONTROL

1.4.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FEAD CM or Engineer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.4.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide the standard cataloged materials and equipment of manufacturers regularly engaged in the manufacture of the products. For material, equipment, and fixture lists submittals, show manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose

scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Dark Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.1.1 Conduits and Raceways

2.1.1.1 Rigid Steel Conduit

Provide hot dipped galvanized rigid steel conduit complying with NEMA RN 1, ANSI C80.1, UL 6 and UL 5 as applicable. Except where installed underground, or in corrosive areas, provide polyvinylchloride (PVC), or protect from corrosion by painting with bitumastic coating or wrapping with corrosion inhibiting tape..

Use threaded fittings for rigid steel conduit.

Use solid gaskets. Ensure conduit fittings with blank covers have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Provide covers with captive screws and are accessible after the work has been completed.

2.1.1.2 Electrical Metallic Tubing (EMT)

Ensure EMT is in accordance with UL 797, UL 5, and ANSI C80.3 and is zinc coated steel. Provide zinc-coated couplings and connectors that are raintight, compression type with insulated throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.1.3 Flexible Metallic Conduit

Ensure flexible metallic conduit is galvanized steel and complies with UL 1 and UL 360.

Ensure fittings for flexible metallic conduit are specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Ensure fittings for liquidtight flexible metallic conduit are specifically designed for such conduit.

2.1.1.4 Intermediate Metal Conduit

Ensure intermediate metal conduit is galvanized steel and complies with

UL 1242, NEMA RN 1, ANSI C80.1, UL 6 and UL 5 as applicable.

2.1.1.5 Rigid Nonmetallic Conduit

Ensure rigid nonmetallic conduit complies with NEMA TC 2, NEMA TC 3, and UL 651 as applicable with a wall thickness not less than Schedule 40.

2.1.1.6 Surface Metal Raceway

Ensure surface metal raceways and multi-outlet assemblies conform to NFPA 70, and have receptacles conforming to NEMA WD 1, Type 5-20R.

UL 5, two-piece painted steel, totally enclosed, snap-cover type.Wire alternate receptacles on different circuits.

2.1.1.7 Surface Nonmetallic Raceway

UL 5A, nonmetallic totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Provide receptacles as specified herein, spaced a minimum of one every 18 inches.

2.1.2 Wireways

Ensure wireways and auxiliary gutters are a minimum 4 by 4-inch trade size conforming to UL 870.

UL 870. Material: steel galvanized 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw- cover NEMA 3R enclosure per NEMA ICS 6.

2.1.3 Outlet Boxes, Pull Boxes and Junction Boxes

Ensure outlet boxes for use with conduit systems are in accordance with NEMA FB 1 UL 514A, UL 514B, UL 514C and ANSI/NEMA OS 1 and are not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.1.4 Dry-Type Distribution Transformers

2.1.4.1 General Requirements

Ensure that general purpose dry-type transformers with windings 600 volts or less are two-winding, 60 hertz, and self-cooled in accordance with UL 506 and UL 1561. Ensure windings have a minimum of two 2-1/2-percent taps above and below nominal voltage.

Provide transformers in NEMA 1 enclosure.

Transformer insulation system:

a. 220 degrees C insulation system for transformers 15 kVA and greater, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C.

b. 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C.

2.1.4.2 Transformer Factory Tests

Submittal: include routine NEMA ST 20 transformer test results on each transformer and also provide the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

2.2 MATERIALS

2.2.1 Device Plates

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. Plates on finished walls: satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick.

d. Screws: machine-type with countersunk heads in color to match finish of plate.

e. Sectional type device plates are not be permitted.

f. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.2.2 Switches

2.2.2.1 Safety Switches

Ensure safety switches comply with NEMA KS 1, and are the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated on the drawings. Ensure fused switch fuse holders comply with UL 4248-1. Ensure switch construction is such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device is coinproof and so constructed that an external tool is used to open the cover. Make provisions to lock the handle in the "OFF" position. Ensure the switch is not capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type and terminal lugs for use with copper conductors.

Ensure safety color coding for identification of safety switches conforms to ANSI Z535.1.

2.2.2.2 Toggle Switches

Ensure toggle switches comply with EIA 480, NEMA WD 1, and UL 20 control Light Emitting Diode (LED), and fluorescent lighting fixtures and are the heavy duty, general purpose, noninterchangeable flush-type.

Provide commercial grade toggle switches, single double-pole, three four -way two-position devices rated 20 amperes at 120/277 volts, 60 hertz alternating current (ac) only.

Ensure all toggle switches are products of the same manufacturer.

2.2.3 Fuses

NEMA FU 1. Provide complete set of fuses for each fusible switch panel and control center. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.2.3.1 Fuseholders

Provide in accordance with UL 4248-1.

2.2.3.2 Cartridge, Current Limiting Type (Class R)

UL 198M, Class RK-1. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.2.3.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.2.3.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 198M, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.2.4 Receptacles

Provide the following:

a. UL 498, hard use (also designated heavy-duty), grounding-type.

b. Ratings and configurations: as indicated.

c. Bodies: white ivory brown as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.2.4.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle: switched when installed.

2.2.4.2 Weatherproof Receptacles

Provide receptacles, will be ground fault circuit interrupter type, UL listed for use in "wet locations." Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, die-cast metal/aluminum cover plate.

2.2.4.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.2.4.4 Plugs

Provide heavy-duty, rubber-covered three-, four-, or five-wire cord of required size, install plugs thereon, and attach to equipment. Provide UL listed plugs with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

2.2.4.5 Tamper-Resistant Receptacles

Provide duplex receptacle with mechanical sliding shutters that prevent the insertion of small objects into its contact slots.

2.2.5 Manufacturer's Nameplate

Ensure each item of equipment has a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable.

2.2.6 Warning Signs

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. Enclosure integrity to conform with IEEE C57.12.28, such as for pad-mounted transformers. Provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Provide decal signs with nominal dimensions of 7 by 10 inches. Print the legend "DANGER HIGH VOLTAGE" in two lines of nominal 2 inch high letters. Show the word "DANGER" in white letters on a red background and the words "HIGH VOLTAGE" in black letters on a white background.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high white letters on a red and black field.

PART 3 EXECUTION

3.1 PREPARATION

Submit manufacturer's instructions including special provisions required to

install equipment components and system packages. Special provisions include impedances, hazards and safety precautions.

Clean and paint conduit, supports, fittings, cabinets, pull boxes, and racks as specified in Section 09 90 00 PAINTS AND COATINGS.

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and abrasive action), and all outdoor installations, refer to Section 09 90 00 PAINTS AND COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by using approved fittings and treatment. Except where other equivalent protective treatment is specifically approved in writing, provide hot-dip galvanized ferrous metals for items such as, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous items not made of corrosion-resistant steel.

3.2 INSTALLATION

3.2.1 Underground Service

Underground service conductors and associated conduit: continuous from service entrance equipment to outdoor power system connection.

3.2.2 Overhead Service

Overhead service conductors into buildings: terminate at service entrance fittings or weatherhead outside building.

3.2.3 Hazardous Locations

Perform work in hazardous locations, as defined by NFPA 70, in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Provide conduit with tapered threads.

3.2.4 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.2.5 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.2.6 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or

specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches.

3.2.6.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.2.6.2 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes: not less than those indicated for the conduit installation. Fasten cables within 12 inches of each turn or offset and at 33 inches maximum intervals. Make cable terminations in accordance with NFPA 70 and cable manufacturer's recommendations. Terminate single-conductor cables of a circuit, having capacities of more than 50 amperes, in a single box or cabinet opening. Color code individual conductors in all outlets and cabinets.

3.2.7 Conduits, Raceways and Fittings

Ensure that conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting does not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or replace conduit.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space as if exposed.

3.2.7.1 Rigid Steel Conduit

Make field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use long radius conduit for elbows larger than 2-1/2 inches.

Provide a flush coupling for all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, when the floor slab is of sufficient thickness. Otherwise, provide a floor box

set flush with the finished floor. For conduits installed for future use, terminate with a coupling and plug; set flush with the floor.

3.2.7.2 Electrical Metallic Tubing (EMT)

Ground EMT in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.2.7.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Use bonding wires in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit is not considered a ground conductor.

Make electrical connections to vibration-isolated equipment with flexible metallic conduit.

Use liquidtight flexible metallic conduit in wet and oily locations and to complete the connection to motor-driven equipment.

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.2.7.4 Intermediate Conduit

Make all field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.2.7.5 Rigid Nonmetallic Conduit

Install a green insulated copper grounding conductor in conduit with conductors and solidly connect to ground at each end. Size grounding wires in accordance with NFPA 70.

3.2.7.6 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating: extend minimum 6 inches above floor.

3.2.7.7 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.2.7.8 Conduit Installed Under Floor Slabs

Conduit run under floor slab: located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.2.7.9 Conduit Installed Through Floor Slabs

Where conduits rise through floor slabs, do not allow curved portion of bends to be visible above finished slab.

3.2.7.10 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends must not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings must allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size: installed parallel with or at right angles to main reinforcement; when at right angles to reinforcement, install conduit close to one of supports of slab. Where nonmetallic conduit is used, convert raceway to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.2.7.11 Stub Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.2.7.12 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the

downward direction.

3.2.7.13 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.2.7.14 Wireway and Auxiliary Gutter

Bolt together straight sections and fittings to provide a rigid, mechanical connection and electrical continuity. Close dead ends of wireways and auxiliary gutters. Plug all unused conduit openings.

Support wireways for overhead distribution and control circuits at maximum 5 -foot intervals.

Ensure auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure contains no switches, overcurrent devices, appliances, or apparatus and is not more than 30 feet long.

3.2.7.15 Surface Raceways and Assemblies

Mount surface raceways plumb and level, with the base and cover secured. Minimum circuit run is three-wire, with one wire designated as ground.

3.2.8 Wiring

Color code feeder and branch circuit conductors as follows:

CONDUCTOR	COLOR AC
Phase A	Black (208VAC); Brown (480VAC)
Phase B	Red (208VAC); Orange (480VAC)
Phase C	Blue (208VAC); Yellow (480VAC)
Neutral	White (208VAC); Natural Gray (480VAC)
Equipment Grounds	Green with Yellow Stripe

Use conductors up to and including AWG No. 2 that are manufactured with colored insulating materials. For conductors larger than AWG No. 2, have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Match terminal and conductor identification as indicated.

Where several feeders pass through a common pullbox, tag the feeders to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.2.9 Wiring Devices

3.2.9.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates are aligned vertically to within 1/16 inch.

Bond ground terminal of each flush-mounted receptacle to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.2.9.2 Device Plates

Ensure device plates for switches are suitably engraved with a description of the loads when not within sight of the loads controlled.

Mark device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets. Show the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Use self-adhesive labels having 1/4 inch embossed letters.

Similarly mark device plates for convenience outlets indicating the supply panel and circuit number.

3.2.10 Splices and Connectors

Make all splices in AWG No. 8 and smaller with approved insulated electrical type .

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Wrap joints with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

3.2.11 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC manufacturer's recommendations. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.2.11.1 Marking Strips

Provide marking strips in accordance with the following:

a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

b. Use permanent ink for the wire numbers

c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.

d. Size marking strips to accommodate the two sets of wire numbers.

e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.

f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.

g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.2.12 Safety Switches

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height 5 feet above floor level, when possible.

3.2.13 Boxes and Fittings

Provide pullboxes where necessary in the conduit system to facilitate conductor installation. For conduit runs longer than 1000 feet or with more than three right-angle bends, install a pullbox at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure using supports that are independent of the conduit entering or leaving the boxes.

Select the mounting height of wall-mounted outlet and switch boxes, as measured between the bottom of the box and the finished floor, in accordance with ICC/ANSI A117.1 and as follows, unless otherwise indicated:

LOCATION	MOUNTING HEIGHT (inches)
Receptacles in offices	18
Receptacles in corridors	18
Receptacles in shops and laboratories	48
Receptacles in rest rooms	48
Switches for light control	48

3.2.14 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of

sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.2.15 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.2.16 Panelboards

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36-inches of the front of the panel. Ensure directory card information is complete and legible.

3.2.17 Dry-Type Distribution Transformers

Connect dry-type transformers with flexible metallic conduit.

3.2.18 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible. Maximum allowed lead length is 3 feet.

3.2.19 Field Fabricated Nameplates

Ensure nameplates conform to ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device, as specified or as indicated on the drawings. Each nameplate inscription identifies the function and, when applicable, the position. Provide nameplates that are melamine plastic, 0.125-inch thick, white with black center core and a matte finish surface with square corners. Accurately align lettering and engrave into the core. Minimum size of nameplates is 1 by 2.5 inches. Lettering is a minimum of 0.25-inch high normal block style.

3.2.20 Identification Plates and Warnings

Provide identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Attach identification plates to process control devices and pilot lights.

Install identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. For circuits 480 volts and above, install conspicuously located warning signs in accordance with OSHA requirements.

3.3 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.5 FIELD APPLIED MOUNTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.6 FIELD QUALITY CONTROL

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential is 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values is not less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes AWG No. 8 and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection end-to-end (i.e correct phase conductor, grounded conductor, and grounding conductor wiring). Repair and verify any damages to existing or new electrical equipment resulting from mis-wiring. Receive approval for all repairs prior to commencement of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment in a clockwise direction, facing the source.

Perform 600-volt wiring test on wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance: 250,000 ohms.

Perform the standard, not optional, transformer tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

Perform ground-fault receptacle test for ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

Submit test reports in accordance with referenced standards in this section.

Final acceptance requires the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved.

-- End of Section --

SECTION 26 05 19.10 10

INSULATED WIRE AND CABLE
05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1202	(2006; R 2012; CORR 1 2012) Flame-Propagation Testing of Wire and Cable

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-58-679	(2014) Control, Instrumentation and Thermocouple Extension Conductor Identification
ICEA T-30-520	(1986) Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 70,000 B.T.U./Hour

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659	(2014) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 26	(2008) Binational Wire and Cable Packaging Standard
NEMA WC 57	(2014) Standard for Control, Thermocouple Extension, and Instrumentation Cables
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA WC 74/ICEA S-93-639	(2012) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(2018) UL Standard for Safety Thermoset-Insulated Wires and Cables

UL 83	(2017) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 1685	(2015) UL Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
UL 2556	(2015) UL Standard for Safety Wire and Cable Test Methods

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wire and Cable; G

Conductors; G

Cable Manufacturing Data

SD-06 Test Reports

Test Report(s), Inspection Report(s), and Verification Report(s); G

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, must be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable must contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in paragraph "High-Voltage Test Source," must be identified as such. Shielded cables rated 2,001 volts and above must be reeled and marked in accordance with NEMA WC 26, as applicable. Reels must remain the property of the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Rated Circuit Voltages

All power wire and cable must have minimum rated circuit voltages in accordance with NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable. Power wire and cable for circuit voltages rated 0-600 volts must be rated not less than 600 volts. Control wire and cable must have minimum rated circuit voltages in accordance with NEMA WC 57, but must be rated 600 volts if routed in raceway with other conductors that are rated 600 volts.

2.1.2 Conductors

2.1.2.1 Material for Conductors

Conductors must conform to all the applicable requirements of NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable. Copper conductors must be annealed copper material and they may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used. "

2.1.2.2 Size

Minimum wire size must be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above must not be less than those listed for the applicable voltage in ANSI/NEMA WC 71/ICEA S-96-659 or NEMA WC 74/ICEA S-93-639, as applicable.

2.1.2.3 Stranding

Conductor stranding classes cited herein must be as defined for control conductors in NEMA WC 57 or as defined for 0-2,000 volts power conductors in NEMA WC 70, as applicable. Lighting conductors No. 10 AWG and smaller must be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, must have Class H or K stranding. All other conductors must have Class B or C stranding, except that conductors as shown, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG. Conductor stranding classes for circuit voltages 2,001 volts and above must be as defined in ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639, as applicable.

2.1.2.4 Conductor Shielding

Use conductor shielding conforming to NEMA WC 57 for control wire and cable as applicable. Use conductor shielding conforming to ANSI/NEMA WC 71/ICEA S-96-659 or NEMA WC 74/ICEA S-93-639, as applicable, on power cables having a rated circuit voltage above 2,000 volts.

2.1.2.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.3 Insulation

2.1.3.1 Insulation Material

Unless specified otherwise or required by NFPA 70, wires in conduit, other than service entrance, must be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW conforming to UL 44. Insulation for control wire and cable must meet the requirements of NEMA WC 57. Insulation requirements for wire and cable rated less than 2,000 volts must meet the requirements of NEMA WC 70. Insulation requirements for wire and cable rated 2,001-5,000 volts must meet the requirements of ANSI/NEMA WC 71/ICEA S-96-659. Insulation requirements for wire and cable rated 5,001 volts and greater

must meet the requirements of NEMA WC 74/ICEA S-93-639.

For shielded cables of rated circuit voltages above 2,000 volts, the following provisions must also apply:

a. XLPE, if used, must be tree-retardant.

b. Insulation must be chemically bonded to conductor shielding.

c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes must all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material must be inspected for voids and contaminants.

d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are prohibited unless specifically approved.

2.1.3.2 Insulation Thickness

The insulation thickness for each conductor must be based on its rated circuit voltage.

2.1.3.2.1 Power Cables, 2,000 Volts and Below

The insulation thickness for single-conductor and multiple-conductor power cables rated 2,000 volts and below must be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors must have a jacket.

2.1.3.2.2 Power Cables, Rated 2,001 Volts and Above

Thickness of insulation for power cables rated 2,001 volts and above must be in accordance with the following

a. Non-shielded cables, 2,001 to 5,000 volts, must comply with ANSI/NEMA WC 71/ICEA S-96-659, as applicable.

b. Shielded cables rated 5,000 volts to 46,000 volts must comply with NEMA WC 74/ICEA S-93-639, as applicable.

2.1.3.2.3 Single-Conductor and Multiple-Conductor Control Cables

The insulation thickness of control conductor sizes 22 AWG to 10 AWG used for control and related purposes must be as required by NEMA WC 57, as applicable. Control conductors larger than 10 AWG must be as required by NEMA WC 70.

2.1.3.3 Insulation Shielding

Unless otherwise specified, provide insulation shielding for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in ANSI/NEMA WC 71/ICEA S-96-659 or NEMA WC 74/ICEA S-93-639, as applicable. The material, if thermosetting, must meet the wafer boil test requirements as described in

ANSI/NEMA WC 71/ICEA S-96-659 or NEMA WC 74/ICEA S-93-639, as applicable. The method of shielding must be in accordance with the current practice of the industry; however, the application process must include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield must not exceed the maximum allowances specified in ANSI/NEMA WC 71/ICEA S-96-659 or NEMA WC 74/ICEA S-93-639, as applicable. The cable must be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system must remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove are prohibited unless specifically approved.

2.1.4 Jackets

All cables must have jackets meeting the requirements of NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, and NEMA WC 74/ICEA S-93-639, as applicable, and as specified herein. Individual conductors of multiple-conductor cables must be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, must be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables must be provided with a common overall jacket, which must be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.4.1 Jacket Material

The jacket must be one of the materials listed below. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

2.1.4.1.1 General Use

Heavy-duty black neoprene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Heavy-duty chlorosulfonated polyethylene	NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Heavy-duty cross-linked (thermoset) chlorinated polyethylene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639

2.1.4.1.2 Accessible Use Only, 2,000 Volts or Less

Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, must have jackets of one of the materials in item "a. General Use" or one of the following:

General-purpose neoprene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Black polyethylene (MDPE)	NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639
Thermoplastic chlorinated polyethylene	NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639

2.1.4.2 Jacket Thickness

The minimum thickness of the jackets must be not less than 80 percent of the respective nominal thicknesses specified below.

2.1.4.2.1 Single-Conductor Cables

Single-conductor cables must have a jacket thickness as specified in NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables must be color-coded in accordance with ICEA S-58-679, except that colored braids will not be permitted. Only one color-code method must be used for each cable construction type. Control cable color-coding must be as indicated . Power cable color-coding must be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included. Other individual conductors must be color-coded as indicated, but such color-coding may be accomplished by applying colored plastic tapes or colored sleeves at terminations.

2.2.2 Cabling

Individual conductors of multiple-conductor cables must be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639. Flat twin cables are prohibited. Fillers must be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers must be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape must consist of a material that is compatible with the other components of the cable and must be lapped at least 10 percent of its width.

2.2.3 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables must not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit cable manufacturing data as requested. The following information must be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

a. Minimum bending radius, in inches - For multiple-conductor cables, this information must be provided for both the individual conductors and the multiple-conductor cable.

b. Pulling tension and sidewall pressure limits, in pounds.

c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.

d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others must be stated. Also, if requested, recommendations must be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 TEST REPORT(S), INSPECTION REPORT(S), AND VERIFICATION REPORT(S)

3.2.1 Cable Data

Do not begin any wire and cable fabrication until materials are submitted and approved by the RPM, FEAD CM or Engineer. Submit cable data for approval including, but not limited to, dimensioned sketches showing cable construction and sufficient additional data to show that wire and cable meet the requirements of this Section.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications must be made by and at the plant of the manufacturer, and must be witnessed by the RPM, FEAD CM or Engineer, unless waived in writing. and the manufacturer must provide certification and certification reports of completed inspections and completed tests. The Government may require or perform further tests before or after installation. Testing in general must comply with NEMA WC 57, NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, or NEMA WC 74/ICEA S-93-639 as applicable. Specific tests required for particular materials, components, and completed cables must be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests must also be performed in accordance with the additional requirements specified below. Submit 5 certified copies of test reports.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits must be made with dc test voltages. Cables to be used exclusively on ac circuits must be tested with

ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages must be used.

3.2.2.2 Flame Tests

All cable assemblies must pass either the vertical cable tray flame tests required by ICEA T-30-520 (stated in, but not required by NEMA WC 70), the vertical tray flame propagation test requirements of UL 1685 and IEEE 1202, the wire and cable burning characteristics test of the UL 2556 VW-1 Test, or (for control cables only) the flame test as required by NEMA WC 57. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests must be submitted. In this case the reports furnished under paragraph "Reports," must include information, identify critical information, and verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.3 Independent Tests

The Government may make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.4 Reports

Furnish results of tests. No wire or cable must be shipped until authorized. Lot number and reel or coil number of wire and cable tested must be indicated on the test reports.

-- End of Section --

SECTION 26 05 26.00 20

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
08/19

PART 1 GENERAL

Section 26 41 00 LIGHTNING PROTECTION SYSTEMS applies to work specified in this section.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS A3.0M/A3.0	(2020) Standard Welding Terms and Definitions
AWS B2.1/B2.1M	(2014; Errata 2015) Specification for Welding Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B187/B187M	(2016) Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA GR 1	(2007) Grounding Rod Electrodes and Grounding Rod Electorode Couplings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code
NFPA 780	(2017) Standard for the Installation of

Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-607	(2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-889	(2016; Rev C) Dissimilar Metals

UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 546	(2008) UL Outline of Investigation for Conductor Termination Compounds

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Ground Rods; G

Ground Wires; G

Connectors and Fasteners; G

Test Wells; G

Conductive Corrosion Inhibiting Compounds; G

Ground Buses; G

SD-06 Test Reports

Bond Resistance Test; G

Ground Resistance Tests; G

Ground Isolation Test; G

Equipment Continuity Test; G

SD-07 Certificates

Ground Resistance Test Equipment; G

Micro-Ohmmeter Test Equipment; G

SD-11 Closeout Submittals

Record Drawings

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FEAD CM or Engineer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

1.3.3 Ground Resistance Test Equipment

Provide combination 3-point and 4-point type ground resistance test equipment specifically designed for grounding electrode resistance and soil resistivity tests. Submit proof of current equipment calibration with test equipment product data.

1.3.4 Micro-Ohmmeter Test Equipment

Perform circuit and bond resistance tests using a micro-ohmmeter with the following characteristics:

a. Resistance range selectable and capable of measuring to 10 micro-Ohms using a minimum of 1 ampere of test current.

b. Positive and negative test leads of the 2-wire balanced type. Provide both clamp and probe type connections to allow measurements across all bonded surfaces. Provide long length balanced test lead to allow measurements from a bonding location to the nearest test well.

Submit proof of current equipment calibration with test equipment product data.

PART 2 PRODUCTS

Submit material, equipment, and fixture lists for grounding systems, including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

2.1 MATERIALS

2.1.1 Ground Rods

Provide ground rods of copper conforming to UL 467 and ANSI/NEMA GR 1. Ensure ground rods are not less than 3/4 inch in diameter and 10 feet in length.

Where ground rod length is greater than 10 feet, provide sectional type ground rods with each section 10 feet in length. Join sectional type ground rods using exothermic welding completely around both rod/coupling joints. Ensure ground rods have cone-shaped point on the end of the first section driven into the ground.

Provide ground rods and ground rod sections die-stamped near the top with the name or trademark of the manufacturer and the length of the segment in feet.

2.1.2 Ground Wires

2.1.2.1 Bare

Provide annealed bare copper, Class "B" stranded ground and bond wires in accordance with ASTM B8 for wires #4 AWG and larger and solid in accordance with ASTM B3 for wires #6 AWG and smaller. Provide conductors with 98 percent conductivity and sized wires in accordance with the requirements of NFPA 70 and NFPA 780.

2.1.2.2 Insulated

Ensure insulated conductors conform to the requirements of Section 26 05 00.00 20 COMMON WORK RESULTS FOR ELECTRICAL.

Where installed in conduit as part of a complete circuit provide conductors with green insulation for sizes #8 AWG and smaller and with green phase tape at each end and in each junction box for sizes #6 AWG and larger.

2.1.2.3 Straps/Jumpers

Provide copper bonding straps and jumpers with a cross-sectional area of not less than as indicated. Ensure bonding straps and jumpers for shock-mounted devices with swivel joints are made of tinned-copper wire.

2.1.3 Connectors and Fasteners

2.1.3.1 Exothermic Welds

Ensure the molds, materials and powder charges used to make exothermic welds are the standard product of a single manufacturer and listed by the manufacturer for use on the specific type, size, quantity and configuration of conductors to which the weld is applied.

2.1.3.2 Irreversible Compression Lugs

Provide irreversible compression lug type connectors manufactured from tin-plated copper and installed using a hydraulic compression tool and die to apply correct, uniformly distributed, circumferential pressure. Ensure tools and dies are as recommended by the irreversible compression lug type connector manufacturer. Use an embossing die code or other standard method

to provide visible indication that a connector has been adequately compressed onto the conductor. Apply irreversible compression lug type connectors in strict accordance with the manufacturer's written instructions and published installation instructions. Use 2-hole lug type connectors for connections to NEMA cable pads and bus bars, and single-hole connectors otherwise.

2.1.3.3 Mechanical

Provide split bolt and clamp style mechanical type connectors manufactured from copper, listed by the manufacturer as suitable for direct burial use. Ensure mechanical type connectors are applied in strict accordance with the manufacturer's published installation instructions.

2.1.3.4 Fasteners

Provide bolts, nuts, washers, lock washers, and associated fasteners used for grounding and bonding connections manufactured of copper. Where fasteners contact dissimilar metals, apply conductive oxide-inhibiting compound.

2.1.4 Test Wells

Provide test wells that are H2O rated, precast reinforced concrete, circular rectangular, with open bottom and concrete or cast iron lid/frame. Ensure test wells have inside dimensions of not less than 15 inches wide by 22 inches long by 24 inches deep. Provide test well lid with cast "GROUND" legend.

2.1.5 Conductive Corrosion Inhibiting Compounds

Provide conductive corrosion inhibiting compounds UL Listed in accordance with UL 546, listed by the manufacturer as suitable for the application, and suitable for all aluminum and copper conductor/connector applications. Ensure conductive corrosion inhibiting compounds inhibit oxidation at the conductor/connector interface and have no deleterious effect on the conductor/connector metal or EPDM, natural rubber, or polyethylene insulating materials.

Provide gritted conductive corrosion inhibiting compound that are non-petroleum based and non-toxic, and contain conductive grit. Ensure gritted conductive corrosion inhibiting compound is specified by the manufacturer for application to the conductor/connector interface of compression connectors.

2.1.6 Ground Buses

Provide electro-tin plated, solid copper ground buses conforming to ASTM B187/B187M with minimum dimensions of 0.25 inches thick, 4 inches wide, and 12 inches in length or as indicated. Ensure ground buses are equipped with two UL Recognized red 1000V rated insulated standoffs and stainless steel mounting brackets.

Provide Telecommunications Main Ground Buses and Telecommunications Ground Buses in meeting the standards of TIA-607.

Provide grounding buses with predrilled NEMA hole configuration as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Install grounding systems in accordance with NFPA 70, NFPA 780 and IEEE C2, and as indicated.

Bond exposed non-current-carrying metallic parts of electrical equipment and metallic raceway systems to ground.

Bond grounding conductors in metallic and non-metallic raceways to ground. Make ground connections at equipment and to ground rods as indicated. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems.

Bond wiring system neutrals to ground in accordance with the requirements of NFPA 70. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

Counterpoise ground systems consist of a series of ground rods with a direct buried grounding conductor loop, configured to minimize the number of dead-ends, interconnecting the individual ground rods. Provide ground rods in the locations indicated.

3.1.1 Ground Rods

Install ground rods so that the top of the rod is not less than 18 inches below finished grade.

3.1.2 Conductors

Install bare or insulated conductors as indicated. Install bare conductors where not specifically identified as bare or insulated except where installed in conduit with associated phase conductors. Install insulated conductors in conduit with insulation of the same material as the associated phase conductors with which it is installed.

Provide straps/jumpers across joints subject to vibration. Install strap/jumper such that vibration will not change its electrical characteristics. Apply strap/jumper to the metallic structure on each side of the joint; do not penetrate any adjacent parts. Install straps/jumpers in areas that are accessible for maintenance. Install strap/jumper such that it does not restrict the movement of the metallic structures to which it is connected. Install strap/jumper such that it does not weaken the metallic structures to which it is attached. Do not connect two or more straps/jumpers in series.

3.1.3 Counterpoise

Install No. 4/0 AWG bare copper counterpoise grounding conductor direct buried outside of the structure drip line, within 24 to 72 inches of the structure foundation, with a minimum of 18 inches of earth cover. Install counterpoise grounding conductor in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved

areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the conductor.

Install ground rods vertically into the earth not less 10 feet with top of ground rod not less than 18 inches below finished grade. Bond ground rods to counterpoise grounding conductor at intervals no less than 20 linear feet nor greater than 40 linear feet of ground counterpoise cable.

3.1.4 Ground Buses

Install ground busses in accordance with manufacturer's instructions.

3.1.5 Building Grounds

Install No. 4/0 AWG bare copper ground conductor from concrete encased foundation rebar and every corner column and intermediate exterior column to counterpoise. Connect conductors to rebar using exothermic welds. Install one conductor a minimum of every 60 feet of concrete foundation perimeter. Connect ground conductors to columns and counterpoise using exothermic welds.

3.1.6 Equipment Grounding

Install ground systems for power, telecommunications, and instrumentation. Independently connect each system to the building counterpoise.

3.1.6.1 Equipment and Enclosure Bonding

Bond each metallic enclosure and all electrical equipment to ground. Make at least one copper connection from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

Individually and directly connect indoor substations, transformers, switchboard frames, switchgear assemblies, motors, motor control centers, air compressors, air handlers, refrigerated air dryers, generators, frames and tracks of cranes, to the building ground. Ensure the current-carrying capacity of the grounding conductor is the same as the current-carrying capacity of the power conductors for circuits utilizing power lines size No. 2 AWG and smaller. For circuits with power wiring larger than No. 2 AWG, ensure the grounding conductor is in accordance with NFPA 70.

3.1.6.2 Bonding of Conduit and Raceway Systems

Bond all metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways. Ensure adequate electrical contact at the joints and terminations. Ensure metallic raceway systems have electrical continuity with equipment. Individually and directly connect equipment to the building ground, independent of the raceway system.

For rigid metal conduit and terminations, ensure threaded connections are wrench-tight with no exposed threads. Ream all ends of the conduit to remove burrs and rough edges. Bond conduits entering boxes and enclosures to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

Conduit systems that are interrupted by PVC dielectric links are bonded separately on either side of the link. Do not jumper the dielectric link.

Install flexible metal conduit with an integral grounding conductor.

3.1.6.3 Cable Tray Bonding

Bond cable tray sections together. Cable tray sections in tandem assembly are considered as having electrical continuity when these sections are bonded with the appropriate bolts. Install bond straps across expansion joints. Bond cable trays to the building ground system.

3.1.7 Bonding Materials And Methods

Accomplish bonding of metal surfaces by welding clamping structural joining methods.

3.1.7.1 Welding

Weld using the exothermic process with procedures conforming to AWS A3.0M/A3.0, AWS B2.1/B2.1M, and manufacturer's recommendation. Where dissimilar metals are to be joined via exothermic weld, follow the weld kit manufacturer's recommendations and published instructions. Ensure connections between dissimilar metals do not produce galvanic action in accordance with MIL-STD-889.

Use welding processes of the exothermic fusion type that makes a connection without corroding or loosening. Ensure process joins all strands and does not cause the parts to be damaged or weakened. Completed connection or joint is equal or larger in size than the conductors joined and has the same current-carrying capacity as the largest conductor. Paint the buried ground connections with a bitumastic paint.

3.1.7.2 Clamping

In external locations, use clamping only where a disconnect type of connection is required. Connection device may utilize threaded fasteners. Construct device such that positive contact pressure is maintained at all times. Use machine bolts with spring-type lockwashers.

3.1.7.3 Cleaning of Bonding Surfaces

Thoroughly clean surfaces that comprise the bond before joining. Apply an appropriate abrasive with gentle and uniform pressure to ensure a smooth and uniform surface. Do not remove excessive metal from the surface. Clean clad metals in such a manner that the cladding material is not penetrated by the cleaning process. Then clean bare metal with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Bond to the cleaned area within one hour after cleaning. Seal joint and refinish the exposed surfaces within two hours of exposure to prevent oxidation. When additional time is required, apply a corrosion preventive compound until the area can be refinished.

3.1.7.4 Protection of Finished Bonds

Protect finished bonds by painting to match the original finish after the bond is made.

3.2 FIELD QUALITY CONTROL

Perform the following tests in the presence of the RPM, FEAD CM or Engineer. Furnish test equipment and personnel and submit written results of each

test. Notify the RPM, FEAD CM or Engineer at least 14 calendar working days prior to each test.

Submit written results of each test to RPM, FEAD CM or Engineer for review and approval. Document each location where test is performed, the field conditions at the time of the test, the measured results of the test, and whether the measured results "PASSED" or "FAILED" relative to specified pass/fail performance criteria.

Perform rework to correct FAILED conditions at no additional cost to the Government.

3.2.1 Bond Resistance Test

Resistance of any bond connection cannot exceed 0.5 milliohm. Rework bonds that exceed this resistance at no additional cost to the Government.

3.2.2 Ground Resistance Tests

Test grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise cannot exceed 50 milliohms.

Make ground resistance and counterpoise tests during dry weather, and no sooner than 48 hours after rainfall. Conduct tests using the ratio method that measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE 81.

3.2.3 Ground Isolation Test

Test ground systems for isolation from other ground systems.

3.2.4 Equipment Continuity Test

Test connection from electrical distribution equipment including panelboards, switchboards, transformers, substations, and motor control centers to counterpoise. Measure and record the circuit resistance between electrical equipment ground connections and the counterpoise. The circuit resistance shall not exceed 5 Ohms.

3.3 CLOSEOUT ACTIVITIES

Submit record drawings indicating the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

-- End of Section --

SECTION 26 05 71.00 20

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES
02/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	((2014; Errata 2016) Electric Meters - Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)

ASTM D877/D877M	(2019) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 443	(1979) NARM Standard for Solid State Relays Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.17	(2012) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
IEEE C37.90	(2005; R 2011) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.13	(2016) Requirements for Instrument Transformers
IEEE C63.2	(2009) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications
IEEE C63.4	(2014) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330	(1992) Design Guide Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(2012) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 20	(2010; Reprint Feb 2012) General-Use Snap Switches
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2018) UL Standard for Safety Industrial Control Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection Diagrams; G

Fabrication Drawings; G

Control Devices; G

Protective Devices; G

SD-03 Product Data

Fuses; G

Motor Controllers; G

Instrument Transformers; G

Enclosures; G

Circuit Breakers; G

Control Devices; G

Protective Relays; G

SD-06 Test Reports

Dielectric Tests; G

Final Test Reports; G

SD-07 Certificates

Insulating Oil; G

SD-08 Manufacturer's Instructions

Control Devices; G

Protective Devices; G

SD-10 Operation and Maintenance Data

Manual Motor Controllers; G

Magnetic Motor Controllers; G

Circuit Breakers; G

Protective Relays; G

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit connection diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit fabrication drawings for control devices and protective devices consisting of fabrication and assembly details performed in the factory.

2.2 EQUIPMENT

2.2.1 Motor Controllers

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Ensure controllers have thermal overload protection in each phase.

2.2.1.1 Manual Motor Controllers

Provide full-voltage, manually operated manual motor controllers for the control and protection of single-phase 60-Hz ac fractional-horsepower squirrel-cage induction motors.

Provide single-throw, single- or double-pole, three-position controllers rated at not more than 1 horsepower at 115 V and 230 V single-phase. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal-overload relay, and terminal connectors. Provide controllers that clearly indicate operating condition: on, off, or tripped.

Provide toggle- or key-operated-type manual motor controllers as indicated and arrange them so that they are lockable with a padlock in the "OFF" position.

Provide recessed manual motor controllers for single-speed, fractional-horsepower, squirrel-cage induction motors. Include a single controller and indicating light in a 4-inch-square wall outlet box; for flush-wiring devices, include matching corrosion-resistant steel flush cover plates. Provide surface-mounted manual motor controllers for single-speed, fractional-horsepower squirrel-cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 , general-purpose enclosure.

Provide recessed and surface-mounted manual motor controllers for two-speed, fractional-horsepower, squirrel-cage induction motors; include two controllers, two indicating lights, and a selector switch in a multiple-gang wall outlet box for flush-wiring devices, with matching corrosion-resistant steel flush cover plates. Provide surface-mounted manual motor controllers for two-speed, fractional-horsepower, squirrel-cage induction motors; include two controllers, two indicating lights, and a selector switch in a NEMA 250, Type 1 , general-purpose enclosure.

2.2.1.2 Magnetic Motor Controllers

a. Full-Voltage Controllers

Provide full-voltage, full-magnetic devices for the control and protection of single- and three-phase, 60 Hz, squirrel-cage induction motors in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508 for magnetic motor controllers.

Ensure that the operating coil assembly operates satisfactorily between 85 percent and 110 percent of rated coil voltage. Provide 120 V, 60 Hz motor control circuits.

Provide the controllers with two normally open and two normally closed auxiliary contacts rated according to NEMA ICS 1 and NEMA ICS 2, in addition to the sealing-in contact for the control circuits.

Provide solderless pressure wire terminal connectors for line and load connections to the controllers.

Include three manual-reset thermal-overload devices for overcurrent protection, one in each pole of the controller. Provide thermal-overload relays of the bimetallic nonadjustable type with continuous-current ratings and service-limit current ratings. Ensure that ratings have a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to reestablish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide an enclosure in accordance with NEMA 250, Type as indicated.

2.2.1.3 Combination Motor Controllers

The following requirements are in addition to the requirements specified for magnetic motor controller:

a. Provide combination motor controllers for the control and protection of single- and three-phase, 60 Hz ac squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

b. For combination motor controllers, include magnetic motor controllers and molded-case circuit breakers or motor circuit protectors (MCPs) in metal enclosures in accordance with NEMA 250 or motor control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

(1) Provide full-voltage, full-magnetic devices as specified in this section under paragraph REMOTE-CONTROL STATION ENCLOSURES for magnetic motor controllers and enclosures.

(2) Provide thermal-magnetic breakers as specified in paragraph MANUAL MOTOR CONTROLLERS for molded-case circuit breakers. Manufacturer's standard MCPs may be used in lieu of molded-case circuit breakers.

(3) Provide control-power transformers 120 V ac maximum, Hand-Off-Auto selector switches, on/off pushbuttons, run light, and pilot lights as required. Provide Hand-Off-Auto selector switch with additional contact blocks for indicating "Hand" and "Auto" positions to the plant PLC. In "Hand" operation the motor shall be controlled by a local Start/Stop pushbutton. In "Off" the motor shall be disabled. In "Auto" the motor shall be controlled by the plant PLC via Ethernet communications.

(4) Identify combination motor controllers with identification plates affixed to the front cover of the controller.

a. Nonreversing Combination Motor Controllers

The following requirements are in addition to the requirements for magnetic

motor controllers:

(1) For the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCPs with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

(2) Provide rating of single and three-phase, single-speed, full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

(3) Provide wiring and connections for full-voltage, single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2.2 Circuit Breakers

Provide circuit breakers that conform to UL 489 and NEMA AB 3.

2.2.2.1 Molded-Case Circuit Breakers

Provide molded-case, manually operated, trip-free circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with a factory-sealed, calibrated sensing element to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal-overload protection and instantaneous magnetic short-circuit protection. Provide an instantaneous magnetic tripping element that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 A.

Size the breaker as required for the continuous-current rating of the circuit. Provide the breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 A and that conform to NEMA AB 3.

Provide the common-trip-type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective-type tripping (time delay, magnetic, thermal, or ground fault).

Provide a phenolic-composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

For meter circuit disconnects, provide circuit breakers of the motor-circuit-protector type that meet the applicable requirements of NFPA 70.

2.2.2.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic, molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to NEMA 250 and UL 489.

Provide enclosed circuit breakers in nonhazardous locations as follows:

a. Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose, sheet-steel enclosures.

b. Contain circuit breakers installed in wet locations in NEMA Type 4, watertight, cast-iron enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 1 for Type 4 enclosures.

c. Contain circuit breakers installed in dry, noncombustible, dust-laden atmospheres in NEMA Type 5, dusttight, corrosion-resistant sheet steel enclosures, with gaskets or their equivalent to prevent the entrance of dust.

2.2.3 Fuses

Provide a complete set of fuses for all switches and switchgear. Ensure that fuses have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, or clearing or melting time of fuses unless written permission is first obtained from the RPM, FEAD CM or Engineer.

Provide nonrenewable-cartridge-type fuses for ratings 30 A, 125 V or less. Provide renewable-cartridge-type fuses for ratings above 30 A 600 V or less with time-delay dual elements, except where otherwise indicated. Ensure that fuses conform to NEMA FU 1.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Do not use plug fuses.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

2.2.4 Control Devices

2.2.4.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-Hz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 percent and 110 percent of its voltage rating.

Provide contactors that are designed with a normally open holding-circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line and load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2.4.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage exceeds 120 V. Provide an encapsulated dry-type, single-phase, 60-Hz transformer, with a 120 V (or 24 V) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide a source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect the secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground the secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

2.2.4.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Ensure that the core-and-coil assembly operates satisfactorily with coil voltages between 85 percent and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120 V, 60-Hz, Class AIB magnetic control relays with a continuous--contact rating of 10 A, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.2.4.4 Pushbuttons and Switches

a. Pushbuttons

For low-voltage ac full-voltage magnetic pushbutton controllers, provide heavy-duty, oiltight NEMA 250, Type 12 , momentary-contact devices rated 600 V, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in

accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Ensure that pushbutton-contact ratings are in accordance with NEMA ICS 1 and NEMA ICS 2, with contact designation A600.

Identify pushbuttons in remote-control stations with identification plates affixed to the front cover in a prominent location. Identify the system being controlled on the identification plate.

b. Selector Switches

Provide heavy-duty, oiltight, maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote-control stations with engraved identification plates affixed to the front cover in a prominent location. Identify the system being controlled on the identification plate.

c. Ammeter Selector Switches

Provide rotary, multistage, snap-action-type ammeter selector switches for switchgear in accordance with UL 20. Use silver-plated contacts rated for 600 V, ac or dc. Provide a manually operated, four-position selector switch rated for 600 V, 20 A, minimum. Ensure that the switch is designed to select the display of current readings on each bus of the main bus from a single indicating instrument. Mount the ammeter switch on the hinged front panel of the switchgear compartment, with engraved escutcheon plate. Completely isolate the switch from high-voltage circuits.

Provide a pistol-grip -type selector switch handle.

d. Voltmeter Selector Switches

Provide rotary, snap-action-type voltmeter selector switches for switchgear in accordance with UL 20. Use silver-plated contacts rated for 600 V ac or dc. Provide manually operated, four-position switches designed to select the display of voltage readings on each phase of the main bus from a single indicating instrument. Mount the voltmeter switch on the hinged front panel of the switchgear compartment, with engraved escutcheon plate. Completely isolate the switch from high-voltage circuits.

Provide a pistol-grip -type selector switch handle.

e. Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

2.2.5 Finish

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations.

2.3 COMPONENTS

2.3.1 Instrument Transformers

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, and IEEE C63.4 for Instrument transformers.

Insulation Class kV	Basic Insulation Level kV	Nominal System Voltage kV	Preferred Test Voltage for Potential Transformers kV	Test Voltage for Current Transformers kV	Radio Influence Voltage Level, Microvolts Dry Type Filled	 Oil
0.6	10	----	----	0.76	250	250
1.2	30	0.208 0.416 0.832 1.04	0.132 0.264 0.528 0.66	0.76	250	250
2.5	45	2.40	1.52	1.6 7	250	250
5.0	60	4.16 4.80	2.64 3.04	3.34	250	250
8.7	75	7.20 8.32	4.57 5.28	5.77	250	250
15L or 15H	95 - 110	12.00 12.47 14.40	7.62 7.92 9.14	9.41	1000	250
25	150	23.00	14.60	15.70	2500	650
34.5	200	34.50	21.90	23.0	----	650
46	250	46.00	29.20	29.30	----	1250
69	350	69.00	43.80	44.00	----	1250
92	450	92.00	58.40	58.40	----	2500
115	550	115.00	73.40	73.40	----	2500
138	650	138.00	88.00	88.00	----	2500

2.3.1.1 Current Transformers

Ensure that current transformers conform to IEEE C57.13 for installation in metal-clad switchgear. Use a standard 3-A secondary transformer.

Provide wound -type transformers.

Provide transformers that have double secondary winding.

Provide transformers that are complete with a secondary short-circuiting device.

For window-type current transformers, provide indoor, dry-type construction, with secondary current ratings as indicated with the specified burden, frequency, and accuracy.

2.3.1.2 Potential Transformers

For potential transformers, conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 120-volt secondary transformers.

Provide transformers that have double secondary winding.

Provide burden, frequency, and accuracy as required.

For disconnecting potential transformers with integral fuse mountings and current-limiting fuses, provide indoor, dry-type two-winding construction with primary and secondary voltage ratings as required.

2.3.2 Enclosures

2.3.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment that is installed inside clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

2.3.2.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with NEMA ICS 6 and NEMA 250.

Contain remote-control stations installed in indoor, clean, dry locations in NEMA Type 1 general-purpose, sheet-steel enclosures. Contain recessed remote-control stations in standard wall outlet boxes with matching corrosion-resistant-steel flush cover plates.

Contain remote-control stations installed in dry, noncombustible, dust-laden atmospheres in NEMA Type 12, dusttight, cast-iron enclosures, with gaskets or their equivalent to prevent the entrance of dust.

Install remote-control stations with the centerline 66 inches above the finished floor.

2.3.3 Protective Relays

2.3.3.1 Overcurrent Relays

Provide a trip unit that employs a combination of discrete components and integrated circuits to ensure the time-current protection functions as required in a modern, selectively coordinated distribution system.

Conform relays to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults, provide single-phase

nondirectional, removable, induction-type overcurrent relays with built-in testing facilities designed for operation on the dc or ac control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse-time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required. Provide attachments that indicate instantaneous trip with adjustable current range as required.

Provide solid-state, static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide complete system-selective coordination by using a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using nonremovable, discrete-step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker, including overload, short circuit, and ground fault.

Wire the trip unit to the appropriate terminals so that an optional, remote, automatic trip accessory can be used to provide the same indication.

Make available for use a series of optional, automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground-fault circuits using a small handheld test kit.

2.3.3.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with IEEE C37.90.

For protection against reverse-power faults, provide single-phase induction relays with adjustable time-delay and instantaneous trip attachments. Provide removable-type relays with inverse-time directional and overcurrent units with built-in testing facilities.

2.3.3.3 Reclosing Relays

Ensure that reclosing relays conform to IEEE C37.90.

Provide reclosing relays that reclose circuit breakers that have tripped from overcurrent. Provide a device that automatically recloses the breaker at adjustable time intervals between reclosures and then locks out the breaker in the open position if the fault persists. Ensure that if the fault disappears after any reclosure, the circuit breaker remains closed

and the reclosing relay resets automatically and is ready to start a new sequence of operation.

Provide removable reclosing relays that have built-in testing facilities and that consist of a timing unit rated at 120/240 V, single-phase, ac and solenoid and contactor units with dc rating as indicated. Arrange contacts for one instantaneous reclosure and two subsequent reclosures at 15 and 45 seconds, respectively. Set the time dial for 60-second drum speed.

2.3.3.4 Undervoltage Relays

Ensure that undervoltage relays conform to IEEE C37.90.

Provide three-phase, induction-type undervoltage relays, including inverse timing with adjustable high- and low-voltage contacts and calibrated scale. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120 V ac circuits, with contacts that are suitable for operation on dc or ac control circuits.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

2.4.1 Factory Testing

Obtain factory test results on control and low-voltage protective devices.

PART 3 EXECUTION

3.1 INSTALLATION

Clearly list fuse information on equipment drawings.

Install control devices and protective devices that are not factory-installed in equipment, in accordance with the manufacturer's recommendations. Field-adjust the devices. Perform operation tests on the control and protective devices. Conform requirements for installation of control and protective devices to NFPA 70, NEMA ICS 1, and NEMA ICS 2.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

Demonstrate the operation and controls of protective devices of non-factory-installed equipment.

Verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D877/D877M, and provide breakdown voltage that is not less than 25,000 V. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field-adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until the results of the recorded test data have been approved by the RPM, FEAD CM or Engineer. Provide final test reports with a cover letter/sheet clearly marked with the system name, date, and the words final test reports to the Contracting Officer for approval.

-- End of Section --

SECTION 26 24 16.00 20

PANELBOARDS
08/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1535	(2014; R 2018) Standard Practice for Specifying Color by the Munsell System

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA PB 1	(2011) Panelboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code
NFPA 70E	(2018; TIA 18-1; TIA 81-2) Standard for Electrical Safety in the Workplace

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 67	(2018; Reprint Oct 2019) UL Standard for Safety Panelboards
UL 489	(2016) UL Standard for Safety Molded-Case

	Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 869A	(2006) Reference Standard for Service Equipment
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Panelboards; G

SD-06 Test Reports

Acceptance Tests; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FEAD CM or Engineer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

Products manufactured more than 3 years prior to date of delivery to site are not to be used, unless specified otherwise.

PART 2 PRODUCTS

2.1 PANELBOARDS

Provide panelboards in accordance with NEMA PB 1, UL 67, and UL 50. Ensure panelboards for use as service equipment are also in accordance with UL 869A. Ensure panelboards have current rating, number of phases, and number of wires as indicated or specified herein. Ensure panelboards are rated for 120/208-volt, three-phase 277/480-volt, three-phase, 60-hertz. Ensure each panelboard, as a complete unit, has a short-circuit current rating equal to or greater than the integrated equipment rating indicated, but in no case less than 10,000 amperes symmetrical.

Provide panelboards with bolt-on circuit breakers only. Use of plug-in style breaker is not permitted. Ensure panelboards are designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining required clearance. Provide main lugs or main circuit breakers mounted "above" or "below" branch breakers with current ratings as indicated. Use of sub-feed breakers is not acceptable unless specifically indicated otherwise. Where "space only" is indicated, make provisions for future installation of breakers.

Submit detail drawings and manufacturer's standard product data for panelboards. Detail drawings consist of fabrication and assembly drawings for all parts of the work in sufficient detail to verify conformity with all requirements. Ensure drawings for panelboards indicate details of bus layout, overall physical features, dimensions, ratings, service requirements, and weights of equipment.

2.2 COMPONENTS

2.2.1 Enclosure

Ensure panelboard enclosures are NEMA 250, Type as indicated and in accordance with UL 50 and NEMA PB 1.

Provide flush-mountedand /or surface mounted panelboard cabinets as indicated. Ensure cabinets are constructed of 12 gauge sheet steel and hot-dipped galvanized after fabrication. Ensure front of cabinet is form-flanged or fitted with structural shapes welded or riveted to the sheet steel for supporting the panelboard front. Provide panelboard cabinets fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 1/8 inch. Provide holes in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface.

Provide front cover with center door for access to circuit breakers. Ensure circuit breaker access doors are equipped with pin-tumbler cylinder locks. Ensure all locks provided, including locks for hinged covers, are identically keyed and properly tagged. Provide two keys for each enclosure.

Finish panelboards with fast drying enamel. Finish color is ASTM D1535 No. 61 gray conforming to FED-STD-595.

2.2.2 Panelboard Buses

Provide copper buses of the rating indicated, with main lugs or main

circuit breaker. Provide all panelboards for use on grounded ac systems with a separate grounding bus in accordance with UL 67 bonded to the panelboard enclosure. Ensure grounding bus is a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors. Provide three-phase, four-wire and single-phase, three-wire panelboards with an isolated full-capacity bus providing spaces for single-pole circuit breaker switches and spaces indicated as spare.

Provide bus bar connections to the branch circuit breakers that are the "distributed phase" or "phase sequence" type. Ensure single-phase, three-wire panelboard busing is such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Ensure that three-phase, four-wire panelboard busing is such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Ensure current-carrying parts of the bus assembly are plated.

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping.

2.2.2.1 Panelboard Neutrals for Non-Linear Loads

Where indicated, provide panelboard specifically listed for use on non-linear loads. Ensure panelboards are heat rise tested in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing. Two neutral assemblies paralleled together with cable is not acceptable. Ensure panel is marked "SUITABLE FOR NON-LINEAR LOADS" with field fabricated nameplate and provide a neutral label with instructions for wiring of panelboard.

2.2.2.2 Panelboard Neutrals

Provide requirement for neutral buss to be 100% rated.

2.2.3 Circuit Breakers

Provide circuit breakers that conform to UL 489 and NEMA AB 3 with frame a trip ratings as indicated.

Provide bolt-on type, molded-case, manually operated, trip-free circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection. Completely enclose circuit breakers in a molded case, with a factory-sealed, calibrated sensing element to prevent tampering. Plug-in type, tandem, and half-size circuit breakers are not permitted.

Provide inverse-time-delay thermal-overload protection and instantaneous magnetic short-circuit protection. Provide an instantaneous thermal-magnetic tripping element that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 ampere.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 A and that conform to NEMA AB 3. Series rating of circuit breakers or overcurrent protective

devices to achieve indicated interrupt rating is not permitted.

Provide the common-trip-type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective-type tripping (time delay, magnetic, thermal, or ground fault).

Provide a phenolic-composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required to meet lock-out/tag-out requirements of NFPA 70E.

Provide shunt trips where indicated.

Ensure branch circuit breakers supplying convenience receptacle circuits have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Provide UL listed single-pole 15- and 20-ampere circuit breakers as "Switching Breakers" at 120 volts ac .

When multiple wires per phase are specified, furnish the circuit breakers with connectors made to accommodate multiple wires.

Ensure circuit breaker spaces called out on the drawings are complete with mounting hardware to permit ready installation of the circuit breakers.

2.2.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.2.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A ground-fault circuit interrupter. Tripping of a branch circuit breaker containing ground fault circuit interruption is not to disturb the feeder circuit to the panelboard.

2.2.3.3 Circuit Breakers for HVAC Equipment

Provide circuit breakers for HVAC equipment having motors (group or individual) marked for use with HACR type and UL listed as HACR type.

2.2.3.4 Circuit Breakers for Fire Alarm Equipment

Circuit Breakers for Fire Alarm Equipment shall be marked in accordance with NFPA 70 Article 760.

2.2.4 Directory Card and Holder

Provide a directory card on the inside of hinged fronts and doors under non-flammable plastic, with spaces for circuit numbers and load supplied.

Where hinged fronts or doors are not required, provide the directory card under plastic mounted on the left-hand side of the front trim. Ensure the directory card includes type written designations identifying each branch circuit with its respective and numbered circuit breaker. Handwritten directories are not acceptable.

2.2.5 Precautionary Label

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, conspicuously mark each panelboard on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, ensure the label is visible when the door is in the open position.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

Provide panelboards in compliance with UL 67.

PART 3 EXECUTION

3.1 INSTALLATION

Install panelboards in accordance with the manufacturer's instructions. Fully align and mount panels so that the height of the top operating handle does not exceed 72inches above the finished floor.

Ensure directory-card information is typewritten in capital letters to indicate loads served by each circuit and is mounted in holders behind protective covering. Labels shall be as specified in Section 26 05 00.00 20

3.2 FIELD QUALITY CONTROL

Do not energize panelboards until the recorded test data has been submitted to and approved by the RPM, FEAD CM or Engineer.

Provide test equipment, labor, and personnel as required to perform the acceptance tests as specified. Record and submit test data. Include the location and identification of panelboards and megohm readings versus time.

Conduct continuity tests using a dc device with bell . Document results as pass-fail.

Conduct continuity and insulation tests on the panelboards after the installation has been completed and before the panelboard is energized. Document results as pass-fail.

Conduct insulation tests on 480-volt panelboards using a 1,000-volt insulation-resistance test set. Record readings every minute until three equal and consecutive readings have been obtained. Ensure resistance between phase conductors and between phase conductors and ground is not less than 50 megohms.

Conduct insulation tests on panelboards rated 300 volts or less using a 500-volt minimum insulation-resistance test set. Record readings after 1 minute and until the reading is constant for 15 seconds. Ensure resistance between phase conductors and between phase conductors and ground is not less than 25 megohms.

Conduct phase-rotation tests on all panelboards using a phase-rotation

indicating instrument. Perform phase rotation of electrical connections to connected equipment in a clockwise direction, facing the source.

3.3 CLOSEOUT ACTIVITIES

Submit manufacturer's instructions for panelboards including special provisions required to install equipment components and system packages. Provide special notices details impedances, hazards and safety precautions.

-- End of Section --

SECTION 26 24 19.00 20

MOTOR CONTROL CENTERS
05/19

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)

ASTM INTERNATIONAL (ASTM)

ASTM B187/B187M	(2016) Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes
ASTM B317/B317M	(2007; R 2015; E 2016) Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, Structural Profiles, and Profiles for Electrical Purposes (Bus Conductor)
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C57.12.01	(2015) General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid-Cast and/or Resin-Encapsulated Windings
IEEE C57.13	(2016) Requirements for Instrument Transformers
IEEE C63.2	(2009) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications
IEEE C63.4	(2014) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA ST 20	(2014) Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(2018) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 506	(2017) UL Standard for Safety Specialty Transformers
UL 845	(2005; Reprint Oct 2018) UL Standard for Safety Motor Control Centers
UL 1063	(2017) UL Standard for Safety Machine-Tool Wires and Cables

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Motor Control Center Equipment Drawings; G

SD-03 Product Data

Motor Control Center Equipment; G

SD-06 Test Reports

Factory Test Procedures; G

Factory Test Results; G

Final Test Reports; G

Acceptance Tests; G

SD-07 Certificates

Motor Control Center Certification; G

SD-11 Closeout Submittals

Warranty; G

Manufacturer's Instructions; G

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FEAD CM or Engineer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.3.2 Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

1.3.3 Standard Products

Ensure material and equipment are standard products of a manufacturer regularly engaged in their manufacture and essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

Ensure all materials conform to the requirements of these specifications. Materials are to be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. Ensure all materials, supplies, and articles not manufactured by the Contractor are the products of other recognized reputable manufacturers.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship the motor control center equipment as completely assembled and wired as feasible so as to require a minimum of installation work. Ensure each shipping section is properly match marked to facilitate reassembly. Provide equipment with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling.

Carefully pack and ship separately any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment. Mark these devices with the number of the panel which they are to be mounted on and fully identified.

Wrap all finished painted surfaces and metal work to protect from damage during shipment. Prepare all parts for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck.

Carefully package and clearly mark all spare parts and accessories.

Locate motor control center equipment in well ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials with ambient temperature between minus 22 and 104 degrees F. Ensure motor control center equipment is protected to prevent moisture from entering enclosure. Handle motor control center equipment in accordance with NEMA ICS 2.

1.5 MAINTENANCE

1.5.1 Accessories and Tools

Furnish a complete set of accessories and special tools unique to the equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus.

1.5.2 Spare Parts

Furnish a list of spare parts as recommended by the manufacturer for the equipment. Ensure all spare parts are of the same material and workmanship, meet the same requirements, and are interchangeable with the corresponding original parts furnished.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, delivery, installation and testing of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

Submit motor control center equipment drawings, including all motor control units and protective devices. Provide a single-line diagram, equipment

list and nameplate schedule. Includes descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Ensure drawings show the general arrangement and overall dimensions of the motor control centers space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables. Include complete wiring diagrams for each motor control center. Provide wiring diagrams in a form showing physical arrangement of the control center with interconnecting wiring shown by lines or by terminal designations (wireless).

2.1.1 Compliance

Provide equipment conforming to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment to meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. Immediately notify the RPM, FEAD CM or EngineerRPM, FEAD CM or Engineer of any requirements of the specifications or proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

2.1.2 Coordination

The general arrangement of the motor control centers is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings is subject to the approval of the RPM, FEAD CM or Engineer. If any conflicts occur necessitating departures from the drawings, submit details of and reasons for departures and approved prior to implementing any change. Completely assemble all equipment at the factory. The motor control centers may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

2.1.3 Nameplates

Provide nameplates of laminated sheet plastic in accordance with ASTM D709. Ensure nameplates are melamine plastic 1/8 inch thick, black matte finish with white center core and square corners. Fasten the nameplates to the equipment in proper positions with anodized round-head screws. Accurately align lettering and engrave into the core. Lettering is a minimum 1/2-inch high normal block style. Nameplate designations are in accordance with lists on the drawings, and as a minimum provide for the following equipment:

a. Motor Control Centers

b. Individual items of equipment mounted in the Motor Control Centers

Provide equipment of the withdrawal type with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

2.2 FABRICATION

2.2.1 Ratings

Provide equipment with the following ratings:

a. Voltage rating: 480Y/277208Y/120 or 240/120V volts AC, 4-wire as indicated.

b. Continuous current rating of the main bus: as indicated.

c. Short-circuit current rating: as indicated.

d. UL listed and labeled as service entrance equipment.

2.2.2 Enclosures

Each motor control center consists of the required number of vertical sections of 90 inches nominal height, bolted together, with steel channel sills and suitable for mounting against a wall. Vertical sections are nominally 90 inches high and 20 inches deep with buses, control wiring, control transformers, small power transformers, terminal blocks, line terminals, cable supports, and clamps accessible from the front. Enclosure is NEMA Type 1 for indoor locations and Type 3R for outdoor . Fabricate the motor control centers from smooth select steel sheets shaped and reinforced to form rigid free-standing structures. Ensure metal thickness for enclosures is no less than specified in NEMA ICS 6 without exception. Fabricate and bolt vertical edges of sections exposed to view so that the joints do not pass a 1/16 inch gauge. Equip vertical sections with full length vertical isolating barriers between sections. Make provisions for leveling the assembled motor-control center sections and bolting them together so that they form a contiguous structural enclosure.

Provide removable 7 gauge lifting angles on the top of each section, extending the entire width of the section, capable of supporting the entire weight of the motor control center section without distortion. Provide base channels with holes to facilitate floor mounting and leveling.

2.2.2.1 Unit Compartments

Provide each operating unit with equipment as shown on the drawings, mounted in an individual cell. The unit assembly, except main circuit breakers, panelboards and auxiliary control devices, is drawout type removed from the front, without rear access or disturbing other units in the control center assembly. Ensure all drawout type unit assemblies have a positive guide rail system to ensure alignment of connection to vertical bus. Mechanically interlock units with the door to prevent removal while in the energized position. Provide each removable unit with a provision for padlocking in a position in which it is disconnected from the vertical bus, although not removed from the stationary structure. Provide all ventilating openings with corrosion-resistant insect-proof screens on the inside. Provide bus closing plugs for all unused openings in vertical bus barriers.

Ensure compartments for future motor-control units are complete with hardware, buses, and hinged doors ready to receive future draw-out units. Compartments for spare motor-control units are complete with buses, hinged doors, and draw-out units but without load terminal connections. Spare spaces are complete with buses and screwed-on front cover plates.

2.2.2.2 Motor Control Center Doors and Covers

Provide each unit compartment, including blank compartments for future use, with either a flange-formed or a rolled-edge door. Mount each door on fully-concealed or continuous full-length piano-type hinges and provide

with positive fasteners. Prevent door sag by proper alignment of hinges made of sufficiently strong material. Interlock the door fastenings to prevent opening when the equipment is energized. Ensure the external operating handle clearly indicates whether the equipment is in an "ON", "OFF" or "TRIPPED" position.

2.2.2.3 Vertical Wireways

Provide vertical wireways in all vertical sections. Connect vertical wireways with horizontal wireways at the top and bottom and be a minimum 4 inches wide. Provide barriers in sections containing both ac and dc circuits. Provide doors on each vertical wireway with the exposed surface of any door not deviating more than 1/16 inch from a true plane. Provide cable tie supports in the vertical wireway to hold cable and wiring in place

If communication wiring is required, add metal shielding in the vertical wiring trough to provide isolation from power and control wiring within the vertical wiring trough.

2.2.2.4 NEMA 3R Enclosures

Provide a non-walk in, NEMA Type 3R, rainproof enclosure motor control center where indicated. The outside enclosure consists of smooth select stainless steel sheets on a stainless steel structural frame. Provide full-length single or double doors with top and bottom bolts and a center latch operated by means of a keyed handle. Ensure steel sheets and doors are not less than No. 10 gauge thick. Doors have bent angle or channel edges with all corner seams welded and ground smooth. Assemble the motor control center within the enclosure with adequate gaskets and structure to assure a measure of vandal resistance. Ventilate openings and provide an effective insulating air space of approximately 2 inches below the roof of the structure which slopes from front to back for adequate drainage. Permit easy sealing of the outside edges of the control center base at the concrete surface with mastic compound. Provide two duplex receptacle units within the outer weatherproof enclosure.

Furnish a 200-watt outdoor lighting fixture with globe and guard to light the front of the assembly. Ensure all lighting connections are watertight. Furnish a weatherproof switch installation on the front or side of the enclosure so that the light can be switched prior to opening the assembly doors. The exterior manual switch is "ac" rated, 15 amperes, 120/277 volts. Wire the lighting fixture and receptacles to the 120-volt ac panelboard located in the control center, and run external wiring in rigid galvanized steel conduit.

2.2.2.5 Shutters

Provide drawout units with shutters which close when the unit is withdrawn to isolate the vertical bus.

2.2.3 Buses

Ensure all buses are copper, and all bolted splices and connections between buses and for extensions or taps for equipment are tin or silver-plated. Copper bars and shapes for bus conductors conform to the applicable requirements of ASTM B187/B187M, and ASTM B317/B317M. Bolt all splices for field assembly with at least two bolts and employ the use of "Belleville" washers in the connection. Base the bus ratings on a 149 degree Fahrenheit maximum temperature rise in accordance with UL 845 requirements. Ensure

bus has a short-circuit current rating of not less than 65,000 RMS symmetrical amperes. Support all bus work on wet process porcelain insulators, glass polyester, or suitable molded material.

2.2.3.1 Horizontal Bus

Provide each control center assembly with a three-phase main horizontal bus, with a continuous current rating not less than 400A for MCC-RW9, 400A for MCC-RW10A and 1,200 amperes for MCC-1, located across the top of each vertical section. Drill the ends of horizontal buses for future extensions. Fully insulate the main horizontal bus.

2.2.3.2 Vertical Bus

Provide each vertical section with a three-phase vertical bus with a continuous current rating of 400A for MCC-RW9, 400A for MCC-RW10A, and 600A for MCC-1 connected to the horizontal bus by brazing, welding, or bolting. Where the incoming feeder breakers are located at the bottom of a control center, rate the vertical bus in that section the same as the main horizontal bus. Extend vertical buses from the horizontal bus to the bottom of the lowest available unit mounting space. Isolate the vertical bus from wireways and equipment in compartments.

2.2.3.3 Ground Bus

Provide a copper ground bus full width at the bottom of the motor control center line-up. Provide a full clamp-type solderless copper lug for No. 4/0 AWG stranded copper cable at each end of the bus for connection to the grounding system. Ensure the ground bus is capable of carrying the rated short-circuit current available in the motor-control center.

2.2.3.4 Neutral Bus

Furnish a fully rated neutral bus continuous through the control center with appropriate capacity.

2.2.4 Painting

Thoroughly clean the interior and exterior steel surfaces of equipment enclosures and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Ensure exterior surfaces are free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces receives not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Prime exterior surfaces, fill where necessary, and give no less than two coats baked enamel with semigloss finish. Ensure equipment located indoors is ANSI Light Gray, and equipment located outdoors is ANSI Light Gray Dark Gray. All touch-up work is done with manufacturer's coatings.

2.3 EQUIPMENT

2.3.1 Connections

Ensure bolts, studs, machine screws, nuts, and tapped holes are in accordance with ASME B1.1. Ensure the sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment are in accordance with ASME B1.20.1. Provide ferrous fasteners with rust-resistant finish, and all bolts and screws equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items

which are integrally replaceable, except threads for external connections to these items meet the above requirements.

2.3.2 Molded Case Circuit Breakers

Ensure molded case circuit breakers conform to the applicable requirements of UL 489. Provide manually-operated circuit breakers of the quick-make, quick-break, common trip type. Furnish automatic-trip breakers unless otherwise specified or indicated on the drawings. Provide the common-trip multipole circuit breakers having a single operating handle and a two-position on/off indication and with provisions for padlocking in the "Off" position. Provide personnel safety line terminal shields for each breaker. Ensure the circuit breakers are products of only one manufacturer, and interchangeable when of the same frame size. Where indicated on the drawings, provide circuit breakers with shunt trip devices.

Size breakers as required for the continuous-current rating of the circuit. Provide the breaker class as required. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval.

Provide sufficient interrupting capacity maximum short-circuit current imposed on the circuit at the breaker terminals as indicated. Provide circuit breaker interrupting capacities with a minimum of 10,000 A and that conform to NEMA AB 3. Series rating of circuit breakers is not permitted.

Provide circuit breakers with temperature compensation for operation in an ambient temperature between -20 and 122degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied.

2.3.2.1 Trip Units

Except as otherwise noted, provide the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection or solid state trip units. Provide Solid state trip units equipped with adjustable long time pick-up and delay,short time pick-up and delay, and ground fault pick-up and delay on frame sizes larger than 250 amperes. Set all protective devices in accordance with approved coordination study. Set nonadjustable instantaneous magnetic trip units at approximately 10 times the continuous current ratings of the circuit breakers.

2.3.2.2 480-Volt AC Circuits

Rate circuit breakers for 480-volt ac circuits 600 volts ac, and have an UL listed minimum interrupting capacity of 14,000 symmetrical amperes at 600 volts ac.

2.3.2.3 120/240-Volt AC Circuits

Rate circuit breakers for 120-volt and 240-volt ac circuits not less than 120/240 or 240 volts ac, and have a UL listed minimum interrupting capacity of 22,000 symmetrical amperes.

2.3.3 Wiring

Provide NEMA Class III, Type ABDBTC. Where Type C wiring is required, locate the master terminal blocks at the topbottom of the vertical section. Wire out combination starter units to split type terminal blocks for easy removal of the starter unit without disturbing either factory or field installed wiring. Ensure all control terminal boards are accessible from the front.

All control wire is stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and passes the VW-1 flame tests included in those standards. Hinge wire has Class K stranding. Current transformer secondary leads cannot be smaller than No. 10 AWG. The minimum size of control wire is No. 14 AWG. Power wiring for 480-volt circuits and below is of the same type as control wiring and the minimum size is No. 12 AWG. Give special attention to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.3.4 Terminal Blocks

Use molded or fabricated circuit terminal blocks for wiring with barriers, rated not less than 600 volts. Provide terminals with removable binding, fillister or washer head screw type. Ensure terminals are no less than No. 10 in size and having sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement is subject to the approval of the RPM, FEAD CM or Engineer. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type. Submit data showing that the proposed alternate accommodates the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.3.4.1 Short-Circuiting Type

Provide short-circuiting type terminal blocks for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit.
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2.3.4.2 Load Type

Provide load terminal blocks rated no less than 600 volts and of adequate capacity for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits except those for feeder tap units. Provide the terminals of of the screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, use screws with hexagonal heads. Provide adequate contact surface and cross-section for conducting parts between connected terminals to operate without overheating. Each connected terminal has the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.3.4.3 Marking Strips

Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations. Mark the wire numbers with permanent ink. Provide reversible marking strips to permit marking both sides, or furnish two marking strips with each block. Provide

marking strips that accommodate the two sets of wire numbers. Assigned a device designation to each device to which a connection is made in accordance with NEMA ICS 1. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations. Prints of shop drawings submitted for approval will be so marked and returned for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

2.4 COMPONENTS

Design each motor control center for operation on 480 or 240 -volts ac, 3-phase or 1-phase, 60-Hz system, and the ensure that equipment conforms to all the applicable requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4, NEMA ICS 6, UL 845 and NFPA 70. List and label vertical sections and individual units under UL 845 where ever possible. In lieu of the UL listing, certification from any nationally recognized, adequately equipped, testing agency that the individual units and vertical sections have been tested and conform to the UL requirements of that agency will be acceptable when approved by the RPM, FEAD CM or Engineer. Provide NEMA Class I II, Type B or C as indicated in the bid item list, motor control centers in accordance with NEMA ICS 2.

2.4.1 Combination Starters

Providefull-voltage, non-reversing combination motor controller units containing motor circuit protectors molded-case circuit breakers, auxiliary and pilot devices or a magnetic contactor with thermal overload relays where indicated on the drawings. Show the ratings of motor circuit protectors, circuit breakers, contactors, motor controllers and other devices on the drawings. Ensure all combination motor controller units have short circuit ratings equal to the MCC KAIC rating or greater. Where control push-buttons, indicating lamps, "Hand-Off-Automatic" switches, and similar control devices are associated with a unit, mount them on the unit compartment door. Door-mounted components cannot interfere with access within the compartments. Molded case circuit breakers for use in combination starters meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Motor circuit protectors are only part of the combination starters as required by NFPA 70 and conform to all requirements of paragraph MOLDED CASE CIRCUIT BREAKERS, except that trip units have provisions for locking the selected trip setting.

Provide Hand-Off-Auto selector switch and run light with additional contact blocks for indicating "Hand" and "Auto" positions to the plant PLC.In "Hand" operation the motor shall be controlled by a local Start/Stop pushbutton. In "Off" the motor shall be disabled. In "Auto" the motor shall be controlled by the plant PLC via Ethernet communications.

2.4.1.1 Magnetic Contactors

Provide magnetic contactors of the NEMA sizes as indicated on the drawings. The rating, performance and service characteristics conforms to

the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Rate motor control contactors for full-voltage starting (Class A controllers). Provide contactors suitable for at least 200,000 complete operations under rated load without more than routine maintenance. Minimize the interruption arc and flame by suitable arc chutes or other means so that no damage is done to other portions of the device. If provided, ensure the arc chutes are easily removable without removing or dismantling other parts. All current-carrying contact surfaces are silver-surfaced or of other approved material. Ensure the contactor operates without chatter or perceptible hum while energized. Provide coils suitable for continuous operation of 120-volt ac , 240-volt, and 480-volt ac circuits. Provide three-pole alternating-current contactors, except where otherwise noted, and insulated for 600 volts ac, electrically- operated, magnetically-held type. Direct-current contactors are two-pole, suitable for controlling circuits operating at 125 volts dc, insulated for 250 volts dc, electrically-operated, magnetically-held type and adequate for full-voltage motor starting service.

2.4.1.2 Variable Frequency Controllers

Provide variable frequency controllers meeting the requirements of Section 26 29 23 ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS.

Provide Hand-Off-Auto selector switch with additional contact blocks for indicating "Hand" and "Auto" positions to the plant PLC, run light, speed potentiometer, and keypad display. These components shall be mounted on the front door panel.

In "Hand" operation the motor shall be controlled by a local Start/Stop pushbutton and potentiometer. In "Off" the motor shall be disabled. In "Auto" the motor shall be controlled by the plant PLC via Ethernet communications.

2.4.1.3 Auxiliary Contacts

Provide each controller with a minimum of three auxiliary contacts which can be easily changed from normally open to normally closed. Where indicated on the drawings, provide a fourth auxiliary contact and red and green indicating lights.

2.4.1.4 Overload Relays

Except as otherwise indicated, provide each controller with solid state NEMA Class 20 thermal overload relays including external manual reset.

Provide solid state, ambient insensitive, self-powered relays with adjustable full-load amperage, phase unbalance, phase loss protection, built-in thermal memory, isolated auxiliary contacts and automatic reset.

2.4.1.5 Individual Control Transformers

Where 120 volt ac control of contactors is indicated or required, provide an individual control transformer on the load side of the unit disconnect. Rate the control transformers 480-120 volts and conform to the requirements for control transformers in UL 506. Verify control transformers have adequate volt-ampere capacity for the control functions indicated. Install transformers with Class J primary fuses. Except as otherwise indicated on the drawings, provide each control transformer with a fuse in one secondary lead and have the other secondary lead grounded.

2.4.1.6 Control Circuit Disconnects

Arrange motor control circuits to ensure that all sources of supply power are disconnected when the disconnecting means is in the open position in accordance with NFPA 70. Where separate disconnecting means are provided, locate disconnects immediately adjacent to each other.

2.4.2 Panelboards for Motor Control Centers

Provide panelboards meeting the requirements of Section 26 24 16.00 20 PANELBOARDS.

2.4.3 Distribution Transformers

Provide dry type, two-winding, 60 hertz transformers for power and lighting loads with voltage and kVA ratings as indicated on the drawings. Ensure the transformers conform to the requirements for general-purpose transformers in IEEE C57.12.01 and NEMA ST 20. Protect each transformer on the primary side with a molded case circuit breaker as indicated on the drawings.

For 15 kVA and greater provide transformers with 428 degrees F insulation system for temperature rise not exceeding 239 degrees F under full-rated load in maximum ambient of 104 degrees F and capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.4.4 Ground Detector Indicator

Provide ground-detector indicator (GDI) rated for 120-volts. Ensure GDI has three lamps, one per phase, three 480-120 volt transformers connected delta-wye, an adjustable loading resistor for balancing capacitive charging current, and a push-to test-switch. GDI provides visual indication of a single ground-fault on any phase (A, B, or C) of a three-phase, three-wire ungrounded power system. When no phase is grounded, ensure all lamps glow at partial brightness, giving long lamp life, the push-to test switch does not affect the brightness of any lamp. When a single ground-fault occurs on any phase, and the lamp that corresponds to the faulted phase is dark and the other two lamps glow at full brightness. The push-to-test switch causes all lamps to return to partial brightness, showing the GDI is functioning properly.

2.4.5 Wiring for Motor Control Centers

Provide wiring meeting the requirements of paragraph WIRING. Provide heavy-duty type terminals for terminating all power cables entering the control centers.

2.4.5.1 Contractor's Wiring

Form wiring into groups, suitably bound together, properly supported and run straight horizontally or vertically with no splices in the wiring. The manufacturer's standard pressure-type wire terminations for connections to internal devices is acceptable. Add terminal blocks for wiring to devices having leads instead of terminals. Use ring tongue indented terminals on all wires terminated on control terminal blocks for external or interpanel connections and at shipping splits. Provide stud terminals with contact nuts and either locking nuts or lockwashers.

2.4.5.2 External Connections

Power and control cables enter the control centers at the where shown on the drawings. Where power and control entry points are not shown, and terminal blocks are not given on the drawings, the Government will furnish this information after award of contract.

2.4.5.3 Terminal Blocks

In no case, the terminals provided for circuit breakers or contactors accommodate less than the number or size of conductors shown on the drawings. Give special attention to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4.6 Control Power

Provide control power for motor control centers using an integrated control power transformer where required. Mount control power transformers for several starter units in a separate compartment and connect its primary windings to the main bus through a molded case circuit breaker of suitable rating. Rate the control power transformers 480-120 volts and conform to the requirements for control power transformers in UL 506. Provide control power transformers with adequate volt-ampere capacity for the control functions indicated and an additional 10 percent capacity. Install control power transformers without primary fuses. Except as otherwise indicated, provide each unit compartment a fuse for control power in one secondary lead and have the other secondary lead grounded.

2.4.7 Accessories and Control Devices

Provide control accessories, and are suitable for mounting on the front of, or inside, the control centers as indicated on the drawings. Control accessories to meet the applicable requirements of NEMA ICS 2. Mount relays and other equipment so that mechanical vibration does not cause false operation.

2.4.7.1 Control Stations

Ensure push-button stations and selector switches conform to NEMA ICS 2, are of the heavy-duty, oil-tight type, rated 600 volts ac, and have a contact rating designation of A600. Provide switches with escutcheon plates clearly marked to show operating positions.

2.4.7.2 LED Indicating Lights

Furnish red and green LED's where shown on the drawings, indicating contact "open" and "closed" position. The LED's are accessible and replaceable from the front of the control center through a finished opening in the compartment door. The LED assemblies are the heavy duty oiltight, watertight, and dusttight type.

2.4.7.3 Control Relays

Control relays are the electrically operated, magnetically held, self-reset, open type, suitable for mounting inside the starter compartments, 120-volt ac. Contacts are as indicated on the drawings and have a contact rating designation of A600 or N600, as required, in

accordance with NEMA ICS 2.

2.4.7.4 Timing Relays

Provide pneumatic type timers, suitable for mounting inside the control center and rated 120 volts ac, 60 Hz. Provide instantaneous and time delay contacts as indicated on the drawings, and have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2. Provide means for manual adjustment over a range as indicated on the drawings.

2.4.7.5 Alternators

Alternators 120-volt, 60 Hz, single-phase, open type, suitable for mounting inside of control center as indicated. Alternators to automatically cycle two motor starters in such a manner that No. 1 will lead and No. 2 will lag during the first cycle, and during the second cycle No. 2 will lead and No. 1 will lag, and the third cycle repeats the first cycle. The duration of a cycle is determined by an adjustable time delay. Provide contacts with a minimum contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.4.7.6 Elapsed-Time Meters

Provide nonreset type hour-indicating time meters with 6- digit registers with counter numbers at least 1/4-inch high. White numbers on black backgrounds provide hour indication with the last digit in contrasting colors to indicate tenths of an hour. Provide an enclosure 3-1/2 inches square and dust resistant. Operating voltage is 120 volts ac.

2.4.8 Feeder Tap Units

Provide feeder tap units as indicated on the drawings. Feeder tap units include externally operable molded-case circuit breakers in combination motor-control unit enclosures for the protection of non-motor loads or remotely located magnetic motor-controllers. Contain not more than two molded-case circuit breakers in feeder tap units.

2.4.9 Metering Section

Provide metering section with instruments as indicated on the drawings.

2.4.9.1 Instrument Transformers

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2 and IEEE C63.4 for instrument transformers.

2.4.9.1.1 Current Transformers (CT)

Provide current transformers conforming to IEEE C57.13 for installation in metal-clad switchgear. Use standard multi-ratio 5A secondary transformers. Ensure CTs are coordinated to the rating of the associated switchgear, relays, and instruments and CTs for relaying have a thermal rating factor of 2.0.

Provide wound bushing bar window type transformers.

Provide transformers that have double secondary winding.

Provide transformers that are complete with secondary short-circuiting device.

Provide indoor dry type construction for window type transformers with secondary current ratings as indicated with specified burden, frequency, and accuracy.

2.4.9.1.2 Potential Transformers

Provide potential transformers conforming to IEEE C57.13 for installation in metal-clad switchgear. Use standard 120-volt secondary, drawout type, 60 Hz transformers with voltage ratings and ratios coordinated to the ratings of the associated switchgear, relays, and instruments. Ensure potential transformers are equipped with two current limiting fuses in the primary sized as recommended by the potential transformer manufacturer.

Provide transformers with double secondary.

Provide burden, frequency, and accuracy as required.

Provide indoor dry type two-winding construction for disconnecting potential transformers with integral fuse mountings and current-limiting fuses with primary and secondary voltage ratings as required.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit, within a minimum of 14 days prior to the proposed date of tests, six copies of manufacturer's routine factory test procedures and production line tests for all motor control centers.

Each item of equipment supplied under this contract is given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein is witnessed by the RPM, FEAD CM or Engineer unless waived in writing, and no equipment shipped until it has been approved for shipment by the RPM, FEAD CM or Engineer. Notify the RPM, FEAD CM or Engineer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the RPM, FEAD CM or Engineer to be present at the tests. The factory test equipment and the test methods used conforms to the applicable NEMA Standards, and is subject to the approval of the RPM, FEAD CM or Engineer. Reports of all witnessed tests are signed by witnessing representatives of the Contractor and RPM, FEAD CM or Engineer. Bear the cost of performing all tests and include in the prices bid in the schedule for equipment.

2.5.1 Motor Control Centers Tests

2.5.1.1 Dielectric Tests

Completely assemble the motor control center and perform dielectric tests in accordance with NEMA ICS 1.

2.5.1.2 Operational Tests

Check the correctness of operation of each air circuit breaker or motor circuit protector and magnetic contactor and of all control devices, accessories and indicating lamps. These checks are made at rated voltage with power supplies to the main buses. Check all magnetic contactors for proper operation with power at 90 percent of rated voltage.

2.5.1.3 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, design tests may be submitted demonstrating that satisfactory short-circuit tests, as specified in NEMA ICS 2, have been made on a motor control center of similar type of construction and having the same available short circuit current at the motor terminals, including any motor contributions, as the motor control centers specified to be furnished under these specifications.

2.5.1.4 Test Results

Submit six complete reproducible copies of the factory inspection results and six complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Contractor's and RPM, FEAD CM or Engineer's Representatives to sign and date report.

PART 3 EXECUTION

3.1 INSTALLATION

Complete assembly is electrically and mechanically connected and assembled from coordinated subassemblies shipped in complete sections from the manufacturer. Align, level and secure the installation to the supporting construction in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

3.2.1 Acceptance Tests

Perform all applicable inspections and electrical tests, including optional tests, in accordance with NETA ATS.

Engage a factory-authorized service representative to perform startup services. Verify complete system operation including all hardware, software and communication devices. Start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Refer to section 26 08 00 for Apparatus Inspection and Testing Perform final equipment adjustments:

a. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.

b. Adjust overload relay settings for power factor correction capacitors connected to the load side of the overload relays.

c. Adjust the trip settings of motor circuit protectors and thermal-magnetic circuit breakers with adjustable.

d. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid state controllers.

Final acceptance depends upon the satisfactory performance of the motor-control centers under test. Do not energize the motor-control center until recorded test data have been approved by the Contracting Officer. Provide final test reports.

3.3 CLOSEOUT ACTIVITIES

Submit manufacturer's instructions for the motor control units and protective devices including special provisions required to install equipment components and system packages. Detail within special notices hazards and safety precautions.

Provide the warranty to the RPM, FEAD CM or Engineer.

-- End of Section --

SECTION 26 28 01.00 10

COORDINATED POWER SYSTEM PROTECTION
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 242	(2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE 399	(1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE C37.13	(2015) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	(2009) Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC 3200 V and below) Power Circuit Breakers
IEEE C57.13	(2016) Requirements for Instrument Transformers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FU 1	(2012) Low Voltage Cartridge Fuses
NEMA/ANSI C12.11	(2007) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 198M	(2018) UL Standard for Mine-Duty Fuses
UL 486E	(2015; Reprint Apr 2019) UL Standard for Safety Equipment Wiring Terminals for Use

	with Aluminum and/or Copper Conductors
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2018) UL Standard for Safety Industrial Control Equipment
UL 1203	(2013; Reprint Jan 2020) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fault Current Analysis
Protective Device Coordination Study
Equipment
System Coordinator
Protective Relays
Installation

SD-06 Test Reports

Field Testing

SD-07 Certificates

Devices and Equipment

1.3 QUALITY ASSURANCE

1.3.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a registered professional electrical power engineer with a minimum of 3 years of current experience in the coordination of electrical power systems. Submit verification of experience and license number, of a registered Professional Engineer as specified above. Experience data shall include at least five references for work of a magnitude comparable to this contract, including points of contact, addresses and telephone numbers.

1.3.2 System Installer

Calibration, testing, adjustment, and placing into service of the protective devices shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of two years of current product experience in protective devices.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide protective devices and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory utility type use for at least two years prior to bid opening. Submit data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of adjustable protective devices, and recommended ratings of non-adjustable protective devices.

2.2 NAMEPLATES

Provide nameplates to identify all protective devices and equipment. Nameplate information shall be in accordance with UL 489.

2.3 CORROSION PROTECTION

Metallic materials shall be protected against corrosion. Ferrous metal hardware shall be zinc or chrome-plated.

2.4 LOW-VOLTAGE FUSES

2.4.1 General

Low-voltage fuses shall conform to NEMA FU 1. Time delay and nontime delay options shall be as specified. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics requires for effective power system coordination.

2.4.2 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. Class H Fuses shall conform to UL 198M. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds. Cartridge fuses shall be used for circuits rated in excess of 30 amperes, 125 volts, except where current-limiting fuses are indicated.

2.4.3 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class G J K L RK1 RK5 RK9 T CC shall have tested interrupting capacity not less than 100,000 200,000 amperes. Fuse holders shall be the type that will reject Class H fuses.

a. Class G J L CC fuses shall conform to UL 198M.

b. Class K fuses shall conform to UL 198M.

c. Class R fuses shall conform to UL 198M.

d. Class T fuses shall conform to UL 198M.

2.4.3.1 Continuous Current Ratings (600 amperes and smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1 RK5 J, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.4.3.2 Continuous Current Ratings (greater than 600 amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.4.3.3 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.5 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

2.5.1 General

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.5.2 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.5.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 0	A-N
NEMA 1	A-P

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.6 MOLDED-CASE CIRCUIT BREAKERS

2.6.1 General

Molded-case circuit breakers shall conform to UL 489 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers. Circuit breakers and circuit breaker enclosures located in hazardous (classified) areas shall conform to UL 1203.

2.6.2 Construction

Molded-case circuit breakers shall be assembled as an integral unit in a supporting and enclosing housing of glass reinforced insulating material providing high dielectric strength. Circuit breakers shall be suitable for mounting and operating in any position. Lugs shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.6.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with UL 489. Ratings shall be coordinated with system X/R ratio.

2.6.4 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and

accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.6.5 SWD Circuit Breakers

Circuit breakers rated 15 amperes or 20 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.6.6 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.6.7 Motor Circuit Protectors (MCP)

Motor circuit protectors shall conform to UL 489 and UL 489 and shall be provided as shown. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short-circuit protection. Motor Circuit Protectors shall be rated in accordance with NFPA 70.

2.7 LOW-VOLTAGE POWER CIRCUIT BREAKERS

2.7.1 Construction

Low-voltage power circuit breakers shall conform to IEEE C37.13 and IEEE C37.16 and shall be three-pole, single-throw, stored energy, electrically operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. Control voltage shall be as indicated. The circuit breaker enclosure shall be suitable for its intended location.

2.7.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with IEEE C37.16. Tripping features shall be as follows:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.

h. Adjustable ground-fault delay.

i. Overload and Short-circuit and Ground-fault trip indicators shall be provided.

2.8 INSTRUMENT TRANSFORMERS

2.8.1 General

Instrument transformers shall comply with NEMA/ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on the drawings.

2.8.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than 1.5 . Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.8.2.1 For kW Hour and Demand Metering (Low Voltage)

Current transformers shall conform to IEEE C57.13. Current transformers with a metering accuracy Class of 0.3 through 1, with a minimum RF of 4 at 86 degrees F, with 600-volt insulation, and 10 kV BIL shall be provided. Butyl-molded, window-type current transformers mounted on the transformer low-voltage bushings shall be provided. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters.

2.8.2.2 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy rating of .15. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.9 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. Submit the study along with protective device equipment submittals. No time extensions or similar contact modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last 3 years. Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the RPM, FEAD CM or Engineer.

2.9.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.9.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Coordinate with the commercial power company for fault current availability at the site. Utilize the fault current availability indicated as a basis for fault current studies.

2.9.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Location of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.9.4 Fault Current Analysis

2.9.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE 242, and IEEE 399.

2.9.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those proposed. Data shall be documented in the report.

2.9.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.9.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. A written narrative shall be provided describing: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.9.6 Study report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the RPM, FEAD CM or Engineer of any discrepancy before performing any work.

3.2 INSTALLATION

Submit procedures including diagrams, instructions, and precautions required to properly install, adjust, calibrate, and test the devices and equipment. Install protective devices in accordance with the manufacturer's published instructions and in accordance with the requirements of NFPA 70 and IEEE C2.

3.3 FIELD TESTING

Prior to field tests, submit the proposed test plan consisting of complete field test procedure, tests to be performed, test equipment required, and tolerance limits, and complete testing and verification of the ground fault protection equipment, where used. Submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

3.3.1 General

Perform field testing in the presence of the RPM, FEAD CM or Engineer. Notify the RPM, FEAD CM or Engineer 7 days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the RPM, FEAD CM or Engineer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results.

3.3.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.3.3 Molded-Case Circuit Breakers

Circuit breakers shall be visually inspected, operated manually, and connections checked for tightness. Current ratings shall be verified and adjustable settings incorporated in accordance with the coordination study.

3.3.4 Power Circuit Breakers

3.3.4.1 General

Visually inspect the circuit breaker and operate the circuit breaker manually; adjust and clean primary contacts in accordance with manufacturer's published instructions; check tolerances and clearances; check for proper lubrication; and ensure that all connections are tight. For electrically operated circuit breakers, verify operating voltages on closing and tripping coils. Verify fuse ratings in control circuits; electrically operate the breaker, where applicable; and implement settings in accordance with the coordination study.

3.3.5 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Submit data including calibration and testing procedures and instructions pertaining to the frequency of calibration, inspection, adjustment, cleaning, and lubrication. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

-- End of Section --

SECTION 26 29 23

ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
02/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN/CENELEC)

EN 61800-3	(2017) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 3.1	(2019) Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA ICS 7	(2014) Adjustable-Speed Drives
NEMA ICS 7.2	(2015) Application Guide for AC Adjustable Speed Drive Systems
NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508C	(2002; Reprint Nov 2010) Power Conversion Equipment

1.2 RELATED REQUIREMENTS

Section 26 05 00.00 20 COMMON WORK RESULTS FOR ELECTRICAL applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15 and EN 61800-3 rules and regulations, must be certified to comply with the requirements for class A computing devices and labeled.

1.3.1.2 Electromechanical and Electrical Components

Ensure electrical and electromechanical components of the Adjustable Speed Drive (ASD) do not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519 Control panel must have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge protective device must be mounted near the incoming power source and properly wired to all three phases and ground. Fuses must not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified must be protected against surges induced on control and sensor wiring installed outdoors and as shown. Test the inputs and outputs in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Schematic Diagrams; G

Interconnecting Diagrams; G

Installation Drawings; G

As-Built Drawings; G

SD-03 Product Data

Adjustable Speed Drives; G

Wires and Cables

Equipment Schedule

SD-06 Test Reports

ASD Test

Performance Verification Tests

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

ASD Test Plan; G

Standard Products

SD-10 Operation and Maintenance Data

Adjustable Speed Drives, Data Package 4

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Submit diagrams showing circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify

proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with ASD's and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes. Submit drawings for government approval prior to equipment construction or integration. Immediately record modifications to original drawings made during installation for inclusion into the as-built drawings.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule must provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule must include the total quantity of each item of equipment supplied and data indicating compatibility with motors being driven. For complete assemblies, such as ASD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation Instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6 DELIVERY AND STORAGE

Store delivered equipment to protect from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system must be warranted by the manufacturer for a period of one year . Repair or replace any component failing to perform its function

as specified and documented at no additional cost to the Government. Items repaired or replaced must be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in FAR 52.246-21 Warranty of Construction.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

Provide one spare ASD of each model provided for HVAC equipment, fully programmed and ready for back-up operation when connected.

1.8.2 Operation and Maintenance Data

Provide in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Provide additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.8.3 Maintenance Support

During the warranty period, provide on-site, on-call maintenance services by drive manufacturer's personnel on the following basis: The service must be on a per-call basis with 36 hour response. Contractor is responsible for the maintenance of all hardware and software of the system during the warranty period. Various personnel of different expertise must be sent on-site depending on the nature of the maintenance service required. Costs must include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, must be borne by the Contractor.

1.8.4 Technical Support

Provide the ASDs with manufacturer's technical telephone support in English, readily available during normal working hours.

PART 2 PRODUCTS

2.1 ADJUSTABLE SPEED DRIVES (ASD)

Provide adjustable speed drive to control the speed of induction motor(s). The ASD must include the following minimum functions, features and ratings.

a. Input circuit breaker per UL 489 with a minimum of 22,000 amps symmetrical interrupting capacity at 240V and 14,000 amps symmetrical

interrupting capacity at 480V and door interlocked external operator.

b. A converter stage per UL 508C must change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter must utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter must be insensitive to three phase rotation of the ac line and must not cause displacement power factor of less than .95 lagging under any speed and load condition.

c. An inverter stage must change fixed dc voltage to variable frequency, variable ac voltage for application to a standard NEMA MG 1 Part 30 motor designed for use with adjustable frequency power supplies. Switch the inverter to produce a sine coded pulse width modulated (PWM) output waveform.

d. The ASD shall be capable of supplying 120 percent of rated full load current for one minute at maximum ambient temperature.

e. The ASD must be designed to operate from a 480 or 240 volt, plus or minus 10 percent, single phase or three phase, 60 Hz supply, and control motors with a corresponding voltage rating. Where an ASD has a 240 volt, single phase input, ASD shall provide a 240 volt, three phase output for use with a 240 volt, three phase motor.

f. Acceleration and deceleration time must be independently adjustable from one second to 60 seconds.

Required deceleration time may be achieved using not only dynamic braking resistor but with other methods described in NEMA ICS 7.2-2015 paragraph 5.2.5.

g. Adjustable full-time current limiting must limit the current to a preset value which must not exceed 110 percent of the controller rated current. The current limiting action must maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override must allow starting current to reach 175 percent of controller rated current to maximum starting torque.

h. The controllers must be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection must be included such that a failure in the controller electronic circuitry must not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency must be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

j. The controller efficiency at any speed must not be less than 96 percent.

k. The controllers must be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components must be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions must not result in component failure or the need for fuse replacement:

(1) Short circuit at controller output

(2) Ground fault at controller output

(3) Open circuit at controller output

(4) Input undervoltage

(5) Input overvoltage

(6) Loss of input phase

(7) AC line switching transients

(8) Instantaneous overload

(9) Sustained overload exceeding 115 percent of controller rated current

(10) Over temperature

(11) Phase reversal

m. Solid state motor overload protection must be included such that current exceeding an adjustable threshold must activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down. Class II ground-fault protection, with start and run delays to prevent nuisance trip on staring, analog communication module.

n. Include slip compensation circuit that will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA MG 1 Part 30 designed for use with adjustable frequency power supplies motors to within plus or minus 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The ASD must be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The ASD must be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.

p. The ASD must include external fault reset capability. All the necessary logic to accept an external fault reset contact must be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The ASD must have a minimum of three user selectable bandwidths.

r. Provide preperly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of ASD failure and for safety transfers motor between power converter output and bypass circuit using a field-selectable automatic and manual bypass mode. Install mechanical and electrical interlocks between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer. Motor overload and short circuit protective features must remain in use

during the bypass mode.

s. Each individual ASD must meet the following Total Harmonic Distortion (THD) requirements at the input terminals to the factory assembly of the ASD or at the load disconnecting means serving the ASD and filter assembly. These measurements should be taken with the drive set at 90 percent frequency (rpms) and the motor under a minimum of 50 percent demand.

(1) The Voltage THD should not exceed 2.0 percent THD.

(2) The Current THD should not exceed 15.0 percent THD.

(3) If the standard factory ASD does not meet or exceed these requirements the factory must install appropriate equipment (Harmonic Traps, Filters, different Drive technology, etc.) to mitigate the distortion to assure performance of the VFD is within the limits.

(4) These tests should be performed at the Manufacturers Laboratory facilities and submitted as part of the Product Data Submittals, in order to prevent the necessity of adding mitigation equipment in the field. If the requirements listed above are met, IEEE 519 will also be met.

t. Minimum Operating Conditions. Designed and constructed ASD's to operate within the following service conditions:

(1) Ambient Temperature Rating: 0 to 120 degrees F.

(2) Non-condensing relative humidity rating: less than 95 percent.

(3) Ambient rating: Not exceed 3,300 feet.

2.1.1 ASD for Industrial Application

Provide the following operator control and monitoring devices mounted on the front panel of the ASD:

a. Manual speed potentiometer.

b. Hand-Off-Auto (HOA) switch. In "Hand" operation the motor shall be controlled by a local Start/Stop pushbutton. In "Off" the motor shall be disabled. In "Auto" the motor shall be controlled by the plant PLC via Ethernet communications.

c. Power on light.

d. Drive run power light.

e. Local display capable of including ASD status, frequency, motor RPM, phase current, fault diagnostic in descriptive text, and all programmed parameters.

2.1.2 ASD for HVAC Application

ASDs must have the following features:

a. A local operator control providing the following functions:

(1) Remote/Local operator selection with password access.

(2) Run/Stop and manual speed commands.

(3) All programming functions.

(4) Scrolling through all display functions.

b. A local operator control panel with the following data displayed:

(1) ASD status.

(2) Frequency.

(3) Motor RPM.

(4) Phase current.

(5) Scrolling through all display functions.

(6) Fault diagnostics in descriptive text.

(7) All programmed parameters.

c. Standard PI loop controller with input terminal for controlled variable and parameter settings.

d. User interface terminals for remote control of ASD speed, speed feedback, and an isolated form C SPDT relay, which energizes on a drive fault condition.

e. An isolated form C SPDT auxiliary relay which energizes on a run command.

f. An adjustable carrier frequency with 16 KHz minimum upper limit.

g. A built-in or external line reactor with 3 percent minimum impedance to protect the DC bus capacitors and rectifier section diodes, reduce power line transient voltage, line notching, DC bus over-voltage tripping and improve the inverter over-current and over-voltage conditions.

h. Historical logging information and displays:

(1) Running log of total power versus time.

(2) Total run time.

(3) Fault log, maintaining last four faults with time and data stamp for each.

i. The ASD must be capable of automatic control by a remote signal, by Ethernet IP network command, or manually by the ASD control panel.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, and NEMA ICS 6, with a heater if located outdoors.

2.3 WIRES AND CABLES

All wires and cables must conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Provide manufacturer's standard, permanent nameplates for internal areas of enclosures.

2.5 SOURCE QUALITY CONTROL

2.5.1 ASD Test Plan

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans.

2.5.2 ASD Test Report

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer must supervise the installation of all equipment, and wiring.

3.2 GROUNDING

Per NEMA ICS 7.2, ASD must be solidly grounded to the main distribution.

3.3 FIELD QUALITY CONTROL

Specified products must be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.3.1 ASD Test

A proposed test plan must be submitted to the RPM, FEAD CM or Engineer at least 28 calendar days prior to proposed testing for approval. The tests must conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. Inform the Government at least 14 working days prior to the dates of testing. Perform the ASD test engaging a qualified

testing agency's field supervisor currently certified by NETA to supervise on-site testing.

3.3.2 Performance Verification Tests

"Performance Verification Test" plan must provide the step by step procedure required to establish formal verification of the performance of the ASD. Compliance with the specification requirements must be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. Inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test must commence. The system must be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of 0.9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. The contractor is not allowed in the building during the endurance test. The system must respond as designed.

3.4 DEMONSTRATION

3.4.1 Training

Coordinate training requirements with the RPM, FEAD CM or Engineer. Provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. Provide all training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the RPM, FEAD CM or Engineer.

3.4.1.1 Instructions to Government Personnel

Provide the services of competent instructors with minimum two-year field experience with the operation and maintenance of similar ASDs who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors must be thoroughly familiar with the subject matter they are to teach. The number of training days of instruction furnished must be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals must be turned over to the Government at the end of last training session.

3.4.1.2 Operating Personnel Training Program

Provide one 2-hour training session at the site at a time and place

mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. Alarm formats

e. Failure recovery procedures

f. Troubleshooting

3.4.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training must be conducted on site at a location designated by the Government. Provide a one-day training session to train four engineering personnel in the functional operations of the system. This training must include:

a. System overview

b. General theory of operation

c. System operation

d. System configuration

e. Alarm formats

f. Failure recovery procedures

g. Troubleshooting and repair

h. Maintenance and calibration

i. System programming and configuration

-- End of Section --

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
11/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code
NFPA 780	(2017) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96	(2016a) UL Standard for Safety Lightning Protection Components
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL Electrical Construction	(2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise RPM, FEAD CM or Engineer of any discrepancy before performing work. Obtain prior approval of RPM, FEAD CM or Engineer before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a commercial third-party inspection company whose sole work is lightning

protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Overall lightning protection system; G

Each major component; G

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G

Lightning Protection and Grounding System Test; G

SD-07 Certificates

Lightning Protection System Installers Documentation; G

Component UL Listed and Labeled; G

Lightning protection system inspection certificate; G

Roof manufacturer's warranty; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean RPM, FEAD CM or Engineer.

1.4.1 Installation Drawings

1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Construction, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System" in the test plan.

1.4.4 Lightning Protection System Inspection Certificate

Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise RPM, FEAD CM or Engineer of any discrepancy before performing work. Obtain prior approval of RPM, FEAD CM or Engineer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as

bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper Only

Provide copper conductors, except where aluminum conductors are required for connection to aluminum equipment.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of solid copper conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

2.2.3 Grounding Plates

Provide grounding plates made of copper-clad steel conforming to UL 96.

2.2.4 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.5 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780, including tie-ins to existing lightning protection systems. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, and grounding electrodes and ground ring electrode conductor. Bond secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or below the level of the grounded metallic parts.

3.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors.

3.1.1.1 Air Terminals

Use adhesive shoes with adhesive approved by the roof manufacturer when installing air terminals on "rubber" (EPDM) type roofs. In areas of snow or constant wind, ensure that a section of roofing material (minimum dimensional area of 1 square foot) is first glued to the roof and then the air terminal is glued to it unless the roof manufacturer recommends another solution. Use a standing seam base for installation of air terminals on a standing seam metal roof that does not produce any roof penetrations.

3.1.1.2 Roof Conductors

Use adhesive shoes with adhesive approved by the roof manufacturer when installing roof conductors on "rubber" (EPDM) type roofs. Use a standing seam base for installation of roof conductors on a standing seam metal roof that does not produce any roof penetrations.

3.1.2 Down Conductors

Protect exposed down conductors from physical damage as required by NFPA 780. Use Schedule 80 PVC to protect down conductors. Paint the Schedule 80 PVC to match the surrounding surface with paint that is approved for use on PVC.

3.1.3 Ground Connections

Attach each down conductor and ground ring electrode to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure. Accessible connections above ground level and in test wells can be accomplished by mechanical clamping.

3.1.4 Grounding Electrodes

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a driven ground rod is 25 ohms, under normally dry conditions when a ground ring electrode is not used. Contact the RPM, FEAD CM or Engineer for direction on how to proceed when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground ring electrode, provide continuous No. 1/0 bare stranded copper cable. Lay ground ring electrode around the perimeter of the structure in a trench not less than 3 feet nor more than 8 feet from the nearest point of the structure foundation, and at least beyond the drip line for the facility. Install ground ring electrode to a minimum depth of 30 inches. Install a ground ring electrode in earth undisturbed by excavation, not

earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable.

3.1.5 Grounding Plates

Provide a grounding plate for each down conductor. Set grounding plates not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. Grounding plate is to be buried as deeply in the existing dirt as local conditions allow, without exceeding 10 feet in depth.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous, having a surface contact of at least 3 square inches.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Exterior Overhead Systems

Bond to the nearest down conductor as close to grade as possible. This includes overhead pipes, conduits, cable trays, or any other metallic objects on the exterior of the building that enter a building. In addition, bond pipes, conduits, and cable trays to any metallic objects (such as steel structural support of air handling units or cooling towers) that are within 6 feet.

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore, to original condition, the areas disturbed by trenching, storing of dirt, cable laying, and other work. Overfill to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Lightning Protection and Grounding System Test

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of 25 ohms. Provide documentation for the measured values at each test point. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the RPM, FEAD CM or Engineer.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2018) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2019) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B164	(2003; R 2014) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B633	(2019) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

EUROPEAN UNION (EU)

Directive 2011/65/EU	(2011) Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	(2011; Errata 2015) IES Lighting Handbook
IES LM-79	(2008) Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80	(2015) Measuring Lumen Maintenance of LED Light Sources
IES RP-16	(2017) Nomenclature and Definitions for Illuminating Engineering

IES TM-15	(2011) Luminaire Classification System for Outdoor Luminaires
IES TM-21	(2019) Projecting Long Term Lumen Maintenance of LED Light Sources
IES TM-30	(2018) IES Method for Evaluating Light Source Color Rendition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2017) Electric Lamps— Specifications for the Chromaticity of Solid State Lighting Products
NEMA C82.77-10	(2020) Harmonic Emission Limits - Related Power Quality Requirements
NEMA SSL 1	(2016) Electronic Drivers for LED Devices, Arrays, or Systems
NEMA SSL 3	(2011) High-Power White LED Binning for General Illumination

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code
NFPA 101	(2018; TIA 18-1; TIA 18-2; TIA 18-3) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 924	(2016; Reprint May 2018) UL Standard for Safety Emergency Lighting and Power Equipment
UL 1598	(2008; Reprint Oct 2012) Luminaires
UL 8750	(2015; Reprint Oct 2019) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications and on the drawings, must be as defined in IEEE 100 and IES RP-16.

b. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in IES LM-80.

c. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one entity, not the source separately and then the source and housing together.

d. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire Drawings; G

Occupancy/Vacancy Sensor Coverage Layout; G; S

Lighting Control System One-Line Diagram; G

Sequence of Operation for Lighting Control System; G

SD-03 Product Data

Luminaires; G

Light Sources; G

LED Drivers; G

Luminaire Warranty; G

Lighting Controls Warranty; G

Switches; G

Power Hook Luminaire Hangers; G

Exit Signs; G

Emergency Drivers; G

Energy Star Label For Residential Luminaires; S

SD-05 Design Data

Luminaire Design Data; G

SD-06 Test Reports

IES LM-79 Test Report; G

IES LM-80 Test Report; G

IES TM-21 Test Report; G

IES TM-30 Test Report; G

Photosensor Verification Test; G

SD-07 Certificates

LED Driver and Dimming Switch Compatibility Certificate; G

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5; G

Lighting Control System, Data Package 5; G

Maintenance Staff Training Plan; G

End-User Training Plan; G

1.4 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES HB-10 as applicable, for the lighting system specified.

1.4.1 Luminaire Drawings

Include dimensions, accessories installation details, and construction details. Photometric data, including CRI, CCT, LED driver type, zonal lumen data, and candlepower distribution data must accompany shop drawings.

1.4.2 Luminaire Design Data

a. Provide safety certification and file number for the luminaire family that must be listed, labeled, or identified in accordance with the NFPA 70. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratories).

b. Provide long term lumen maintenance projections for each LED luminaire in accordance with IES TM-21. Data used for projections must be obtained from testing in accordance with IES LM-80.

1.4.3 IES LM-79 Test Report

Submit test report on manufacturer's standard production model of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data in IES format as outlined under "14.0 Test Report" in IES LM-79.

1.4.4 IES LM-80 Test Report

Submit report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "8.0 Test Report" in IES LM-80.

1.4.5 IES TM-21 Test Report

Submit test report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data, as well as required interpolation information as outlined under "7.0 Report" in IES TM-21.

1.4.6 IES TM-30 Test Report

Submit color vector graphic in accordance with IES TM-30 on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Include spectral distribution of test LED light source.

1.4.7 LED Driver and Dimming Switch Compatibility Certificate

Submit certification from the luminaire, driver, or dimmer switch manufacturer that ensures compatibility and operability between devices without flickering and to specified dimming levels.

1.4.8 Test Laboratories

Test laboratories for the IES LM-79 and IES LM-80 test reports must be one of the following:

a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program for both LM-79 and LM-80 testing.

b. One of the qualified labs listed on the Department of Energy - LED Lighting Facts Approved Testing Laboratories List for LM-79 testing.

c. One of the EPA-Recognized Laboratories listed for LM-80 testing.

1.4.9 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70, unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

1.4.10 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.10.1 Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.10.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.5 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.5.1 Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

a. Provide a written five year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return authorization number is required, return shipping information, and

closest return location to the luminaire location.

(1) Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

(2) Material warranty must include:

(a) All LED drivers and integral control equipment.

(b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective, non-starting, or operating below 70 percent of specified lumen output.

b. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

c. Provide replacements that are promptly shipped, without charge, to the using Government facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and assembly.

1.6 OPERATION AND MAINTENANCE MANUALS

1.6.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system for the building. Additional requirements for the Navy are provided in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Include the following:

a. Manufacturers' operating and maintenance manuals.

b. Luminaire shop drawings for modified and custom luminaires.

c. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

2.2 LUMINAIRES

UL 1598, NEMA C82.77-10. Provide luminaires as indicated in the luminaire schedule and NL plates or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be specifically designed for use with the driver and light source provided.

2.2.1 Luminaires

UL 8750, IES LM-79, IES LM-80. For all luminaires, provide:

a. Complete system with LED drivers and light sources.

b. Housings constructed of non-corrosive materials. All new aluminum housings must be anodized or powder-coated. All new steel housings

must be treated to be corrosion resistant.

c. IES TM-21, IES LM-80. Minimum L70 lumen maintenance value of 50,000 hours unless otherwise indicated in the luminaire schedule. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. Minimum efficacy as specified in the luminaire schedule. Theoretical models of initial lamp lumens per watt are not acceptable. If efficacy values are not listed in the luminaire schedule, provide luminaires that meet the following minimum values:

Luminaire Style	Minimum Luminaire Efficacy
Industrial Locations besides High-Bay	143 LPW
High Bay, and Industrial Locations	175 LPW
Exterior Wall Sconce	126 LPW

e. UL listed for dry or damp location typical of interior installations. Any luminaire mounted on the exterior of the building must be UL listed for wet location typical of exterior installations.

f. LED driver and light source package, array, or module are accessible for service or replacement without removal or destruction of luminaire.

g. Lenses constructed of heat tempered borosilicate glass, UV-resistant acrylic, or silicone. Provide polycarbonate vandal-resistant lenses as indicated. Sandblasting, etching and polishing must be performed as indicated in the luminaire description.

h. IES TM-15. Provide exterior building-mounted luminaires that do not exceed the BUG ratings as listed in the luminaire schedule. If BUG ratings are not listed in the luminaire schedule, provide luminaires that meet the following minimum values for each application and mounting conditions:

Lighting Application	Mounting Conditions	BUG Rating
Exterior Wall Sconce	Above 4 feet AFF	B1-U0-G2

2.3 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type, delivered lumen output, and wattage as indicated in the luminaire schedule on project plans.

2.3.1 LED Light Sources

Provide LED light sources that meet the following requirements:

a. NEMA ANSLG C78.377. Emit white light and have a nominal CCT of 3500 Kelvin.

b. Minimum Color Rendering Index (CRI) of 80.

c. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

d. Light source color consistency by utilizing a binning tolerance within a 3-step McAdam ellipse.

2.4 LED DRIVERS

NEMA SSL 1, UL 8750. Provide LED drivers that are electronic, UL Class 1 or Class 2, constant-current type and that comply with the following requirements:

a. The combined driver and LED light source system does not exceed the minimum luminaire efficacy values as listed in the luminaire schedule provided.

b. Operates at a voltage of 120-277 volts at 50/60 hertz, with input voltage fluctuations of plus/minus 10 percent.

c. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.

d. Maximum Total Harmonic Distortion (THD) less than 20 percent at full input power and across specified dimming range.

e. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.

f. Withstands Category A surges of 4 kV without impairment of performance. Provide surge protection that is integral to the driver.

g. Integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.

h. 47 CFR 15. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

i. Class A sound rating.

j. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

k. Provide dimming capability as indicated in the luminaire schedule on project plans. Dimmable drivers must dim down to 1 percent. Dimmable drivers must be controlled by a Class 2 low voltage 0-10VDC controller dimming signal protocol unless otherwise specified. LED drivers of the same family/series must track evenly across multiple luminaires at all light levels.

2.5 LIGHTING CONTROLS

2.5.1 Devices

2.5.1.1 Switches

When used for non-digital loads, devices must be rated at 20 Amps inductive load, and be compatible with the lighting control systems.

2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT

2.6.1 Exit Signs

UL 924, NFPA 101. Provide wattage as indicated in the luminaire schedule on project plans. Provide LED Exit Signs that meet the following criteria:

a. Housing constructed of clear polycarbonate housing.Edge-lit type with clear acrylic, edge-lit face and aluminum trim having white finish.

b. UL listed for wet location.

c. Configured for universal mounting.

d. 6 inch high, 3/4 inch stroke red lettering on face of sign with chevrons on either side of lettering to indicate direction.

e. Single or double face as indicated in project plans and luminaire schedule.

2.6.1.1 Exit Signs with Battery Backup

Equip with automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1-1/2 hours. LEDs must have a minimum rated life of 10 years. Provide self-diagnostic circuitry integral to emergency LED driver.

2.6.2 Self-Diagnostic Circuitry for LED Drivers

UL 924, NFPA 101. Provide emergency lighting unit with fully-automatic, integral self-testing/diagnostic electronic circuitry. Circuitry must provide for a one minute diagnostic test every 28 days, and a 30 minute diagnostic test every six months, minimum. Any malfunction of the unit must be indicated by LED(s) visible from the exterior of the luminaire. A manual test switch must also be provided to perform a diagnostic test at any given time.

2.7 LUMINAIRE MOUNTING ACCESSORIES

2.7.1 Suspended Luminaires

a. Provide hangers capable of supporting twice the combined weight of luminaires supported by hangers.

b. Hangers must allow luminaires to swing within an angle of 45 degrees. Brace pendents 4 feet or longer to limit swinging. Provide with swivel hangers to ensure a plumb installation for rigid stem pendents.

Provide cadmium-plated steel with a swivel-ball tapped for the conduit size indicated.

c. Single-unit suspended luminaires must have twin-stem hangers. Multiple-unit or continuous row luminaires with a separate power supply cord must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end.

d. Provide all linear pendent and surface mounted luminaires with two supports per four-foot section or three per eight-foot section unless otherwise recommended by manufacturer.

2.7.2 Recess and Surface Mounted Luminaires

Provide access to light source and LED driver from bottom of luminaire. Provide trim and lenses for the exposed surface of flush-mounted luminaires as indicated on project drawings and specifications. Luminaires recessed in ceilings which have a fire resistive rating of one hour or more must be enclosed in a box which has a fire resistive rating equal to that of the ceiling. For surface mounted luminaires with brackets, provide flanged metal stem attached to outlet box, with threaded end suitable for supporting the luminaire rigidly in design position. Flanged part of luminaire stud must be of broad base type, secured to outlet box at not fewer than three points.

2.7.3 Luminaire Support Hardware

2.7.3.1 Wire

ASTM A641/A641M. Galvanized, soft tempered steel, minimum 0.11 inches in diameter, or galvanized, braided steel, minimum 0.08 inches in diameter.

2.7.3.2 Wire for Humid Spaces

ASTM A580/A580M. Composition 302 or 304, annealed stainless steel, minimum 0.11 inches in diameter.

ASTM B164. UNS NO4400, annealed nickel-copper alloy, minimum 0.11 inches in diameter.

2.7.3.3 Threaded Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.7.3.4 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.7.4 Power Hook Luminaire Hangers

UL 1598. Provide an assembly consisting of through-wired power hook housing, interlocking plug and receptacle, power cord, and luminaire support loop. Power hook housing must be cast aluminum having two 3/4 inch threaded hubs. Support hook must have safety screw. Luminaire support loop must be cast aluminum with provisions for accepting 3/4 inch threaded stems. Power cord must include 16 inches of 3 conductor No. 16 Type SO

cord. Assembly must be rated 120 volts or 277 volts, 15 amperes.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

UL 1598. All luminaires must be clearly marked for operation of specific light sources and LED drivers. The labels must be easy to read when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Note the following light source characteristics in the format "Use Only _____":

a. Correlated Color Temperature (CCT) and Color Rendering Index (CRI) for all luminaires.

b. Driver and dimming protocol.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of corrosion-resistance testing.

PART 3 EXECUTION

3.1 INSTALLATION

IEEE C2, NFPA 70.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature (CCT), color rendering index (CRI), and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Provide accessories as required for ceiling construction type indicated on Finish Schedule. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a luminaire may be installed. Provide wires, straps, or rods for luminaire support in this section.

Install luminaires with vent holes free of air blocking obstacles.

3.1.2.1 Suspended Luminaires

Measure mounting heights from the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain architect approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Support suspended luminaires from structural framework of ceiling or from inserts cast into slab.

a. Provide suspended luminaires with 45 degree swivel hangers so that they hang plumb and level.

b. Locate so that there are no obstructions within the 45 degree range in all directions.

c. The stem, canopy and luminaire must be capable of 45 degree swing.

d. Rigid pendent stem, aircraft cable, rods, or chains 4 feet or longer excluding luminaire must be braced to prevent swaying using three cables at 120 degree separation.

e. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces.

f. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints.

g. Support steel luminaires to prevent "oil-canning" effects.

h. Match supporting pendents with supported luminaire. Aircraft cable must be stainless steel.

i. Match finish of canopies to match the ceiling, and provide low profile canopies unless otherwise shown.

j. Maximum distance between suspension points must be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.3 LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

3.1.4 Exit Signs

NFPA 101. Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

Connect exit signs on separate circuits and serve from a separate circuit breaker. Provide only one source of control, which would be the separate circuit breaker. Paint source of control red and provide lockout capability.

3.1.5 Lighting Controls

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

3.2.1.1 Lighting Control Verification Tests

Verify lighting control system and devices operate according to approved sequence of operations. Verification tests are to be completed after commissioning.

b. Verify any light fixture integral photosensors operate as described in sequence of operations. Provide testing of sensor coverage, aiming, and calibration in all spaces where sensors are placed. This is to be completed only after all furnishings have been installed. Submit photosensor verification test.

3.2.1.2 Emergency Lighting Test

Interrupt power supply to demonstrate proper operation of emergency lighting. If adjustments are made to the lighting system, re-test system to show compliance with standards.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Commissioning

Factory Trained Field Service Technician is responsible for calibration and programming sequences for input devices and systems in accordance with the requirements described in the sequence of operation.

3.3.2 Training

3.3.2.1 Maintenance Staff Training

Submit a Maintenance Staff Training Plan at least 30 calendar days prior to training session that describes training procedures for Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide on-site training which demonstrates full system functionality, assigning schedules, calibration adjustments for light levels and sensor sensitivity, integration procedures for connecting to third-party devices, and manual override including information on appropriate use. Provide protocols for troubleshooting, maintenance, repair, and replacement, and literature on available system updates and process for implementing updates.

3.3.2.2 End-User Training

Submit an End-User Training Plan at least 30 calendar days prior to training session that describes training procedures for end-users on the lighting control system. Provide users with a list of control devices located within user-occupied spaces, such as photosensors and occupancy and vacancy sensors, including information on the proper operation and schedule for each device. Provide demonstration for each type of interface. Provide users with the building schedule as currently commissioned, including conditional programming based on astronomic time clock

functionality. Provide users with the correct contact information for maintenance personnel who will be available to address any lighting control issues.

Provide laminated instructions to the user at each scene wallstation. Provide only instructions relevant to the functionality of the specific scene wallstation. Provide a description of each labeled scene control button. If the room utilizes occupancy/vacancy sensors or photosensors, include a description of this functionality on the instruction sheet.

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E	(2005) Cabinets, Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596	(2016) Indoor Optical Fiber Cables
ICEA S-90-661	(2012) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568	(2006) Standard for Installing Building Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66	(2019) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-21	(1988a; R 2012) FOTP-21 - Mating

	Durability of Fiber Optic Interconnecting Devices
TIA-526-7	(2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-526-14	(2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568-C.0	(2009; Add 1 2010; Add 2 2012) Generic Telecommunications Cabling for Customer Premises
TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.2	(2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard
TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-606	(2017c) Administration Standard for the Telecommunications Infrastructure
TIA-607	(2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-1152	(2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding
TIA/EIA-604-2	(2004b; R 2014) FOCIS 2 Fiber Optic Connector Intermateability Standard
TIA/EIA-604-3	(2004b; R 2014) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3
TIA/EIA-604-10	(2002a) FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC
TIA/EIA-604-12	(2000) FOCIS 12 Fiber Optic Connector Intermateability Standard Type MT-RJ

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 444	(2008; Reprint Apr 2015) Communications Cables
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 969	(2017; Reprint Mar 2018) UL Standard for Safety Marking and Labeling Systems
UL 1286	(2008; Reprint Jan 2018) UL Standard for Safety Office Furnishings
UL 1666	(2007; Reprint Jun 2012) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2004; Reprint Oct 2019) UL Standard for Safety Communication Circuit Accessories

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606 and IEEE 100 and herein.

1.2.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.2.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.2.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or

equipment. (International expression for horizontal cross-connect (HC).)

1.2.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.2.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.2.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.2.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.2.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.2.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.3 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G

Telecommunications Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Patch panels; G

Telecommunications outlet/connector assemblies; G

Equipment support frame; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests; G

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.5 QUALITY ASSURANCE

1.5.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.5.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, and FD's to the telecommunications work area outlets. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, CD's, BD's, FD's, and the EF and ER for telecommunications keyed to floor plans by room number. Mount the laminated schematic in the EF telecommunications space as directed by the RPM, FEAD CM or Engineer. The following drawings shall be provided as a minimum:

a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.5.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.5.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.5.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.5.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication

system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the RPM, FEAD CM or Engineer.

Note that only the key personnel approved by the RPM, FEAD CM or Engineer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The RPM, FEAD CM or Engineer.

1.5.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

1.5.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.5.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FEAD CM or Engineer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.7 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.9 MAINTENANCE

1.9.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.9.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided on electronic media using Windows based computer cable management software. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.

b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

PART 2 PRODUCTS

2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the RPM, FEAD CM or Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 . Provide system furniture pathways in accordance with UL 1286.

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70. Provide a labeling system for cabling as required by TIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling

manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Backbone Cabling

2.3.1.1 Backbone Copper

Copper backbone cable shall be solid conductor, 24 AWG, 100 ohm, 100 -pair, Category 3, UTP, in accordance with ICEA S-90-661, TIA-568-C.1, TIA-568-C.2 and UL 444, formed into 25 pair binder groups covered with a gray thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular length marking intervals in accordance with ICEA S-90-661 . Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG)communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70.

2.3.1.2 Backbone Optical Fiber

Provide in accordance with ICEA S-83-596, TIA-568-C.3, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode(OS1), tight buffered fiber optic cable.

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598.

Provide plenum (OFNP) riser (OFNR) , or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598.

2.3.2 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568-C.1.

2.3.2.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568-C.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661 . Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a blue thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in

accordance with NFPA 70.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility and telecommunication equipment rooms to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA-606.

2.4.1 Backboards

Provide void-free, interior grade A-C plywood 3/4 inch thick4 by 8 feet . Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible. Paint applied over fire retardant backboard shall be UL 723 fire retardant paint. Provide label including paint manufacturer, date painted, UL listing and name of Installer. When painted, paint label and fire stamp shall be clearly visible. Backboards shall be provided on a minimum of two adjacent walls in the telecommunication spaces.

2.4.2 Equipment Support Frame

Provide in accordance with ECIA EIA/ECA 310-E and UL 50.

b. Racks, floor mounted modular type, 16 gauge steel construction, minimum, treated to resist corrosion. Provide rack with vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug and a surge protected power strip with 6 duplex 20 amp receptacles. Rack shall be compatible with 19 inches panel mounting.

2.4.3 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inches equipment racks and telecommunications backboards. Cable guides of ring or bracket type devices mounted on rack panels for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws, and or nuts and lockwashers.

2.4.4 Patch Panels

Provide ports for the number of horizontal and backbone cables terminated on the panel plus 25 percent spare. Provide pre-connectorized optical fiber and copper patch cords for patch panels. Provide patch cords, as complete assemblies, with matching connectors as specified. Provide fiber optic patch cables with crossover orientation in accordance with TIA-568-C.3. Patch cords shall meet minimum performance requirements specified in TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3 for cables, cable length and hardware specified.

2.4.4.1 Modular to 110 Block Patch Panel

Provide in accordance with TIA-568-C.1 and TIA-568-C.2. Panels shall be third party verified and shall comply with EIA/TIACategory 6 requirements. Panel shall be constructed of 0.09 inches minimum aluminum and shall be rack mounted and compatible with anECIA EIA/ECA 310-E 19 inches equipment rack. Panel shall provide 48 non-keyed, 8-pin modular ports, wired to T568A. Patch panels shall terminate the building cabling on Type 110 IDCs and shall utilize a printed circuit board interface. The rear of each panel

shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port.

2.4.5 Optical Fiber Distribution Panel

Rack mounted optical fiber distribution panel (OFDP) shall be constructed in accordance with ECIA EIA/ECA 310-E utilizing 18 gauge steel minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide 12 multimode and 12 single-mode pigtails and adapters. Provide adapters as MT-RJ with thermoplastic alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568-C.1, and TIA-568-C.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA-568-C.2 Category 6 requirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired as indicated. UTP outlet/connectors shall comply with TIA-568-C.2 for 200 mating cycles. UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.

2.5.2 Optical Fiber Adapters(Couplers)

Provide optical fiber adapters suitable for duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves, duplex SC in Accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves, MT-RJ in accordance with TIA/EIA-604-12 with thermoplastic alignment sleeves, and ST in accordance with TIA/EIA-604-2 with metallic alignment sleeves as indicated. Provide dust cover for adapters. Optical fiber adapters shall comply with TIA-455-21 for 500 mating cycles.

2.5.3 Optical Fiber Connectors

Provide in accordance with TIA-455-21.

2.5.4 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, TIA-568-C.2, TIA-568-C.3; flush or oversized design constructed of 302 stainless material. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606.

2.7 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.9 TESTS, INSPECTIONS, AND VERIFICATIONS

2.9.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-526-7 for single mode optical fiber , and TIA-526-14 for multimode optical fiber cables.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling.

3.1.1 Cabling

Install UTP, and optical fiber telecommunications cabling system as detailed in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Backbone Cable

a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.

b. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings Do not untwist Category 6 UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 10 feet in the telecommunications room, and 12 inches in the work area outlet..

3.1.2 Pathway Installations

Provide in accordance with TIA-569 and NFPA 70.

3.1.3 Cable Tray Installation

Only CMP and OFNP type cable shall be installed in a plenum.

3.1.4 Work Area Outlets

3.1.4.1 Terminations

Terminate UTP cable in accordance with TIA-568-C.1, TIA-568-C.2 and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568-C.3

3.1.4.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.4.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.4.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.5 Telecommunications Space Termination

Install termination hardware required for Category 6 and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.5.1 Patch Panels

Patch panels shall be mounted racks with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel as recommended by the manufacturer to prevent movement of the cable.

b. Fiber Optic Patch Panel. Fiber optic cable loop shall be provided as recommended by the manufacturer. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.6 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings.

3.1.7 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using laser printer .

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled.

Label and fire rating stamp must be unpainted.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA-568-C.2, . Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2, , . Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-14 using Method A, Optical Power Meter and Light Source for multimode optical fiber. For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source for single-mode optical fiber. Perform verification acceptance tests.

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

a. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA-568-C.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3.

3.5.1.4 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.

b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --

SECTION 27 13 23.00 20

COMMUNICATIONS OPTICAL BACKBONE CABLING
11/14

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4976	(2012a) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

TIA/EIA 455-41-A	(1993a; R 2001) FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(2016) Optical Fiber Outside Plant Communications Cable; 4th Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6 & 8	(2020) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2020) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)

National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-33	(2005b; R 2013) Optical Cable Tensile Loading and Bending Test
TIA-455-78-B	(2002) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation
TIA-455-82	(2020c) FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
TIA-455-104	(2016b) Standard for FOTP-104 Fiber Optic Cable Cyclic Flexing Test
TIA-455-177	(2003b) FOTP-177 IEC-60793-1-43: Measurement Methods and Test Procedures - Numerical Aperture
TIA-472D000	(2007b) Fiber Optic Communications Cable for Outside Plant Use
TIA-526-7	(2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-526-14	(2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard
TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-590	(1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-455-25	(2016d) FOTP-25 Impact Testing of Optical Fiber Cables
TIA/EIA-455-81	(2000b) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1753F-601	(1994) Specifications for Filled Fiber Optic Cables (PE-90)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-188-176	(1996; Notice 1) Standardized Profile for Asynchronous Transfer Mode (ATM)

1.2 DEFINITIONS

References in this section to cable refer to fiber optic ("FO") cable. Fiber optic cable consists of optical fibers, strength member, and jacketing. Associated components include optical fiber connectors, optical patch panels, terminal bay cabinets, and splice closures as indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-Installation Meetings

Within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the RPM,FEAD CM,or Engineer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with pre-construction and installation drawings and documents. Ensure drawings show the general arrangement and overall dimensions of the cable installation, control centers, space requirements, details of any hidden floor supports or ceiling systems and provisions for conduits for external cables. Submit the following for review and approval:

a. Fiber Optic System Contract Drawings

b. Detailed Shop Drawings

c. Qualifications

d. Quality Assurance Plan

Submit a quality assurance plan for fiber optic cable systems consisting of detailed procedures defining methods to ensure compliance to contract drawings and specifications by drawing control, inspection and procurement records, and test plan showing when and how each system will be tested, material testing, and certification records. Submit test plan to the Technical Representative for approval at least 30 calendar days prior to the start of testing.

Submit manufacturer's product data for the following items. Ensure data includes a complete list of parts, special tools, and supplies with current unit prices and source of supply:.

a. Optical Fibers

b. Fiber Optic Cable Design

c. Splice Organizers

d. Pre-Connected Cable Assembly

e. Fiber Optic Terminal Cabinets

f. Optical Patch Panel Assemblies

g. Fiber Optic Media Types

h. Fiber Optic Terminations and Connectors

i. Fiber Optic Enclosures

j. Fiber Optic Cable Installer and Splicer Qualifications

k. Manufacturer's Qualifications

l. Fiber Optic System Instructions

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications

Quality Assurance Plan; G

SD-02 Shop Drawings

Fiber Optic System Contract Drawings; G

Detailed Shop Drawings; G

Record (As-Built) Drawings; G

SD-03 Product Data

Optical Fibers; G

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Fiber Optic Terminal Cabinets; G

Optical Patch Panel Assemblies; G

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1.5 QUALITY CONTROL

1.5.1 Fiber Optic Cable Installer and Splicer Qualifications

Provide technicians installing FO media, splices and performing system tests who are certified and trained in accordance with an approved manufacturers training program, with a minimum of 3 years FO experience in installing equivalent FO systems. Submit data for approval to the RPM, FED CM or Engineer. Submit FO technician qualifications for approval 30 days before splices are to be made on the cable. Certification includes the training, and experience of the individual on specific type and classification of FO media to be provided under this contract.

RPM, FED CM or Engineer may require each person who is to perform fiber optic cable splicing to perform a minimum of one acceptable sample splice and termination. Do not incorporate sample splices and terminations in the job.

1.5.2 Quality Assurance Plan

Prepare a quality assurance plan which provides a detailed outline of all testing to be accomplished, addresses whether cladding modes have been stripped prior to testing, source wavelength (peak), spectral width full width/half maximum (FWHM), mode structure, fiber end preparation, and bandwidth measurements of fiber links both greater and less than 1 kilometer. Quality assurance plan includes, as a minimum, a schedule of when tests will be performed relative to installation milestones, specific test procedure that will be used, a list of test equipment that will be used including manufacturer, model number, range, resolution accuracy and conformance to the specified requirements.

1.5.3 Manufacturer's Qualifications

Ensure FO media manufacturer has a minimum of 3 years experience in the manufacturing, assembly, and factory testing of FO media which comply with RUS Bull 1753F-601. Ensure manufacturer provides a list of customers with 3 years of maintenance logs documenting experience with government

customers.

1.5.4 Fiber Optic Factory Test Plan

Prepare and provide to the Government for review a test plan for factory and field tests of the FO media. Provide factory Optical Time Domain Reflectometer(OTDR) test data as part of the test report. Provide a list of factory test equipment. Include a FO link performance test plan. Submit the plan at least 30 days prior to tests for government approval. Refer to TIA-569 for performance measurement criteria. Conduct tests at all operating bandwidths. Provide calculations for optical power budget and bandwidth as required by RUS Bull 1753F-601 using test method TIA-455-78-B or TIA/EIA-455. Submit test plans and reports to the Government for review and approval.

1.5.5 Fiber Optic Field Tests Plan

Prepare and provide technicians and test equipment for field tests of FO media. Conduct OTDR reel tests at the job site prior to installation. Perform OTDR and end to end tests of all installed media. Conduct tests on single mode fiber in accordance with TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A for multi mode fiber.

1.6 DELIVERY, STORAGE, AND HANDLING

Ship media to job site on factory reels in 1000-ft lengths or in factory cartons. Provide a reel drum radius no smaller than the minimum bend radius recommended by the manufacturer for the media. Wind cable on the reel so that unwinding can be done without kinking the cable. Provide 6 1/2-feet pigtails of cable at each end of the reel readily accessible for testing. Attach a permanent label on each reel showing length, media, identification number, and date of manufacture. Provide water resistant label and ink on the labels. Apply end seals to each end of the media after testing and before terminating to prevent moisture from entering the cable while stored at the job site. Ensure reels are suitable for outside storage conditions when temperature ranges from minus 40 degrees F to plus 150 degrees F, with relative humidity from zero to 100 percent. Store equipment, other than FO media, delivered and placed in storage with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 PROJECT/SITE CONDITIONS

Ensure that the buried cable is fed through the plow into the ground at zero tension. Do not allow tension to develop in the cable.

Whenever the plow is stopped, unreel sufficient cable to guard against sudden jerks when the plow is started.

Exercise caution to ensure that the plow is not backed up while the blade is in the ground. Cable can be severely damaged by the plow backing up even a slight amount. During the plowing operation, the plow may strike a buried object or rock that would stop the equipment and necessitate removal of the plow from the ground. When this occurs, remove the plow carefully without backing up. When it is necessary to back the plow, uncover the cable a sufficient distance back from the plow for inspection by the RPM, FED CM or Engineer to determine if there is any damage. Immediately report any damage to the RPM, FED CM or Engineer. Repair or replace damages as directed by the RPM, FED CM or Engineer.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide fiber optic cables for the duct in the existing cable duct and manhole system and/or directly buried to the facility. Provide modifications as design located within the fiber optic terminal in existing facility buildings.

Provide installation methods and procedures for installing the FO media and pathway system. Include methods and procedures for installing FO media, pathway, splices, and associated hardware. Submit installation procedures and equipment list to the RPM, FED CM or Engineer.

Provide detailed drawings for the fiber optic cable and pathway system. Provide single line schematic details of the fiber optic and pathway media, splices, and associated construction materials. Ensure drawings are in AUTOCAD.DXF or compatible format. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the fiber optic system. Include drawing details of fiber optic terminations in equipment rooms. Show final configuration, including location, fiber pair count, pathway innerduct arrangement, and pathway assignment of outside plant. Verify FO system is compatible with MIL-STD-188-176.

2.1.1 Fiber Optic Cable Design

2.1.1.1 Fiber Optic Media Types

Verify FO media meets all performance requirements of TIA-568-C.1, TIA-568-C.3 and the physical requirements of ICEA S-87-640 and TIA/EIA-598.

a. Multi Mode Fiber Media

Provide FO media with outer sheath jacket, strength member, ripcords, water blocking material, optional steel shield, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. Provide FO media with an all glass, graded index material with a nominal core diameter of 50 microns. Provide a cladding material for the fiber which is compatible with the core. Center media transmission window at 850 and 1300 nanometer wavelengths, with attenuation at 1300 nanometers less than 2.0 dB per kilometer, and minimum bandwidth of 500 mHz-Km.

2.1.1.2 Cable Length

Ensure cable is manufactured continuous with no factory splices.

2.1.1.3 Construction

a. Number of Fibers Per Tube Per Cable

36-fiber cable and 72-fiber cable are required as follows:

(1) Provide 36-fiber cable containing multimode and single mode fibers, with cable core configuration comprised of six loose buffer tubes, each containing six fibers. Color code six fibers in each loose buffer tube using the first colors of the standard

Munsell color code, Blue, Orange, Green, Brown, Slate, and White. Color code loose buffer tubes using the standard Munsell color code, Blue, Orange, Green, Brown and Slate. Ensure sixth buffer tube is Pink. Consider single mode fibers last in configuration.

(2) Provide 72-fiber cable containing multimode and single mode fibers, with cable core configuration comprised of 12 loose buffer tubes, each containing six fibers. Color code six fibers in each loose buffer tube using the first colors of the standard Munsell color code, Blue, Orange, Green, Brown, Slate and White. Color code loose buffer tubes using the standard Munsell color code, Blue, Orange, Green, Brown, Slate, Red, Black, Yellow, and Violet. Ensure eleventh and twelfth buffer tubes are Blue/White and Orange/White, respectively. Consider single mode fibers last in configuration.

b. Inner Jacket

Locate buffer tubes concentrically around the cable central core member and covered with a polyethylene inner jacket. Ensure inner jacket is medium density polyethylene in accordance with ASTM D4976. Fill space between the buffer tubes and inner jacket with a gel compound to prevent air, moisture, or water intrusion in the inner jacket.

c. Pulling Strength Member

Use a ramid type material as pulling strength members in the cable to provide pulling strength of at least 400 pounds for the cable during installation.

d. Cable Outer Jacket

Apply black medium density, high-molecular weight, polyethylene materials in accordance with ASTM D4976 longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket. Ensure outer jacket is smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. Overall outside cable diameter cannot exceed 0.75 -inch.

e. Metallic Armor

Provide a metallic armor shield for direct buried cable for additional tensile strength, rodent protection, and high crush and moisture resistance. Provide metallic armoring of metallic tube or steel corrugation-coated with anti-corrosion material, sealed at the longitudinal overlap.

2.1.2 Cable Identification Symbol

First of three lines on the ID symbol employ 5 characters.

First and second characters, from left to right, denotes the number of active optical fibers in the cable.

Third character is a slash.

Fourth and fifth characters denote optical transmission windows which the optical fiber can support. These windows are defined herein as follows:

a. Fourth character is an "A" or an "O." The "A" denotes a window at a wavelength of 850 nanometers (nm) with an attenuation of 4 dB/kilometer (km) and a bandwidth of 800 MHz-km. Use an "O" character if these requirements are not met.

b. Fifth character is a "B" or an "O." The "B" denotes a window at a wavelength of 1,300 nanometer (nm) with an attenuation of 1.0 dB/km and a bandwidth of 1,000 MHz-km. Use an "O" character if these requirements are not met.

Two lower lines of the cable ID symbol indicate multi-mode or single mode fibers, the cable number and the fiber count:

Example:

72/OB	Identifies the number of optical fibers (72) and the optical transmission window (OB - See preceding paragraph)
FM05 : 61-120	Identifies Multi-Mode Fiber Cable 05 with MM Fibers 61 through 120.
FS05 : 13-24	Identifies Single Mode Fiber Cable 05 with SM Fibers 13 through 24.

2.1.3 Temperature Environment

Provide fiber optical cable compliant with the mechanical performance requirements herein while used in duct applications where the temperature varies from 17.6 degrees F to 100 F. Ensure optical performance degradation is less than five percent of the optical performance requirements in the temperature range of minus 4 degrees F to 140 degrees F. Do not damage fiber optical cable in storage where the temperature may vary from minus 40 degrees F to 149 degrees F.

2.1.4 Splice Compatibility Test

When the material of the optic fiber is different from Cornings' Class Code No. 1517 for multi-mode graded index fiber and No. 1528 for single-mode fiber, perform and document the Splice Compatibility Test with Vendor as follows:

a. Select fiber samples from a minimum of 3 different production lots of the fiber type proposed for the job.

b. Fabricate and measure a minimum of 10 fusion splices using fiber from the different production lots and a sample of Corning fiber, Class Code No. 1517 and No. 1528, supplied by the Government.

c. Measure fusion splices using an Optical Time Domain Reflectometer (OTDR) operating in the region of 1250 through 1350 nm. Ensure the insertion loss of the fusion splice equals the average of two OTDR measurements, one taken with the OTDR installed on the Corning fiber, and the other with the OTDR installed on the vendor's fiber. Verify Vendor's fiber and the Corning fiber are each a minimum of 1 Km in length throughout the testing.

d. Consider vendor's fiber compatible with the Corning fiber if the maximum splice insertion loss of each of 10 fusion splices tested

measures less than 0.2 dB.

Allow a maximum of three retries on any one splice to obtain a loss of 0.2 dB or less.

Perform these tests under Government supervision.

2.2 EQUIPMENT

2.2.1 Replacement Cable

Provide not less than a 0.5 kilometer reel of each size and type of the manufacturer's furnished cable in addition to cable sections indicated.

Deliver replacement cable reels to the Government as directed by the RPM, FED CM or Engineer.

2.2.2 Splice Organizers

Provide fusion spliced single mode or multi-mode fibers with a protective sleeve covering, stored in an organizer with a minimum of 18-inches spare coiled buffer tubing. Ensure single mode fibers are spliced last in the splice tray.

2.2.3 Fiber Optic Pathway System

Provide an FO pathway system including raceway conduit, duct system, and maintenance manholes and handholes as shown on the drawings. Provide pathway materials compliant with TIA-569, and the following commercial standards for construction materials, NEMA RN 1 (PVC), NEMA TC 2 (PVC), NEMA TC 3 (PVC), NEMA TC 6 & 8, and NEMA TC 9.

2.2.3.1 Conduit

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2.4 FO Media Tags

Provide stainless steel, 1 5/8-inches in diameter 1/16-inch thick, and circular in shape.

2.2.5 Buried Warning and Identification Tape

Provide color, type and depth of tape as specified in paragraph "Buried Warning and Identification Tape" in Section 31 23 00.00 20 Excavation and Fill. Ensure FO media is marked and protected as required by TIA-590.

2.2.6 Grounding Braid

Provide low electrical impedance connections grounding braid from flat tin-plated copper for dependable shield bonding.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Factory FO Quality Control

Provide conduit factory quality tests of FO media as required by TIA-472D000.

2.3.2 Factory Test Certificates

Provide fiber optical cable complying with the following optical and mechanical test requirements.

2.3.2.1 Optical Performance

a. Multi-Mode Fibers in the Cable

Verify optical attenuation of each optical fiber in the cable (reeled) is no greater than 1.0 dB/Km at 1300 plus or minus 50 nm optical spectrum window. Measure attenuation on completed cable reel length, and normalized linearly to 1 Km.

Verify bandwidth at minus 3 dB optical power of each optical fiber in the cable (reeled) is a bandwidth length product, gamma equals 1, greater than 1 GHz-Km at 1300 plus or minus 50 nm optical spectrum window.

Verify numerical aperture of each optical fiber is 0.2 plus or minus 0.015 at 1300 nm optical spectrum window. Ensure method of numerical aperture measurement is in accordance with TIA-455-177, at central wavelength 1300 nm nominal. When this requirement is not met, apply the fusion splice compatibility test.

2.3.2.2 Mechanical Performance

a. Minimum Bend Radius

Provide cable which withstands bending to a minimum radius of 10 times the cable outer diameter without tensile load applied, and of 20 times the cable outer diameter with maximum tensile load applied (during installation), without damage to cable components or degradation of the optical fiber performance at room temperature.

b. Tensile Strength

Provide fiber optical cable which withstands a pull force of at least 400 pounds to be applied to the pulling strength member during the installation, and a tensile load of at least 300 newtons during operation without incurring any damage or detriment to fiber optical cable and optical performance. Ensure tensile strength test is in accordance with TIA-455-33.

c. Flexing or Bending Cycles

Provide fiber optical cable which withstands at least 20 bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. Ensure cyclic flexing test is in accordance with TIA-455-104.

d. Crush Resistance

Provide minimum crush resistance of the fiber optical cable greater than 650 newton/centimeter (cm) without damage to cable components or degrading optical performance. Ensure crush resistance test is in accordance with TIA/EIA 455-41-A.

e. Impact Resistance

Provide fiber optical cable capable of withstanding 20 impacts, at five newton-meters force, without damage to cable components, or degradation of optical performance. Ensure impact resistance test is in accordance with TIA/EIA-455-25.

f. Gel Filling Compound Drip Test

Test optical cable for the ability of the gel filling compound in the interior of the inner jacket and loose tube buffer to resist flow at the temperature range of minus 40 degrees C to 60 degrees C in accordance with TIA/EIA-455-81.

g. Fluid Penetration

Provide optical cable capable of preventing the entry and axial migration of pressurized water when subjected to fluid penetration testing in accordance with TIA-455-82.

2.3.3 Factory Reel Test

Test 100 percent OTDR test of FO media at the factory prior to shipment in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Provide digitized or photographic traces to the RPM, FED CM or Engineer.

PART 3 EXECUTION

3.1 INSTALLATION

Install and test the FO media in accordance with contract drawings, specifications, IEEE C2, NFPA 70, and TIA-590. Provide all necessary power, utility services, technicians, test equipment, calibration equipment as required to perform reel and final acceptance tests of the media. Replace all media which fails the factory or reel tests or final acceptance field tests and re-test at the contractors expense.

3.1.1 Fiber Splices

Splices are not permitted unless shown on the construction drawings.

Field test splices within 24 hours after splice installation. Test splices to demonstrate a maximum 0.2 dB loss. Provide a minimum of 6 1/2-feet for routing and testing media. Provide fusion type outside plant fiber splices along the fiber route. Make all splice measurements at 1300 nm, plus or minus 5 nm. Mount all splices in trays. Do not increase number of splices.

Protect media ends of unspliced FO media during splicing operations. Cover completed splice with a protective sleeve heat shrink type to restore the protective properties of the fiber coating and buffering. Deviations to the splice, location and pulling plan will be permitted, upon approval by the RPM, FED CM or Engineer, at no additional cost to the Government.

Ensure all fiber colors are continuous from end to end. No switching or staggering of color scheme within the cable at splice points is allowed. Splice fibers in order with multi-mode fibers identified first and single mode fibers at the end.

Bring cables out of the manhole in a controlled environment to perform the fiber fusion splice operation. Complete splice by returning the cable to the manhole such that the excess cable does not impede future entrance and utilization. Secure cable at regular intervals.

3.1.2 Contractor Damage

Promptly repair indicated utility and communications lines or systems damaged during site preparation and construction. When Contractor is advised in writing of the location of a non-indicated line or system, such notice provides that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the RPM, FED CM or Engineer of damage.

3.1.3 Buried Cable

3.1.3.1 Location

Verify location of the cable splice overlaps as indicated. Ensure that all cable ends are sufficiently long before cutting.

3.1.3.2 Field Staking

When staking the cable plow or trench line, place stakes at least every 100-feet in level country and more frequently in rolling country or in dense vegetation, so that the construction force can sight at least two successive stakes at all times. Stakes should be placed at changes in direction. The beginning and end of all turns should be staked clearly. Where existing buried cable is encountered within 2 -feet of the proposed line, decrease the distance between stakes to a minimum of 10 -feet. When possible, stakes should project above the vegetation along the line. When a road or other crossings are involved, stakes should be placed at both extremes of the right-of-way.

A stake, with the appropriate number or explanation noted on it, should be used to show the location of each caution point, such as underground utility crossings and culverts; miscellaneous points, such as physical cable protection; and buried cable warning sign locations.

3.1.3.3 Method of Cable Placement

Place a warning tape above all direct buried cable.

Ensure depth of buried cable in soil measured from the top of the cable to the surface of the ground is a minimum of 30 -inches. When existing utilities are crossed, use hand excavation at a distance of no less than four -feet on each side of the utility.

a. Open Trench Method

(1) Ensure trench is free of all rock and debris.

(2) Pull cable from cable reel truck or dolly and place in the trench by hand.

(3) Place cable in trench as soon as practical and backfill immediately to avoid cave-in, and ensure safe operational conditions.

(4) Provide inspection closely behind the cable reel dolly and ensure that the cable lies flat on the trench bottom, and is placed at the required minimum depth.

(5) Pull cable by hand on each end simultaneously, to remove excess slack, prior to backfilling.

(6) Backfill trench in six -inch lifts to ensure proper fill. Compact each backfill lift with hand tamp tools. Hand tamp first lift prior to placing the cable.

b. Direct Plow Method

(1) Ensure plow is clear of any obstruction which may damage cable and that all rollers on the tractor and on the plow turn freely and are properly located.

(2) Hand feed cable off the reel at all times to ensure that no damage is done to the cable due to excess tension.

(3) Closely inspect the cable for any blemish or damage, and ensure a free and continuous flow of the cable from the reel to the plow. Ensure that the cable is plowed at the minimum required depth.

3.1.3.4 Compaction

Compact the plow slot following the plowing or trenching of wire or cable.

3.1.4 Underground Cable

Provide inner duct assignment of individual cables as indicated. Do not place cables in ducts other than those specified.

Exercise adequate care when handling and storing reels of cable to prevent damage to the cable. Do not install cable with dents, flat spots, or other sheath distortions.

3.1.4.1 Securing Cable

Immediately after cable placement, attach a permanent identification tag as indicated to visible cable sections. Check cables to ensure that the markings are intact.

Support and secure cables and equipment as indicated. Where the specific method of support is not shown, use supports and fasteners to secure cables and equipment in position. Provide metallic supports and fasteners with a corrosion resistant finish. Rout all cables along the interior sides of manholes.

Provide two or more cable hooks per manhole.

Use clamps and straps as necessary to properly secure the cable.

3.1.4.2 Bending

Use caution when bending cable to avoid kinks or other damage to the sheath. Bend radius is as large as possible with a minimum of 10 -inches. Increase minimum radius when necessary to meet cable manufacturer's

recommendation. Do not rest cables against any sharp edges.

Pull and splice cable in the manner and at the locations shown.

3.1.4.3 Pulling

Attach pulling lines to both cable ends when cable is destined for bi-directional pull, and fitted with factory-installed pulling eyes. Pull cables not equipped with a pulling eye using a pulling line attached to the cable end by means of a cable grip. Do not use core hitches.

Locate and align cable reels so that the cable is paid out from the top of the reel into the duct or conduit in a long, smooth bend without twisting. Do not pull cable from the bottom of the reel. Use a cable feeder guide of proper dimensions at the mouth to guide the cable into the duct or conduit.

Set up rigging at the pulling end so that the pulling line and cable exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Do not pull cable ends around sheave wheels. When the sheave or pulley cannot be positioned to obtain sufficient cable end slack for proper racking and splicing with the pulling line attached to the end of the cable, a split cable grip may be used to obtain the necessary slack.

3.1.4.4 Lubricant

Use pulling lubricant to minimize pulling tension and prevent sheath damage when pulling cables into ducts and conduits. Apply lubricant to the cable sheath with a lubricator. When pulling has been completed, wipe the exposed cable ends clean of lubricant.

Ensure lubricants are compatible with and intended for use with plastic-sheathed cables. Do not allow soap and grease type lubricants.

Check all equipment and the pulling set to minimize interruptions once pulling begins. Pull cable without stopping until the required amount of the cable has been placed. When the pulling operation is halted before the pull is completed, do not release the tension of the pulling line. When pulling is resumed, overcome the inertia of the cable by increasing the tension in small steps a few seconds apart until the cable is in motion. Feed the cable from the top of the reel by rotating the reel in the feed direction at the rate of pull. Do not strip cable off the reel by pulling.

3.1.4.5 Damage and Defects

Use a tension monitoring device to ensure that the maximum pulling tension that may be applied to the cable to be pulled into a conduit section is not exceeded. Any damage to the cable due to exceeding the maximum tension will require a new cable furnished by the Contractor.

Carefully inspect cable for sheath defects or other irregularities as it is paid out form the reel. When defects are detected, stop pulling immediately and repair or replace the cable section at the discretion of the RPM, FED CM or Engineer. Maintain a system of communications between pulling and feed locations so that pulling can be stopped instantly, when required.

Hand guide cable through intermediate manholes and into the next duct section when making pull-throughs. Use proper rigging in the intermediate

manhole to keep the pulling line and cable aligned with the exit duct to prevent the line or cable from rubbing against the edge of the duct. Set up cables in pull-through manholes and rack before the cable ends in adjacent manholes are set up and racked.

Tie cable ends pulled into manholes, vaults, or terminal locations that are not to be racked or otherwise permanently positioned immediately, in fixed positions to prevent damage to the cables and provide adequate working space.

3.1.4.6 Seal

Seal ducts or innerduct in which cable is placed with urethane foam duct seal. Insert this material between the cable and the duct or innerduct of which it is in, between the innerduct and the duct, and in all unused innerduct, in order to prevent damage to the cable sheath and to prevent the entrance of dirt or water into the manhole or vault.

Provide cables in continuous lengths as required to accomplish the required installation without splices from termination to termination, except where field splices are specifically shown.

3.1.5 Cable Installation in Cable Trays

Do not install communication cables in the same cable tray with ac power cables.

Install cables placed in cable trays in a neat and orderly manner and not crossed or interlaced with other cables except at breakout points.

Individually retain cables in vertical trays with straps at a maximum of 6 -feet on center.

3.1.6 Grounding Systems

Ground cables at each termination point or as indicated.

3.1.7 Underground Ducts

Construct underground duct as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Encase in concrete any ducts under roads, paved areas, or railroad tracks.

3.1.7.1 Connections to Existing Maintenance Holes and Handholes

For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and the duct line envelope.

3.1.7.2 Connections to Concrete Pads

For duct line connections to concrete pads, break an opening in the pad out to the dimensions required and preserve the steel in the pad. Cut the steel and extend it out to tie into the reinforcing of the duct line envelope. Chip out the opening in the pad to form a key for the duct line envelope.

3.1.7.3 Connections to Existing Ducts

Where connections to existing duct lines are indicated, excavate the lines to the maximum depth required. Cut off lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide reinforced concrete collar, poured monolithically with the new duct line to take the shear at the joint of the duct lines.

3.1.8 Reconditioning of Surfaces

3.1.8.1 Unpaved Surface Treatment

Restore unpaved surfaces disturbed during the installation of duct or direct burial cable to their original elevation and condition. Carefully preserve existing sod and topsoil and replace after the back-filling is completed. Replace damaged sod with sod of quality equal to that removed. Where the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.8.2 Paving Repairs

a. Where trenches, pits, or other excavations are made in existing roadways and in other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement to the same thickness and to the same kind as previously existed. Ensure surface treatment or pavement matches and ties into the adjacent and surrounding existing surfaces.

3.1.9 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of FO media. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on media when entering or leaving the maintenance holes. Do not place media in ducts other than those shown without prior written approval of the RPM, FED CM or Engineer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up media reels on the same side of the maintenance hole as the pathway section in which the media is to be placed. Level the reel and bring into proper alignment with the pathway section so that the media pays off from the top of the reel in a long smooth bend into the duct without twisting. Do not, under any circumstances roll the media off from the bottom of the reel. Check the equipment set up prior to beginning the media cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between media reel and face of duct to protect media and guide cable into the duct as it is rolled off the reel. As media is rolled off the reel, lubricate and inspect media for sheath defects. When defects are noticed, stop pulling operations and notify the RPM, FED CM or Engineer to determine required corrective action. Stop media pulling if reel binds or does not roll off freely. Rectify cause of binding before resuming pulling operations. Provide media lubricants recommended by the cable manufacturer. Provide 3.3-feet of spare media in all manholes and enclosures for final termination and testing.

3.1.9.1 FO Media Tensions

Install FO media as shown on construction drawings. Provide devices to monitor media tension during installation. Do not exceed manufacturers

recommended maximum FO tensions and bending radii during installation.

3.1.9.2 Pulling Eyes

Equip media 1-1/4-inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide media with diameter smaller than 1-1/4-inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Do not beat rings to prevent grip from slipping into the cable sheath. Use a swivel grip of 3/4-inch links between pulling-in eyes or grips and pulling strand.

3.1.9.3 Media in Maintenance Manholes, Handholes, and Vaults

Do not install media utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances. Support media on brackets and cable insulators at a maximum of 4-feet. In existing maintenance manholes, handholes, and vaults where new ducts are to be terminated, or where new media are to be installed, modify the existing installation of media, cable supports, and grounding as required with cables arranged and supported as specified for new media.

3.1.10 Grounding

Ground exposed non current carrying metallic parts of telephone equipment, media sheaths, media splices, and terminals.

3.2 FIELD QUALITY CONTROL

3.2.1 Test Requirements

Ensure test equipment used for verifying installation testing is calibrated by a certified testing company within 3 weeks of use.

3.2.1.1 Single and Multi-Mode OTDR Test

Ensure the Optical Time Domain Reflectometer (OTDR) conforms to the following minimum requirements:

a. Operating wavelengths: 1,300 plus or minus 20 nanometers

b. Attenuation Range (one way): minimum 15 dB at 1,300 nm

c. Attenuation Resolution: 0.01 dB

d. Accuracy: plus 0.5 dB

Use OTDRs with digital readout capability and a means of providing a permanent record in the form of a photograph .

3.2.1.2 End-to-End Attenuation Tests

An attenuation measurement test set consists of an optical power meter and an optical power source. Provide attenuation measurement test set in accordance with the applicable National Bureau of Standards (NBS) standards for a stable optical source. Meter may be analog or digital. Include end-to-end attenuation test reading on the test reference loss. Ensure measurement test set conforms to the following minimum requirements:

a. Operating wavelengths: 1,300 plus or minus 10 nanometers

b. Attenuation Range: at least 30 dB at 1,300 nm

c. Attenuation Resolution: 0.01 dB

d. Accuracy: The accuracy of the attenuation measurement test set is plus or minus 5 percent.

Ensure optical source is capable of coupling sufficient power into the fiber so that the light received at the meter is within the meter delectability limits.

3.2.1.3 End-to-End Bandwidth Tests

Ensure bandwidth test conforms to the following minimum requirements:

a. Operating wavelengths: 1,300 plus or minus 10 nanometers

b. Bandwidth range: minimum 1000 megahertz

c. Bandwidth Resolution: 1 megahertz

d. Accuracy: plus or minus 0.5 megahertz, Measurement Method: Swept Frequency

As a minimum, test each fiber cable before and after installation for any faults or attenuations using an Optical Time Domain Reflectometer (OTDR). Conduct end-to-end attenuation tests after complete installation.

Clearly state all test equipment, test procedures, and testing techniques in the quality assurance plan. Conduct tests in accordance with the approved Quality Assurance Plan. Ensure all field tests are witnessed by the RPM, FED CM or Engineer. Give RPM, FED CM or Engineer at least 20 calendar days notice prior to performing each test.

Provide each test sheet with a sign-off blank for both Contractor and the RPM, FED CM or Engineer. Deliver copies of the completed test forms and test results as indicated.

Record sequential cable markings along the cable on the sequential cable form, prior to and after each end of splice point,and submit for approval.

Submit test results on all installed fiber cabling before and after each pre-connectorized cable assembly splice is completed.

Maintain an accurate test record during all field tests.

3.2.2 Field Reel Tests

Perform the following tests on FO media at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, perform these tests at the factory and submit certified test results with the media. Perform OTDR tests with media on reels and compare factory and field test data.

3.2.2.1 Reel Test Reports

Provide results of reel tests to the RPM, FED CM or Engineer within working

days before installation is to commence. Verify results indicate reel number of the media, manufacturer, type and number of fiber tested, and recorded readings in the report. When reel tests indicate that the media does not comply with factory reel test reports remove the media from the job site and replace with compliant media.

3.2.3 Final Acceptance Tests

Perform end-to-end tests including power meter light source and OTDR tests. Perform OTDR measurements as required by TIA-568-C.1 and TIA-568-C.3. Test single mode fiber in accordance with TIA-526-7 (Optical Power Loss). Test multi mode fiber in accordance with TIA-526-14(Optical Power Loss).

3.2.3.1 Test Results

Provide results of final acceptance tests (attenuation tests, OTDR traces, etc.), to the RPM, FED CM or Engineer within 5 working days after completion of tests.

3.3 CLOSEOUT ACTIVITIES

Submit 4 copies of the Record (As-Built) Drawings to the RPM, FED CM or Engineer.

-- End of Section --

SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)
05/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ASC/X9 X9.52	(1998) Triple Data Encryption Algorithm Modes of Operation

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	(2018) Ethernet
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INTELLIGENCE COMMUNITY STANDARD (ICS)

ICS 705-1	(2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2	(2001) Security Requirements for Cryptographic Modules
NIST FIPS 197	(2001) Advance Encryption Standard

OPEN NETWORK VIDEO INTERFACE FORUM (ONVIF)

ONVIF	(2017) Core Specification Version 17.06

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-222	(2018H; Add 1 2019) Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures
TIA-568-C.2	(2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-606	(2017c) Administration Standard for the Telecommunications Infrastructure

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8500.01	(2014) Cybersecurity

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 437	(2013; Reprint Oct 2017) UL Standard for Safety Key Locks
UL 634	(2007; Reprint Mar 2015) Connectors and Switches for Use with Burglar-Alarm Systems
UL 639	(2007; Reprint Nov 2019) Standard for Intrusion Detection Units
UL 681	(2014) Installation and Classification of Burglar and Holdup Alarm Systems
UL 796	(2016) UL Standard for Safety

	Printed-Wiring Boards
UL 969	(2017; Reprint Mar 2018) UL Standard for Safety Marking and Labeling Systems
UL 1037	(2016; Reprint Sep 2017) UL Standard for Safety Antitheft Alarms and Devices
UL 1076	(2018) UL Standard for Safety Proprietary Burglar Alarm Units and Systems
UL 1610	(2016) UL Standard for Safety Central-Station Burglar-Alarm Units

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

ESS Components; G

Overall System Schematic; G

SD-03 Product Data

Premise Control Unit; G

Detection Sensors; G

Access Control Unit; G

Access Control Devices; G

Cameras; G

Camera Lenses; G

Camera Housing and Mounts; G

Thermal Imaging System; G

Video Recording; G

Printers; G

Communications Interface Devices; G

Radio Frequency Link; G

Network Switch; G

Video and ESS Transmission; G

Infant Protection Alarm System (IPAS); G

Uninterruptible Power Supply (UPS); G

Batteries; G

Component Enclosure; G

Equipment Rack; G

SD-05 Design Data

Backup Battery Capacity Calculations; G

Access Control Throughput Rates; G

CCTV Storage Calculations

SD-07 Certificates

Contractor Qualifications; G

Instructor Qualifications; G

Data Encryption; G

SD-10 Operation and Maintenance Data

Training Plan; G

Training Content; G

ESS Components and ESS Software: Data Package 4; G

ESS Software and ESS Components: Data Package 4; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA

SD-11 Closeout Submittals

As-Built Drawings; G

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

The advisory provisions in each of the publications referred to in this specification are mandatory. Interpret these publications as though the word "must" has been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.3.2 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening, and have been utilized in applications of equipment and materials under similar circumstances and of similar size.

b. Have been available on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer.

d. Provide commercial off-the-shelf (COTS) products in which the manufacturer allows a network of qualified distributors to sell, install, integrate, maintain, and repair the hardware and software products that make up the system.

1.3.2.1 Alternative Qualifications

Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.3.2.2 Material and Equipment Manufacturing Date

Products manufactured more than one year prior to date of delivery to the site are not acceptable.

1.3.2.3 Product Safety

System components are to conform to applicable rules and requirements of NFPA 70. Equip system components with instruction stickers including warnings and cautions describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

1.3.3 Shop Drawings

1.3.3.1 ESS Components

Submit the ESS Components, Data Package 4 with the ESS Software submittal package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.Submit drawings that clearly and completely indicate each ESS component function that includes:

a. Termination device points

b. Interconnections required for system operation

c. Interconnections between modules and devices

d. Proposed wireway or conduit systems to be used including:

(1) Locations

(2) Sizes

(3) Types

e. Drawings showing:

(1) Device locations and spacing

(2) Mounting and positioning details

(3) Riser Diagrams with cable sizes and types

(4) Bill of Materials (Device make, model and quantities)

(5) Alarm and access control zones

(6) CCTV and sensor coverage areas

(7) Spare capacity

1.3.3.2 Overall System Schematic

Indicate the relationship of integrated components on one-line diagram and show:

a. Power source

b. System controls

c. Impedance matches

d. Interconnecting wire data including:

(1) Number

(2) Size

(3) Identification

(4) Maximum lengths

1.3.4 Evidence of Experience and Qualifications

1.3.4.1 Contractor Qualifications

Submit experience and certified qualifications data prior to installation. Show that specific installers who will perform the work have a minimum of 2 years of experience successfully installing ESS of the same type and similar design as specified. Include the names, locations, and points of contact of at least two installations of similar type and design as specified in this document where the installer has installed such systems. Indicate the type of each system installed. Certify that each system has performed satisfactorily in the manner intended for a period of at least 12 months.

1.3.4.2 Instructor Qualifications

Submit the instructor's experience and certified qualifications data prior to installation. Show that the instructor has received a minimum of 24 hours of ESS training from a technical organization such as the National Burglar and Fire Alarm Association, and 2 years experience in installing the specified ESS type.

1.4 Environmental Conditions

1.4.1 Interior Conditions

Equipment installed in environmentally protected interior areas must meet performance requirements specified for the following ambient conditions:

1.4.1.1 Temperature

32 to 120 degrees F. Components installed in unheated security protected areas must meet performance requirements for temperatures as low as 0 degrees F

1.4.1.2 Pressure

Sea level to 15,000 feet above sea level

1.4.1.3 Relative Humidity

5 to 95 percent

1.4.1.4 Fungus

Components must be constructed of non fungus nutrient materials or be treated to inhibit fungus growth

1.4.1.5 Acoustical Noise

Components must be suitable for use in high noise areas above 100 dB, without adversely affecting their performance

1.4.2 Exterior Conditions

Components in enclosures must meet performance requirements when exposed to the following ambient conditions:

1.4.2.1 Temperature

Minus 25 to 140 degrees F

1.4.2.2 Pressure

Sea level to 15,000 feet above sea level

1.4.2.3 Solar Radiation

Six hours of solar radiation per day at dry bulb temperature of 120 degrees F including 4 hours of solar radiation at 104 watts per square foot

1.4.2.4 Rain

2 inches per hour and 5 inches per hour cyclic with wind plus one period of 12 inches per hour

1.4.2.5 Humidity

5 to 95 percent

1.4.2.6 Wind

Continual velocity up to 50 mph with gusts to 66 mph, except that fence sensors must detect intrusions up to 35 mph

1.4.2.7 Acoustical Noise

Components must be suitable for use in high noise areas above 110 dB without adversely affecting their performance. Examples areas include flight lines, run-up pads, and generator sites.

1.5 SYSTEM CALCULATIONS AND ANALYSIS

1.5.1 Backup Battery Capacity Calculations

Submit calculations showing that backup battery capacity exceeds sensor operation, communications supervision, and alarm annunciation power requirements for proposed equipment plus 25 percent spare capacity.

1.5.2 CCTV Storage Calculations

Submit calculations showing the required storage capacity for each video storage device.

1.6 ESS SOFTWARE, DATA PACKAGE 4

Submit the ESS software, Data Package 4 with the ESS Components submittal package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Describe the functions of all software in the software manual and include:

a. All information necessary to enable proper loading, testing, and operation

b. Terms and functions definitions

c. Use of system and application software

d. Procedures for system initialization, start-up and shutdown

e. Alarm reports

f. Reports generation

g. Database format and data entry requirements

h. Directory of all files

i. All communication protocol descriptions, including data formats, command characters, and a sample of each type of data transfer

j. Interface definition

k. List of software keys

1.7 AS-BUILT DRAWINGS

Maintain a separate set of drawings, elementary diagrams, and wiring diagrams of the system to be used for as-built drawings. Keep this set

accurately and neatly up-to-date with all changes and additions. This set is not to be used for installation purposes.

Finish the final drawings submitted with the endurance test report in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS for as-built requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete and integrated electronic security system (ESS) . ESS must be compatible with the Installation's central monitoring system and monitored within the secure/protected area . ESS consisting of the following subsystems and features:

a. Intrusion Detection System (IDS)

b. Access Control System (ACS)

c. Closed-circuit Television System (CCTV)

d. Security Command Center (SCC)

e. Communications System

f. Security Lighting Systems

Include materials not normally furnished by the manufacturer with the ESS equipment as specified in:

2.2 PERFORMANCE REQUIREMENTS

Integrate the installed and operating subsystems into the overall ESS system to detect intrusion, control access, provide CCTV surveillance, provide visual verification, and perform as an entity, as specified below. Provide electronic equipment that complies with 47 CFR 15 and are suitable for the environment where they will be installed.

2.2.1 Growth Capability

Provide capability for modular ESS expansion of inputs, outputs, card readers, and remote control stations with minimal equipment modification. Software must be able to handle design requirements plus 25 percent spare capacity. Growth capability is not to be limited by the provided products.

2.2.2 Hazardous Locations

When located in areas where fire or explosion hazards exist, provide system components rated and installed according to Chapter 5 of NFPA 70.

2.2.3 Network Certification

Certify all Platform Information Technology (PIT) in accordance with DODI 8500.01 and the individual service implementation policy.

2.2.4 Maintainability

Provide components that can be maintained using commercially available

tools and equipment. Arrange and assemble components to be readily accessible to maintenance personnel without compromising system defeat resistance and with no degradation in tamper protection, structural integrity, EMI or RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions.

2.2.5 Availability

Provide components rated for continuous operation. Provide solid-state electronic components mounted on printed circuit boards, conforming to UL 796. Provide boards that are plug-in, quick-disconnect type. Do not impede maintenance with densely packed circuitry. Provide power-dissipating components with safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity. Provide solid-state type or hermetically sealed electromechanical type light duty relays and similar switching devices.

2.2.6 Fail-Safe Capability

Provide fail-safe capability in critical elements of the ESS including, but not be limited to, the capability to monitor communication link integrity and to provide self-test. Provide fault annunciation when diminished functional capabilities are detected. Annunciate fail-safe alarms to clearly distinguish from other types of alarms.

2.2.7 Line Supervision

Provide the same geographic resolution for fault isolation at the systems level as provided for intrusion detection. Provide either a static or dynamic system with active mode for line supervision of communication links of the ESS.

a. The static system must represent "no-alarm" always by the same signal, which is different than the originally transmitted signal.

b. The dynamic system must represent "no-alarm" with a signal which continually changes with time.

2.2.8 Power Loss Detection

Detect AC and DC power loss and generate an alarm when a critical component of the system experiences temporary or permanent loss of power. Annunciate the alarm in the Secured Area to clearly identify the component experiencing power loss.

2.2.9 Controls and Designations

Provide controls and designations as specified in NEMA ICS 1.

2.2.10 Special Test Equipment

Provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.2.11 Electromagnetic Interference (EMI)

Configure and provide ESS components employing electromagnetic radiation constructed to provide minimal vulnerability to electronic countermeasures.

2.2.12 Electromagnetic Radiation (EMR)

Provide only ESS communication components which are Federal Communications Commission (FCC) licensed and approved. Provide system components which are electromagnetically compatible.

2.2.13 Interchangeability

Use off-the-shelf components which are physically, electrically, and functionally interchangeable with equivalent components as complete items. Equivalent, replacement components must not require new or other component modification. Do not use custom designed or one-of-a-kind items. Interchangeable components or modules must not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

2.3 INTRUSION DETECTION SYSTEM (IDS)

The IDS primary function is to detect intrusion into secured areas. Utilize a single database for all IDS programming data that seamlessly integrates with the ESS under a single operating environment. The IDS events must be viewable as separate or as a combined list of all ESS events. Control the IDS alarm monitoring through software control from the ESS.

a. Provide both supervised and non-supervised alarm point monitoring.

b. Arm or disarm alarm points both manually and automatically by time of day, day of week or by operator command.

2.3.1 IDS Components

Provide components:

a. Premise Control Units (PCU)

b. Detection Sensors

c. Tamper Switches

2.3.2 Detection Sensitivity

The sensitivity of the IDS must allow for the following:

a. Locating intrusions

b. Locating intrusions at individually protected assets or at an individual portal

c. Locating intrusions within the coverage on a single volumetric sensor

d. Locating failures or tampering at individual sensors

2.3.3 Detection Alarm and Reporting Capacity

Collect, communicate, and display up to 32 sensor zone alarms .

Identify individual sensors in alarm if the sensor zone is a multiple alarm source combination. Annunciate a single alarm within 2 seconds maximum, after sensor transducer or other detection device activation .

2.3.4 False Alarm Rate

The false alarm rate for each interior IDS zone must not exceed one false alarm per 30-day period. The false alarm rate for each exterior IDS zone must not exceed one false alarm per 24-hour period.

2.3.5 Nuisance Alarm Rate

The nuisance alarm rate for each interior IDS zone must not exceed three nuisance alarms per 30-day period. The nuisance alarm rate for each exterior IDS zone must not exceed three nuisance alarms per 24-hour period.

2.3.6 Premise Control Unit (PCU)

Install the PCU command processor in a tamper resistant enclosure that is specified in paragraph "Component Enclosure". Package the following with the PCU:

a. Power transformer

b. Battery(s)

c. Network connection cable

d. Keypad(s)

e. Keypad connection cable(s)

f. Additional components as required for full functionality

2.3.6.1 PCU Capabilities

Provide the PCU at a minimum but not limited to, the following capabilities;

a. Expansion to a total of at least 10,000 user codes with 99 user profile definitions.

b. Support 8 keypads with alphanumeric display. Each keypad must be capable of arming and disarming any system area based on a pass code or access control card and or key FOB authorization. Provide keypad alphanumeric display with complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.

c. Four 4 shift schedules per area.

d. A total of at least 100 programmable output relay schedules.

e. 32 individual reporting areas.

f. Data line supervision or two separate lines of communication.

g. Two-man access code or credentials.

h. Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.

i. Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.

j. Provide a minimum of a 4,000 event log buffer per PCU. Record and hold alarm activity information in the log buffer until the ESS is connected and receives the information. Provide a software-configurable warning log buffer filling notification for PCU(s) configured with network switch capabilities.

k. Support a Network Interface Card (NIC) plug-in module with built in network router capable of 128 Bit AES Rijndael Encryption process certified by NIST (National Institute of Standards and Technology).

2.3.6.2 Overcurrent Protection and Indication

When overcurrent more than it is rated for is detected by the PCU, communication bus(es) and keypad(s) are to be shut down and an overcurrent notification LED lit to indicate the situation.

2.3.6.3 Manual and Self-Test

All testing from any alphanumeric keypad include testing for: standby battery, alarm bell or siren, and communication to the Security Command Center (SCC). Include provisions for an automatic, daily, weekly, 30 day, or up to 60 day communication link test from the PCU installation site to the SCC. Include a provision for displaying the internal system power and wiring conditions.

Include the following for internal monitoring points:

a. The bell circuit

b. AC power

c. Battery voltage level

d. Charging voltage

e. Panel box tamper

f. Phone trouble line 1

g. Phone trouble line 2

h. Transmit trouble

i. Network trouble

A battery test must be automatically performed to test the integrity of the standby battery by disconnecting the standby battery from the charging circuit and placing a load on the battery. Perform this test at an

interval no greater than 180 days.

2.3.7 Detection Sensors

a. Sensors are to detect facility perimeter or protected zone penetrations by unauthorized personnel or intruders and transmit an alarm signal to the alarm annunciation system upon change detection. Accomplish this with a probability of detection (PD) of 0.9 with a 95 percent confidence level and conforming to UL 639 where applicable.

b. Required sensor power is 12 VDC unless otherwise specified.

c. An interior IDS zone is a room or space within a building that can be armed and disarmed independently from all other zones.

d. Provide line supervision for all sensors with an end-of-line resistor at the sensor or within a tampered junction box with conduit from the junction box to the sensor.

d. Provide sensors and components rated for operation in the installed environment. The sensors must transmit an alarm signal to the alarm annunciation system upon change detection. Provide all sensors with a tamper switch and elements housed in a tamper-alarmed enclosure in accordance of paragraph "Component Enclosure".

2.3.7.1 Interior Sensors

2.3.7.1.1 High Security Balanced Magnetic Switch (BMS)

Mount the BMS inside the secure location and on the opening side of the door. BMS sensors do not have the capability to incorporate an end-of-line (EOL) resistor.

2.3.7.1.1.1 Level 1 Switch

UL 634. Level 1 High Security

2.3.7.1.1.2 Level 2 Switch

UL 634. Level 2 High Security

2.3.7.1.2 Glass Break Detection

UL 639.

2.3.7.1.2.1 Window-Mounted Glass Break Shock Sensor

Provide sensors with an LED for adjusting sensitivity.

Provide sensor with an exterior label to protect tape from direct sunlight. Seismic vibrations or other ambient stimuli are not to initiate an alarm. Test glass breakage sensors by using test units supplied by the manufacturer which simulate glass breakage.

2.3.7.1.2.2 Ceiling Or Wall-Mounted Dual Technology Glass Break Sensor

Provide a sensor that eliminates occupant-generated false alarms by combining a passive infrared motion detector (PIR) with glass break sensing. The combination will extend coverage to occupied areas, allowing

the sensors to be armed while people are present.

2.3.7.1.2.3 Ceiling or Wall-Mounted Recessed Glass Break Sensor

Provide a sensor employing pattern recognition technology that listens for the actual pattern of breaking glass. The sensor is to be able to detect the difference from breaking glass and normal room sounds by listening across the glass break frequency spectrum. Provide a range of 25 feet to cover the area to be protected.

2.3.7.1.3 Vibration Vault Sensor

Provide a sensor that senses short duration, large amplitude signals like those produced in attacks from explosions, hammering or chiseling and also detect long duration, small amplitude signals like those produced in attacks from torches, thermic lances, drills, grinders, or cutting discs.

Provide sensor equipped with a manual and an automatic test alarm output with test indicator not visible or audible during normal operations. The test indicator is to annunciate when the sensor detects an intruder when active. The alarm indication may be located within the sensor or as a separate device.

2.3.7.1.4 Fiber Optic Mesh Sensors

Fiber optic mesh sensors are to be comprised of a web of optical fiber cables which are deployed within:

a. Building walls

b. Partitions

c. Flexible structures

d. Water-side installations

e. Mobile facilities

f. Mobile container shells

2.3.7.1.5 Utility Inlet Opening Protection

Provide protection by a sensor of the breakwire type consisting of up to 26 AWG hard-drawn copper wire with a tensile strength of 4 pounds maximum interlaced throughout the opening such that no opening between wires is larger than 4 inches on center.

Tamper protect terminated sensors so that any attempts to cut the wire or enlarge openings between wires cause an alarm.

2.3.7.1.6 Passive Infrared Sensors

UL 639.

2.3.7.1.7 Microwave Sensors

UL 639.

2.3.7.1.8 Dual Technology Sensors

UL 639. Provide sensor combining passive infrared (PIR) and microwave sensors configured and manufactured specifically to be mounted in a single tamper alarmed enclosure. The sensor must provide "AND" logic for alarm indication . Provide sensors that have a local means of indicating detection for use during installation and calibration with a means of disabling the indication.

The sensor is to have an LED walk test indicator which is not visible during normal operations. When visible, the walk test indicator will light when the sensor detects an intruder. Provide a sensor equipped with a manual control, located within the sensor's housing, to enable and disable the test indicator or with the test indicator located within the sensor housing so that it can only be seen when the housing is open or removed.

2.3.7.1.9 Photoelectric Sensors

UL 639. The sensor is to detect opaque bodies and not allow an intruder to disable detection by shining another light source into the receiver.

Provide sensor with a local means of indicating detection for use during installation and calibration with a means of disabling the indication.

2.3.7.2 Tamper Switches

a. Corrosion-resistant tamper switches are required for the following IDS and CCTV equipment with hinged doors or removable covers that contain open circuits:

   (1) Enclosures

   (2) Cabinets

   (3) Housings

   (4) Boxes

   (5) Raceways

   (6) Fittings

   (7) Sensors

b. Tamper switches are to initiate an alarm signal when the door or cover is moved as little as 1/4 inch from the normally closed position. Mechanically mount tamper switches to maximize defeat time when enclosure covers are opened or removed. One second is the minimum amount of time required to depress or defeat the tamper switch after opening or removing the cover. Enclosure and tamper switch must prevent direct line of sight to internal components and prevent switch or circuit tampering. Conceal mounting hardware so switch cannot be observed from enclosure exterior.

c. Tamper switches on doors which are opened to make normal maintenance adjustments to the system and to service power supplies must not have a maintenance position.

2.3.7.2.1 Tamper Switch Performance Requirements

Tamper switches are to be:

a. Inaccessible until switch is activated.

b. Under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating.

c. Annunciated to be clearly distinguishable from intrusion detection alarms and exempt from being disarmed, shunted, or silenced.

d. Spring-loaded and held in the closed position by the door, or cover protected.

e. Wired to break the circuit when the door or cover is disturbed.

f. Wired so that each sensor and device is annunciated individually at the central reporting processor.

2.4 CLOSED-CIRCUIT TELEVISION (CCTV) SYSTEM

Select system components that conform to the Open Network Video Interface Forum (ONVIF) specification. Provide compatible UL listed CCTV components to provide visual assessment of ESS alarms automatically upon alarm or upon SCC operator selection. Otherwise, the subsystem is to continuously display the coverage area. Display alphanumeric camera location ID on all monitors. Provide the number of alarm monitors as required. The scene from each camera must appear clear, crisp, and stable on the respective monitor during both daytime and nighttime operation. Provide component equipment that minimizes both preventive and corrective maintenance. Provide components from a single manufacturer or justify mixing manufacturer components and demonstrate compatibility in submittal information.

2.4.1 Cameras

2.4.1.1 CCTV Camera

Provide cameras of digital fixed, pan-tilt-zoom (PTZ), or panoramic type as identified on the drawings.

a. Day-Night Color fixed, PTZ or panoramic cameras are to be used in all outdoor environments. Standard fixed, PTZ, or panoramic cameras are to be used for all indoor applications except when backlighting issues are observed. Use Day-Night cameras or standard cameras with backlighting compensation for backlighting or high contrast applications.

b. Provide PTZ cameras with a direct drive motor assembly. Belt driven PTZ camera units are not acceptable. Equip PTZ cameras with a slip ring assembly having an optical interface and be rated for continuous duty. PTZ cameras have to be fully integrated units. The pan-tilt mechanism must be an integral part of the camera.

c. Provide cameras that operate over a voltage range of 12 VDC 24 VDC 12 24 VAC at 60 Hz Power over Ethernet (PoE) IEEE 802.3.

d. All cameras must be constructed to provide rigid support for electrical and optical systems so that unintentional changes in alignment or

microphonic effects do not occur during operation, movement, or lens adjustments.

e. Video Frame Rate: 30 frames per second (fps)

f. Minimum essential requirements for cameras include the following:

2.4.1.1.1 Sensitivity

Minimum Illumination: 0.08 foot-candles at F1.4 color mode; 0.01 foot-candles at F1.4 in the B&W mode.

2.4.1.1.2 Signal-To-Noise Ratio

Show a signal-to-noise ratio of not less than 50 decibels (dB) at Automatic Gain Control (AGC) "Off", weight "On".

2.4.1.1.3 Resolution

Provide a minimum of 2.1 megapixel resolution. The imager must have a minimum of 1920 horizontal x 1080 picture in progressive scan format. Resolution is to be maintained over the specified input voltage and frequency range, and not vary from minimum specification over the specified operating temperature range.

2.4.1.1.4 Synchronization

Provide cameras that have internal and line lock.

2.4.1.1.5 Low Light Level

Provide Day-Night cameras that have a B-W mode that may be automatically engaged on low light level and permit the use of an external infrared illuminator. Electronic removal of the color signal is not acceptable. The camera must have an infrared cut filter capable of being removed automatically upon low light threshold or manually.

2.4.1.2 Camera Lenses

Camera lenses are to be all glass with coated optics. Provide lens mount that is C or CS mount, integrated with the cameras. Provide lens with the camera that have a maximum f-stop opening of f/1.2 or the maximum available for the focal length specified. The lens is to have an auto-iris mechanism unless otherwise specified. Lenses having auto iris, manual iris, or zoom and focus functions are to be supplied with connectors, wiring, receiver and driver units, and controls as needed to operate the lens functions. Provide lenses with sufficient circle of illumination to cover the image sensor evenly. Lenses are not to be used on a camera with an image format larger than the lens is configured to cover. Provide lens with focal lengths as indicated or specified in the manufacturer's lens selection tables.

2.4.1.3 Camera Housing and Mounts

The camera and lens are to be enclosed in a tamper resistant housing installed on a camera support. Any ancillary housing mounting hardware needed to install the housing at the camera location is to be provided as part of the housing. The camera support must be capable of supporting the mounted equipment and withstanding wind and ice loads normally encountered

at the site.

2.4.1.3.1 Environmentally Sealed Camera Housing

The housing is to provide an environment needed for camera operation and be condensation free; dust and water tight; keep the viewing window free of fog, snow, and ice, and be fully operational in 100 percent condensing humidity. Provide housing equipped with a sunshield. Both the housing and sunshield are to be white. Purge the housing of atmospheric air and pressurized with dry nitrogen, equipped with a fill valve, overpressure valve, and include a humidity indicator visible from the exterior. Housing must not have a leak rate greater than 2 psi at sea level within a 90 day period.

Provide housing equipped with supplementary camera mounting blocks or supports needed to position the camera and lens to maintain the proper optical centerline. All electrical and signal connections required for camera and lens operation are to be supplied. Provide a mounting bracket as part of the housing which allows weight adjustment to center the weight of the assembly.

2.4.1.3.2 Indoor Camera Housing

Provide housing with a tamper resistant enclosure for indoor camera operation and with the proper mounting brackets for the specified camera and lens. The housing and appurtenances color are not to conflict with the building interior color scheme.

2.4.1.3.3 Interior Mount

Provide camera mount suitable for either wall or ceiling mounting and have an adjustable head for mounting the camera. The wall mount and head must be constructed of aluminum or steel with a corrosion-resistant finish. Provide adjustable head with 360 degrees of pan and plus or minus 90 degrees of tilt.

2.4.1.3.4 Low Profile Ceiling Mount

Provide tamperproof ceiling housing which is low profile and suitable for use in 2 by 2 foot ceiling tiles. The housing must be equipped with a camera mounting bracket and allows a 360 degree viewing setup.

2.4.1.3.5 Interior Dome Housing

The dome housing is to be capable of being mounted by pendant, pole, ceiling, surface, or corner as shown on the drawings. The lower dome is to be black opaque acrylic and have a light attenuation factor of not more than 1 f-stop. Provide housing with:

a. Integral pan-tilt complete with wiring

b. Wiring harnesses

c. Connectors

d. Receiver-driver

e. Pan-tilt control system

f. Pre-position cards

g. Heavy duty bearings

h. Hardened steel gears

i. Permanent lubrication

j. Motors that are thermally or impedance protected against overload damage.

k. Any other hardware and equipment as needed to provide a fully functional pan-tilt dome. Provide pan movement of 360 degrees and tilt movement of at least plus or minus 90 degrees. Pan speed must be at least 20 degrees per second and tilt speed be at least 10 degrees per second.

2.4.1.3.6 Exterior Dome Housing

Provide dome housing capable of being mounted by pendant, pole, ceiling, surface, or corner as shown on the drawings and constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. Purge the housing of atmospheric air and pressurize with dry nitrogen. Provide a fill valve and overpressure valve with a pressure indicator visible from the exterior. The housing is to be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline.

Provide all electrical and signal connections required for camera and lens operation. The housing is to provide the environment needed for camera operation. The lower dome is to be black opaque acrylic with a light attenuation factor of not more than 1 f-stop. Provide housing with:

a. Integral pan-tilt complete with wiring

b. Wiring harnesses

c. Connectors

d. Receiver-driver

e. Pan-tilt control system

f. Pre-position cards

g. Heavy duty bearings

h. Hardened steel gears

i. Permanent lubrication

j. Motors that are thermally or impedance protected against overload damage.

k. Any other hardware and equipment as needed to provide a fully functional pan-tilt dome. Provide pan movement of 360 degrees and tilt movement of at least plus or minus 90 degrees. Pan speed must be at least 20 degrees per second and tilt speed be at least 10 degrees per second.

2.4.1.3.7 Exterior Wall Mount

Provide exterior camera wall mount that is 24 inches long, and has an adjustable head for mounting the camera. The wall mount and head must be constructed of aluminum, stainless steel, or steel with a corrosion-resistant finish. Provide adjustable head for at least plus and minus 90 degrees of pan, and at least plus and minus 45 degrees of tilt. If to be used in conjunction with a pan-tilt, provide bracket without the adjustable mounting head, and a bolt hole pattern to match the pan-tilt base.

2.4.1.3.8 Pan-Tilt Mount

a. Provide pan-tilt mount capable of supporting the camera, lens, and housing specified that is weatherproof and sized to accommodate the camera, lens and housing weight plus maximum wind loading encountered at the installation site if the pan-tilt is to be mounted outdoors. Provide pan-tilt with:

   (1) Heavy duty bearings

   (2) Hardened steel gears

   (3) Externally adjustable limit stops for pan and tilt

   (4) Mechanical, dynamic, or friction brakes

   (5) Permanent lubrication

   (6) Motors that are thermally or impedance protected against overload damage.

b. Provide pan movement of 360 degrees pan rotation, a minimum tilt movement of plus and minus 90 degrees. Manual pan speed must be a minimum of 0 to 80 degrees per second , and a minimum tilt speed of 10 degrees per second . A minimum automatic pan speed of 280 degree per second and tilt speed of 160 degree per second .

c. The pan-tilt is to be supplied complete with wiring, wiring harnesses, connectors, receiver-driver, pan-tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan-tilt mount to fulfill the site design requirements.

2.4.1.3.9 Explosion Proof Housing

The explosion proof housing must meet the requirements in paragraph "Component Enclosure" for hazardous locations. Configure housing to provide a tamper resistant enclosure and supply with the proper mounting brackets for the specified camera and lens.

2.4.2 Thermal Imaging System

IP Thermal Cameras

a. Provide an integrated thermal imaging device in an environmental enclosure.

b. Provide a native digital image from the image sensor to the IP video

stream.

c. Provide of an uncooled, sun-safe amorphous silicon micro bolometer, long-wavelength infrared (LWIR) camera capable of 640 x 480 and 384 x 288 resolution formats.

d. Provide a temporal Noise Equivalent Temperature Difference (NETD) below 50mK at f/1.0 capable of multiple display formats including white hot, black hot, and rainbow.

e. Allow for input voltage of 24 VAC, 24 VDC, or a selectable power source of 120 VAC.

f. Provide a built-in heater and defroster and sun shroud in accordance of paragraph "Component Enclosure".

g. Support two simultaneous, configurable video streams. MJPEG and H.264 compression formats that are available for primary and secondary streams with selectable Unicast and Multicast protocols. The streams are to be configurable in a variety of frame rates, bit rates, and group of pictures (GOP) structures.

h. Use a standard Web browser interface for remote administration and camera parameter configurations.

i. Provide a 100Base-TX network port for live streaming to a standard Web browser.

j. Provide built-in video analytics.

2.4.3 Video Analytics (VA)

2.4.3.1 Software

Provide capability range from basic activity detection to the search through databases to pre-empt serious incidents. The VA is to provide graphic identified movement identification, user-selectable monitored areas, compensation for environmental movement, and other features specified when provided as a capability of the DVR . Provide the following features:

2.4.3.1.1 Basic Motion Detection

a. Adaptive Motion

b. Abandoned Object

c. Object Removal

d. Camera Sabotage

e. Directional Motion

f. Object Counting

g. Loitering Detection

h. Stopped Vehicle

2.4.3.1.2 Advanced VA

2.4.3.1.2.1 Intruder Identification

This refers to identifying unauthorized humans in specified areas within the field of view.

2.4.3.1.2.2 Environmental Compensation

Recognizing and ignoring wind-blown debris, animals, background traffic, and so on.

2.4.3.1.2.3 Counting

This refers to recognizing a quantity of a particular object moving or activity performed.

2.4.3.1.2.4 Directional Identification

This refers to the ability to ignore objects moving in one direction, while alarming for objects moving in unauthorized directions.

2.4.3.1.2.5 Item Recognition

This refers to activation when specific user-selected items are removed from, placed in, or passed through the field of view.

2.4.3.1.2.6 Subject Tracking

Highlighting and following a specific person or item as it moves about the field of view, or from the field of view of one camera to another.

2.4.3.1.2.7 Multiple Subject Tracking

Highlighting and following multiple persons or items simultaneously as they move about the field of view, or from the field of view of one camera to another.

2.4.3.2 Embedded VA

2.4.3.2.1 Intelligent Video Analysis

a. Provide camera capable of processing and analyzing video within the camera itself, with no extra hardware required.

b. The camera is to be capable of detecting and sending alarms for abnormal events.

c. The camera is to be configurable to analyze up to 10 different scenes for one or more of the following events:

(1) Line Crossing

(2) Loitering

(3) Idle Object

(4) Removed Object

(5) Conditional Change

(6) Trajectory Tracking

(7) Filters

d. The camera is to allow users to set up to 10 separate profiles and switch profiles based on a day, night, or holiday schedules.

e. The camera is to support scene tours that automatically reposition the camera to each scene for a specified duration.

f. The camera is to incorporate an Alarm Rule Engine, enabling abnormal events that VA detects to prompt the camera to take one or more actions:

(1) Trigger a relay connected to an alarm siren, strobe, or both.

(2) Trigger a visual alert to be displayed on the operator's screen.

(3) Go to a specified scene (preset position).

2.4.3.2.2 Motion Tracking with PTZ Cameras

a. The camera is to offer Intelligent Tracking to continuously track an object using pan, tilt, and zoom actions.

b. The camera is to provide automatic motion tracking using intelligent video analytics.

c. Provide camera with the ability to follow an object continually when passing behind a privacy mask.

d. Provide camera with the ability to restart tracking if a target starts moving in the same area where the initial target stopped moving or if the camera detects an object moving along the last known trajectory.

e. The camera is to allow an operator to select an object to track in the live image view.

2.4.4 Color Video Monitors

Except as specified, provide video monitors that:

a. Are rated for continuous operation and incorporate printed circuit board modular construction.

b. Have printed circuit modules that are easily replaceable.

c. Use solid-state devices for electronic circuits.

d. Are constructed to provide rigid support for electrical systems so that unintentional changes in alignment or microphonic effects will not occur during operation or movement.

e. Incorporate circuit safety margins of not less than 25 percent where possible, with respect to power dissipation ratings, voltage ratings, and current carrying capacity.

f. Have a diagonal viewing angle that nominally measures 42 inches for

monitors, LCD displays.

g. Provide adequate safeguards to protect personnel from exposure to line voltage during operation or adjustment.

h. Have at least the following essential requirements:

(1) Resolution for LCD monitors to be: 17 inch monitors - 1280x1024, 500 TV lines (maximum); 20.1 inch monitors - 1600x1200 (maximum)

(2) Geometry: No point in the active raster is to deviate from its correct position by more than 2 percent of raster height.

2.4.4.1 Mounting and Identification

a. Mount monitors and other devices to facilitate easy replacement.

b. The printed circuit board functions and component numbers or markings are to be easily read.

c. Mount monitors in a desk top console.

d. Protect monitors from circuit overloads by fuse or fuses in the power source line. Mount power source line fuses in finger-operated extractor fuse posts. Fuse holders are to be located in a readily accessible position.

2.4.4.2 Video and Signal Input

Monitors are to operate with video input requiring a one HDMI nominal composite video signal switchable to either loop-through or internal 75-ohm terminating impedance.

Signal input connectors must be HDMI type.

2.4.5 Ancillary Equipment

Equipment is to consist of the items specified below:

2.4.5.1 Video Date and Time Generator

The video time and date is to originate from either the camera, video, video recorder, or time server.

2.4.5.2 Camera Identifiers

Label video signal from each camera using alphanumeric identifiers. Camera alphanumeric identifiers may originate from either the camera or the video recorder.

2.4.5.3 Video Recording

2.4.5.3.1 Digital Video Recorder (DVR)

Provide DVR with 8 or 16 video channels. The DVR will record all cameras onto a hard drive and allow remote network viewing via intranet browser. Hard drive capability must be sized to store all cameras recording 24 hour a day, 7 days a week at 15 frames per second per camera for 4 weeks.

2.4.5.3.2 Video Recording Performance

The video recording performance is to be as follows:

a. The DVR is to use modular hard disk media, with a digital format capacity of 250GB per module.

b. Provide a 16 channel triplex video multiplexer capable of performing encoding, recording and multiscreen viewing modes simultaneously. Provide 9 channels of live, simultaneous video images in which all channels are refreshed at 15 frames per second.

c. Provide a 10-100Base-T connection for record review and camera view and control that is compatible for a PC workstation equipped with latest Microsoft Windows Professional operating system software, Internet Browser Software.

d. PC workstation Viewing: Include direct access from the ESS PC workstations to each DVR via a Microsoft Internet Explorer Web Browser. All necessary descriptive bookmarks and shortcuts are to be prepared on each PC workstation to allow this direct access. All functions are to be accessible through HTML commands from a user's web browser interface. Pictures are to be available for attachment via a user-provided SMTP-based e-mail transport system, and included capability for 16 users and 3 user access levels (admin, control and user).

e. Include sampling at 720(H) by 480(V) and 320(H) by 240(V) (Pixel Memory) with 15 frames per second and 3-D scan conversion to enable jitter-free stabilized pictures in a single frame. Modes include:

(1) Emergency

(2) Event

(3) Schedule

(4) Manual Recording

f. Each camera is to support individual Recording Rate and Image Quality settings for each mode (Emergency, Event, Schedule and Manual Recording). This array of Camera Recording Rate and Image Quality settings by the Recording Modes is to form one of four Program Actions. The Program Action is to be assignable to a Time Table to form one of 16 Independent Recording Profiles. Allow each Recording Profile to be manually activated, activated via RS-232C interface, automatically activated by Time Table, or activated by separate alarm or emergency inputs.

g. Digital display on the monitor and also recording of the following information to included:

(1) Year

(2) Month

(3) Day

(4) Hour

(5) Minute

(6) Second

(7) Alphanumeric camera location ID up to 8 characters. The DVR is to feature video loss detection on all channels.

h. Pre-event recording: Buffer at least 20 seconds of pre-event pictures simultaneously for all individual camera channels.

i. Motion-based Recording: Advanced integrated VMD is to be used to detect a specific area, direction and motion duration for each camera channel, independently and simultaneously. Motion Search may be executed for a single camera channel for a selected area on the image.

j. Disk Partitioning: Provide within the DVR an automated disk management and a RTOS (real-time operating system) platform to include a minimum of 4.8 TB of digital video storage on a single partition.

The video recording system is to provide a choice of Physical Partitioning as RAID 1 or Disk Mirroring redundant array recording. Allow the operator to be able to partition the available recording areas in a Virtual Partition by Regular, Event, and Copy Partitions. Manually and Scheduled recorded video information is to be assigned to a Regular Recording Partition, which may be overwritten. Event and Emergency Recording Data is to be assignable to an Event Partition, where image overwriting is be prohibited. Any copied data is to be able to be assigned to the Copy Partition, which may be overwritten or saved as required.

k. Playback: Permit direct camera selection for recording playback of any of 9 video sources at the same time as multiscreen viewing and multiplexed camera encoding (triplex multiplexer capability).

l. Multiplexer Functions: Include an integral, programmable switcher with programmable dwell time and camera order that automatically switches multiple camera images to enable sequential spot monitoring and simultaneous field recording. Provide switcher with separate spot, multiscreen, multiscreen-RGB, and cascaded video monitor outputs. The unit must have full screen, 9 multiscreen monitoring modes.

m. Outputs

(1) Provide via BNC female connections 9 looping outputs for all video source connections to external monitoring systems including multiscreen and spot monitor video outputs.

(2) Provide via RCA phone jacks four channels of audio connection, including audio loop through.

(3) Provide via High Speed (480 Mbps) serial interface one External Storage connection.

(4) Provide via High Speed (480 Mbps) serial interface one External Copy connection.

(5) Provide two independent Video Outputs assignable to Multiscreen .

(6) Provide one Cascade output for connecting 3 additional digital video recorders for centralized control using a single video monitor.

(7) Provide virtual camera number programming capability to support 64 camera channels on a single system.

(8) Provide one independent RGB Video output, capable of monitoring all DVR functions.

n. All camera selection buttons are to have Tri-State Indication, corresponding to Recording, Viewing and Control functions on actual DVR hardware. PC emulation is not an acceptable alternative. Furnish the following indicators:

(1) Alarm

(2) Alarm Suspend

(3) Operate

(4) HDD1, Hard drive identifier

(5) Timer and Error indicators

(6) Camera Selection

(7) Iris

(8) Preset

(9) Camera Automatic Mode

(10) Pan-Tilt

(11) Set

(12) Jog Dial

(13) Shuttle Dial

(14) Setup-Esc

(15) Record

(16) Search

(17) Play-Pause

(18) Pan-Tilt Slow

(19) Stop

(20) Pan-Tilt Go to Last

(21) Zoom-Focus

(22) A-B

(23) Repeat

(24) Shift

(25) Alarm Reset Buttons

o. Networking: All DVR recording, review, playback, camera control and setup are to be available via the internally mounted Network Interface. A 10-100Base-T connection for record review and camera view and control will be required on a personal computer equipped with Internet Browser Software and an Ethernet 100Base-T connection. Permit direct camera selection for recording playback of any of 9 video sources at the same time as multiscreen viewing and multiplexed camera encoding (triplex multiplexer mode). Support a minimum of 8 simultaneous clients viewing and 2 simultaneous FTP sessions.

p. Power: The video recording equipment must have a power source of 120 VAC at 60 Hz.

2.4.5.4 Camera Control

Provide access to camera functions and control for all cameras via the multiplexer for all camera control, set-up and alarm functions, including preset sequence, digital motion detector mask set, and back light compensation set-up. Controllable camera functions are to be accessible via front panel controls or the optional system controller. These functions are to include:

(1) Direct access of preset position

(2) Zoom (near/far)

(3) Focus (near/far)

(4) Iris (open/close)

(5) Pan (left/right)

2.4.6 Camera Mounting Structures

Provide camera mounting structures designed specifically for CCTV cameras. The structure is to accommodate appropriate wiring pathways for power and communication as well as proper grounding and surge protection. Design loads for the camera mounting structure must conform to TIA-222 and all applicable addendums of the TIA standard. Allowable pole deflection is determined from the point of the camera mount and must not exceed 0.5 percent of the pole height under adjusted maximum wind load conditions. Adjusted maximum wind load conditions for deflection calculations must be 30 miles per hour (mph) or 35 percent of the basic wind speed as determined by TIA-222, whichever is greater. Confirm compliance to TIA standards by structure manufacturer data or by analysis. Provide additional measures as required to stabilize the camera if placed in an environment that is subject to induced vibrations such as heavy winds or excessive traffic.

2.5 SECURITY COMMAND CENTER (SCC)

The SCC must integrate all subsystems and communications, and provide operator control interface to the ESS system. The components are as follows:

a. ESS Software

b. Monitoring Display Software

c. Graphical Map Software

d. Printers

e. Controls and Display Integration

f. Enrollment Center Equipment

2.5.1 ESS Software

a. Provide commercial off-the-shelf ESS software that utilizes a single database for the subsystem integrations provided under a single operating environment. The system is to archive all events in a database stored either on a local hard drive or a networked database server. The software has to support configuration and simultaneous monitoring of all subsystems.

b. Allow the networked PC workstation configurations connected via a TCP/IP network. Administrative tasks including configuration, monitoring, schedules, report generation and graphic display are provided from any PC workstation on the network. All system programming data must be instantly accessible to every PC Workstation connected to the network. The system is to utilize a non-proprietary SQL-based, ODBC-compliant database, managed by Sybase Adaptive Server Anywhere, Microsoft SQL Server, or Oracle.

c. Utilize a preemptive multi-tasking operating system, such as the latest Microsoft Windows Professional environment, that is multitasking, with many processes running at the same time without interference with each other and with higher priority tasks taking precedence over lower priority tasks.

d. Provide capabilities to define visual exclusion areas.

2.5.1.1 Alarm Call up

Support responses to alarms entering the system with each alarm capable of initiating one or more of the following actions:

a. Sending alarm commands to a CCTV system interface

b. Triggering DVR event recording

c. Activating output devices

d. Playing PC audio files

e. Controlling doors

f. Display graphical maps associated with the alarm device

Provide mode of system operation that requires an operator to acknowledge any alarm. While alarm is still active, the alarm cannot be cleared.

2.5.1.2 Programming

Provide the capability of, but not limited to, the following programming and functionality:

2.5.1.2.1 Daylight Savings Time Adjustment

The ACU(s) and PCU(s) must not need to be connected to the ESS in order for the adjustment to occur.

2.5.1.2.2 Operator Privileges

Support an unlimited number of system operators, each with a unique login and password combination. Operators are to be assigned privileges based on the loops, commands, or programming features that are available to each individual operator.

2.5.1.2.3 Alarm Priorities

Provide the ability for each alarm device to be user configured to belong to one of 10,000 priority levels which are assigned to an alarm based on alarm importance. These priorities are to define which alarm events to display on individually specified ESS workstations.

2.5.1.2.4 Reports

Include integrated reporting capabilities as well as the ability to run Crystal Report templates.

2.5.1.2.5 User Interface

The ESS programming is to be menu-driven, with "wizards" to assist with software configuration, and include 'Help' information.

2.5.1.2.6 Messages

Permit the use of user-selected colors for event messages.

2.5.1.2.7 Graphics

Provide the capability to display a floor-plan graphic for card activity and alarm events as part of the ESS integration.

2.5.1.2.8 Device Status

Provide the capability to display the dynamic status of a user-selected list of devices, including doors, inputs, and outputs.

2.5.1.2.9 Diagnostics

Include diagnostic software tools that interface and query the hardware for information and to issue commands.

2.5.1.2.10 Mandatory Data Fields

Require any cardholder data field to be selected by the user as mandatory.

2.5.1.2.11 User Defined Data Fields

Provide 20 unassigned data fields for storing user-defined data that support user-defined labels, and are user-configurable as plain text fields or drop-down selection lists.

2.5.1.2.12 Archive Database

Include a connection to an archive database which stores purged events and deleted programming and which can be accessed for reporting.

2.5.1.2.13 Programmable Database Backup

Include the capability of performing user-scheduled database backups without the use of third-party backup software.

2.5.1.2.14 Programmable Database Purging

Include the capability of performing user-scheduled database purging, moving selected events to an archive database when the events have aged a user-specified number of days.

2.5.1.2.15 Database Importing

Include the capacity to import user data from an ODBC data source (Access, Excel, text).

2.5.1.2.16 Data Exporting

Include the capacity to export data from any table in the database to either a text HTML Excel Access file in any user-selected order.

2.5.1.2.17 Event Log Output

Include the capacity to send a continuous stream of user-selected types of event messages to a text file, serial port, or TCP/IP address.

2.5.1.2.18 Data Audit Trail

Record changes to programming, recording the date and time stamp of the change, the name of the operator making the change, and the nature of the change. This data audit is to be available in history for reporting.

2.5.2 ESS Monitor Display Software

ESS Monitor display software is to provide for text and graphic map displays that include zone and device status integrated into the display. Different colors are to be used for the various components and real time data. Colors must be uniform on all displays. Follow the color coding as follows.

a. FLASHING RED to alert an operator that a zone has gone into an alarm or that primary power has failed.

b. RED to alert an operator that a zone is in alarm and that the alarm has been acknowledged.

c. YELLOW to advise an operator that a zone is in access.

d. GREEN to indicate that a zone is secure or that power is on.

2.5.3 Graphical Map Software

a. ESS graphical map software is to show the graphic and visual data of all subsystem devices. Use a 19 inches, LCD flat screen display with messages displayed in the English language. Provide graphical maps showing a layout of all the protected facilities. Highlight zones corresponding to those monitored by the ESS on the graphical maps. Display status of each zone using graphical icons as required within each designated zone.

b. Provide capability for graphical maps to be linked together using a layered tree structure. For example, a top-level map might be a top view of the site and its buildings, the next level the individual buildings floor, followed by a map of the area on a floor containing the device in alarm. Allow for 3 layers of maps to be defined for any given ESS device. To speed an incident location, each map level contains a clearly visible indicator as to which sub map the operator should select next to find the device that is in alarm.

c. The ESS may also be configured to display a map automatically on a new alarm presentation, providing the operator with prompt visual indication that an alarm has occurred.

d. The status of intrusion devices, access control readers, doors, auxiliary monitor points, and auxiliary outputs is to be able to be requested from any map by simply selecting the icon representing the device and its current state will be displayed. CCTV camera control, digital video review, alarm panel transactions and intercom requests are to be available for inclusion on the map with the associated management module installed.

e. Allow for SCC operators to change a current setting by pressing the right mouse button anywhere on the screen or on a specific system device icon. Pressing the right mouse button is to cause the appropriate command options list to appear for selection. Confirmation is provided by reflecting the change in status on the display after a command is selected.

f. The display of intrusion or auxiliary door alarms may be automatically enabled or disabled by the use of timed commands, either by device or by a group of devices. This may be used, for example, to disable all door alarms on internal doors, during normal office hours.

g. Create maps using standard office tools allowing drawings to be imported in Jpeg, Bitmap, Windows metafile, PDF or DXF file formats to provide maximum flexibility.

2.6 COMMUNICATIONS

a. Communications are to link together subsystems of the ESS and be in accordance with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. Interfaces between subsystems cannot be accomplished by use of an electro-mechanical relay assembly. Communications links must be supervised. Provide common communications interface devices throughout the ESS. Provide dry contact sensor to control unit interface that is normally OPEN or normally CLOSED, except as specified otherwise.

b. Use digital, asynchronous, or multiplexed data control unit for central alarm reporting and display processor interface. Group individual data bits into word format and transmit as coded messages. Implement interface with network switches which function as a communications controller, perform data acquisition and distribution, buffering message handling, error checking, and signal regeneration as required to maintain communications.

c. Provide totally automatic status changes communication, commands, field initiated interrupts, and any other communications required for proper system operation. Do not require system communication operator initiation or response. System communication is to return to normal after any partial or total network interruption including power loss or transient upset. Automatically annunciate communication failures to the operator with communication link identification that has experienced a partial or total failure.

2.6.1 Radio Frequency Link

a. Provide a full duplex, supervised RF, polling system specifically used for alarm data communications with components manufactured by one manufacturer operating in the VHF, 134 to 154 MHz band. System is to interface directly with ESS hardwire data link from control unit to central alarm reporting and display location and is to translate (reduce) the data rate for RF transmission, modulate and demodulate the data signal, and transmit and receive ESS data.

b. Provide a factory-tested complete RF link which both automatically and upon operator command transmits a signal with a unique identification from the central alarm monitoring location to the control unit locations. Message receipt at control unit location is to be ignored by all units except the addressee. Unit with the correct address is to decode the interrogation signal and respond to the interrogation with the status of the reporting sensors. Re-interrogate when the addressee fails to respond. Alarm upon failure to respond a second time.

c. Remote units in the RF system are to be individually polled in turn. Polling response time and transmission data rate, data error rate, and equipment reliability is to ensure that overall ESS alarm annunciation time reliability and Pd is not degraded.

d. Provide RF transmitters, receivers, or transceivers in sufficient quantities to meet specified requirements. RF link transmissions are to be on one or more of the frequencies within the specified band as required to meet specified requirements and neither interfere with other ESS components nor any facility electronic components. Provide transmitters which are in accordance with applicable requirements of 47 CFR 15.

e. Message types and content are to be identical to those transmitted by other portions of the ESS data communications subsystem. ESS alarms sent by RF link are not to fail, and are to be transmitted by the RF link due to event occurrence during "off air" periods. RF link is to provide message transmission priority in the following order:

(1) Intrusion alarms

(2) Tamper alarms

(3) Access denial alarms

(4) Other alarms on a first-in, first-out basis including loss of communication signal, fail-safe, low battery, and power loss.

f. Provide omnidirectional, coaxial, half-wave dipole antennas for alarm transmitters and transceivers with a driving point impedance to match transmission output. Provide antennas and antenna mounts that are corrosion resistant and able to withstand wind velocities of 100 mph and physical damage caused by vandalism. Antennas cannot be mounted directly to any facility fence or roofing system.

g. Provide antennas from the same manufacturer as the rest of the RF link. Provide coaxial cable in lengths as required. Cables are to use PL-type fittings or connectors, properly protected against moisture. Cables must match transmitter output impedance.

2.6.2 Data Encryption

Incorporate data encryption equipment on data transmission circuits as shown on the drawings. The algorithm used for encryption must be the Advanced Encryption Standard (AES) algorithm described in NIST FIPS 197 of TDES, ASC/X9 X9.52, as a minimum. Data encryption must be in accordance with NIST FIPS 140-2.

2.6.3 Network Switch

The small form-factor pluggable (SFP) is to provide full-duplex 1000/100/10-Mbps connectivity between switches over multimode fiber (MMF) infrastructures. Provide mounting accessories for a typical cabinet . Rack requirements as specified in paragraph EQUIPMENT RACK.

2.6.3.1 Inside Plant

Provide a network switch for ESS system with 24 SFP Ethernet ports. Allow dynamic port base security and rapid spanning tree protocol with VLAN assignments for specific users regardless of where the switch is connected. The switch will use AC input voltage nominal of 120 VAC at 60 Hz. The switch is to be less than 2 Rack Units (RU) and Layer 3 capable. The switch is to have the capability of commanding a self-healing ring configuration. 1000Base-LX SFP Fast Ethernet Interface Converter is to be a hot swappable device that plugs into a Gigabit fiber SFP uplink port on the switch. The switch is to be a fully managed power over Ethernet (PoE) to all ports. Provide switch capable of using a Layer 3 (routed) port to connect to a LAN gateway port for Internet and web base access. The Mean Time Between Failure (MTBF) must be greater than 210,000 hours.

2.6.4 Video and ESS Transmission

Transmission is to be by optical fiber dedicated to the associated circuit. Video and ESS transmission cables must conform to the industry standards in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM .

Install interior cable in Electrical Metallic Tubing (EMT) conduit unless indicated otherwise. Cable is to be rated for the installation method intended. Install exterior cable underground installed in Schedule 80 Polyvinyl chloride (PVC) conduits.

2.6.5 Wire and Cable

Provide all wire and cable not indicated as Government-furnished equipment. Wiring must meet NFPA 70 standards and as indicated in the Wire and Cable Data Sheets Attachment at the end of this section.

2.6.6 Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at the SCC or at a secondary control and monitoring site is to be optical fiber cable. Interconnecting cables conform to the industry standards in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.6.7 Aboveground Sensor Wiring

Sensor wiring is to be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware. Provide multiconductor wire with a PVC outer jacket.

2.6.8 Direct Burial Sensor Wiring

Sensor wiring is to be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware.

2.6.9 Local Area Network (LAN) Cabling

Cabling must be in accordance with TIA-568-C.2, Category 6.

2.6.10 Cable Construction

Provide all cable components that will withstand the environment in which the cable is installed for a minimum of 20 years.

2.7 BACKUP POWER

a. Intrusion alarms are not to be generated as a result of power switching; however, Provide a power switching indication and on-line source at the alarm monitor.

b. The system is to automatically switch back to the primary source upon primary power restoration. Detect and report failure of an on-line battery as a fault condition.

c. Provide backup power to the primary power by uninterruptible power supply (UPS).

2.7.1 Uninterruptible Power Supply (UPS)

Backup power required for uninterrupted ESS operation is to be provided by a UPS.

The UPS is to consist of a rectifier, battery and support racks, a static inverter, static switch transfer, and a manual bypass switch. Provide UPS with a continuous output to supply the maximum load requirements of the ESS. Size the battery to sustain the UPS at full rated load for 15 minutes .

2.8 SURGE SUPPRESSION DEVICES

Comply with requirements in Section 33 82 00 TELECOMMUNICATION OUTSIDE

PLANT (OSP).

2.9 COMPONENT ENCLOSURE

Alarm enclosures with a tamper switch(es). Refer to paragraph "Tamper Switch". Enclosures is to be formed and assembled to be sturdy and rigid. These include:

a. Consoles

b. Annunciator housings

c. Power supply enclosures

d. Sensor control and terminal cabinets

e. Control units

f. Wiring gutters

g. Other component housings

2.9.1 Interior Sensor

Provide sensors to be used in an interior environment with a housing that provides protection against dust, falling dirt, and dripping noncorrosive liquids. Refer to paragraph "Interior Enclosures" for enclosure ratings.

2.9.2 Exterior Sensor

Provide sensors to be used in an exterior environment with a housing that provides protection against windblown dust, rain and splashing water, and hose directed water. Sensors are not to be damaged by the ice formation on the enclosure. Refer to paragraph "Exposed-to-Weather Enclosures" and "Corrosion-Resistant Enclosures" for enclosure ratings.

2.9.3 Interior Enclosures

Enclosures to house equipment in an interior environment must meet the requirements of NEMA 250 Type 1 .

2.9.4 Exposed-to-Weather Enclosures

Enclosures to house equipment in an outdoor environment must meet the requirements of NEMA 250 Type 4X .

2.9.5 Corrosion-Resistant Enclosures

Enclosures to house equipment in a corrosive environment must meet the requirements of NEMA 250 Type 4X.

2.9.6 Hazardous Environment Equipment

All system electronics to be used in a hazardous environment must be housed in a metallic enclosure which meets the requirements of paragraph "Hazardous Locations."

2.9.7 Metal Thickness

Thicknesses of metal in cast and sheet metal enclosures of all types must be not less than those listed in Tables 8.1, 8.2, and 8.3 of UL 1610 for alarm components, and NEMA ICS 2 and NEMA ICS 6 for other enclosures. Sheet steel used in enclosure fabrication is to be at least 16 gage; consoles are to be at least 18 gage.

2.9.8 Doors and Covers

a. Doors and covers are to be flanged. Provide tight pin hinges or the ends of hinge pins are to be tack welded to prevent ready removal where doors are mounted on hinges with exposed pins.

b. Provide doors having a latch edge length of less than 24 inches with a single lock. Provide the door with a three-point latching device with lock where latch edge of a hinged door is 24 inches or more in length; or alternatively with two locks, one located near each end.

c. The covers of provided junction boxes to facilitate initial system installation are to be held in place by tack welding, brazing, or one-way screws.

2.9.9 Ventilation

Ventilation openings in enclosures and cabinets must conform to requirements of UL 1610.

2.9.10 Mounting

Sheet metal enclosures are to be rated for wall mounting with top hole slotted, unless otherwise indicated. Mounting holes are to be in positions which remain accessible when major operating components are in place and door is open, and be inaccessible when door is closed.

2.9.11 Labels

Label boxes containing connections that they contain ESS connections and indicate that the box is part of the ESS system.

2.9.12 Test Points

Provide readily visible and accessible with minimum disassembly of equipment to test points, controls, and other adjustments inside enclosures. Test points and other maintenance controls must be readily accessible to operator personnel.

2.10 EQUIPMENT RACK

Provide standard 19 inch electronic rack cabinets conforming to UL 50 for the ESS system at the SCC and remote control and monitoring sites as shown on the drawings. Equipment rack must be in accordance with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.10.1 Labels

Provide a labeling system for cabling as required by TIA-606 and UL 969. Provide stenciled lettering for voice and data circuits using laser printer .

2.11 LOCKS AND KEY LOCK

2.11.1 Lock

Provide locks on system enclosures for maintenance purposes that meet UL 437 and are round-key type, with three dual, one mushroom, and three plain pin tumblers or conventional key type lock having a five cylinder pin and five-point three position side bar combination. Keys must be stamped "U.S. GOVT. DO NOT DUP.". Keys are only to be withdrawn when in the locked position. Key all maintenance locks alike and furnish only two keys for all of these locks.

2.11.2 Key-Lock Operated Switches

All key-lock-operated switches required to be installed on system components are to be UL 437, with three dual, one mushroom, and three plain pin tumblers, or conventional key type lock having a five cylinder pin and five-point three position side bar combination. Keys must be stamped "U.S. GOVT. DO NOT DUP.". Key-lock-operated switches are to have two positions, with the key removable in either position. Key all key-lock-operated switches differently and furnish only two keys for each key-lock-operated-switch.

2.11.3 Construction Locks

Use a set of temporary locks during installation and construction. Do not include any of the temporary locks in the final set of locks installed and delivered to the Government.

2.12 FIELD FABRICATED NAMEPLATES

Nameplates must comply with ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription is to identify the function and, when applicable, the position.

Nameplates are to be melamine plastic, 0.125 inch thick, white with black center core. Surface is to be matte finish. Corners are to be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be 1 by 2.5 inches. Provide lettering a minimum of 0.25 inch high normal block style. Nameplates are not be required for devices smaller than 1 x 3 inches.

2.12.1 Manufacturer's Nameplate

Each item of equipment is to have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.13 FACTORY APPLIED FINISH

Electrical equipment is to have factory-applied painting systems which meets the requirements of the NEMA 250 corrosion-resistance test as a minimum.

PART 3 EXECUTION

3.1 INSTALLATION

Install the system in accordance with safety and technical standards NFPA 70, UL 681, UL 1037, and UL 1076. Configure components within the system with appropriate service points to pinpoint system trouble in less than 20 minutes.

Install all system components, including any equipment that is furnished by the Government, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown on the drawings, and furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Existing Equipment

Connect to and utilize existing equipment, control signal transmission lines, and devices as shown on the drawings. Any equipment and signal lines that are usable in their original configuration without modification may be reused with Government approval.

Make written requests and obtain approval prior to disconnecting any signal lines and equipment that creates equipment outage. Such work can proceed only after receiving Government approval of these requests. If any device fails after work has commenced on that device, signal, or control line, diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment. The Contractor will be held responsible for repair costs due to negligence or abuse of Government equipment on their part.

3.1.2 Software Installation

Load software as specified and required for an operational system, including databases and specified programs. Provide original and backup copies on optic discs of all accepted software, including diagnostics, upon successful endurance test completion.

3.1.3 Enclosure Penetrations

Enclosures are to be penetrated from the bottom unless shown otherwise. Penetrations of interior enclosures having transitions of conduit from interior to exterior, and penetrations of exterior enclosures are to be sealed with rubber silicone sealant to preclude the entry of water. Terminate conduit risers in a hot-dipped galvanized metal cable terminator that is filled with a sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable.

3.1.4 Cable and Wire Runs

Perform required cable and wire routings per NFPA 70 , , and as specified. Terminate conduits including flexible metal and armored cable in the sensor or device enclosure. Fit ends of conduit with insulated bushings. Exposed conductors at ends of conduits external to sensors and devices are not acceptable.

3.1.5 Soldering

Soldered electrical connections must use composition Sn60, Type AR or S,

for general purposes; use composition Sn62 or Sn63, Type AR or S, for special purposes. Flux must conform to ASTM B32 when Type S solder is used for soldering electrical connections.

3.1.6 Galvanizing

Ferrous metal is to be hot-dip galvanized in accordance with ASTM A123/A123M. Provide screws, bolts, nuts, and other fastenings and supports that are corrosion resistant.

Field welds or brazing on factory galvanized boxes, enclosures, conduits, and so on, are to be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.7 Conduits

Install interior conduits in accordance with NFPA 70, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL and ICS 705-1. Install exterior conduits in accordance with NFPA 70, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and ICS 705-1.

3.1.8 Underground Cable Installation

Install underground conductors connecting protected structures and objects to the central alarm updating and display unit as direct burial or in conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Coaxial cable cannot be spliced.

3.1.9 Camera Housings, Mounts, and Poles

a. Provide a foundation for each camera pole as specified and designed.

b. Provide a ground rod for each camera pole and connect the camera pole to the ground rod as shown on the drawings

3.1.10 Field Applied Painting

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 ADJUSTMENT, ALIGNMENT, SYNCHRONIZATION, AND CLEANING

a. Clean each system component of dust, dirt, grease, or oil incurred during and after installation or accrued subsequent to installation from other project activities subsequent to installation.

b. Prepare for system activation by manufacturer's recommended procedures for adjustment, alignment, or synchronization.

c. Prepare each component in accordance with appropriate provisions of component installation, operations, and maintenance manuals.

d. Remove large vegetation that may sway in the wind and touch fencing.

e. Adjust sensors so that coverage is maximized without mutual interference.

3.3 SYSTEM STARTUP

Do not apply power to the system until after:

a. Set up system equipment items and communications in accordance with manufacturer's instructions.

b. Conduct a system visual inspection to ensure that defective equipment items have not been installed and that there are no loose connections.

c. Test and verify system wiring as correctly connected.

d. Verify system grounding and transient protection systems as properly installed.

e. Verify the correct voltage, phasing, and frequency of the system power supplies.

Satisfaction of the requirements above does not relieve the contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as result of Contractor work or equipment.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

Provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the Contracting Officer. These representatives are to be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives are also to be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives are to participate in the system testing and validation and provide certification that their respective system portions meet the contractual requirements.

The above requirements supplement the quality control requirements specified elsewhere in the contract.

3.5 ESS TRAINING

Conduct training courses for 10 designated personnel in system maintenance and operation. Coordinate training with the Government. The training is to be oriented to the specific system being installed. Training content is to include training manuals and audio-visual materials. Deliver training manuals for each trainee with 2 additional copies delivered for archiving at the project site. The manuals are to include an agenda, defined objectives for each lesson, and a detailed subject matter description for each lesson.

Furnish audio-visual equipment and other training materials and supplies. Deliver copies of the audio-visual materials to the Government either as a part of the printed training manuals or on the same media as that used during the training sessions when course portions are presented using audio-visual material.

3.5.1 ESS Training Outline

Submit a training plan for the training phases, including type of training to be provided, outline of training manuals, training course agendas, and a

list of reference material, for Government approval.

3.5.2 Typical Training Day

A training day is defined as:

a. Eight hours of classroom instruction, with

(1) Two 15-minute breaks

(2) One hour lunch break

b. Conducted:

(1) Monday through Friday

(2) During the daytime shift in effect at a Government-provided training facility

For guidance in planning the required instruction, assume that attendees will have a high school education or equivalent, and are familiar with ESS. Approval of the planned training schedule is to be obtained from the Government at least 30 days prior to the training.

3.5.3 ESS Administrator Training

a. ACS and IDS Administrator Training includes:

(1) Two eight-hour on-site training sessions

(2) Operating system procedures and configuration

(3) Operator functions

(4) Database functions and setup

(5) Card holder input and deletion procedures

(6) Report generation

(7) Applications programs (as applicable)

(8) Graphics generation and manipulation

(9) Items unique to the ACS and IDS interfaces with other systems

(10) System backup and restore

b. CCTV System Administrator Training includes:

(1) One eight-hour session on site

(2) Training is to include all administrator and operator functions, and items unique to the installed CCTV System, and interfaces with other systems.

3.5.4 ESS Operator Training

Coordinate the operator training syllabus with the Government prior to conducting operator training.

a. ACS and IDS Operator Training includes:

(1) Four (one-day) 8 hour on-site training sessions

(2) System operating procedures

(3) System configuration orientation

(4) Alarm acknowledgment

(5) Alarm response logging

(6) Graphics functionality

(7) Items unique to the ACS and IDS interfaces with other systems

b. CCTV Operator Training includes:

(1) Two (one-day) 8 hour on-site training sessions

(2) System operating procedures

(3) System configuration

(4) Video call-up

(5) Camera and monitor control

(6) Graphics functionality

(7) Basic device terminology and troubleshooting

3.5.5 Maintenance Personnel Training

The system maintenance course is to be taught at the project site after endurance test completion for a period of five training days. A maximum of five personnel, designated by the Government, will attend the course. The training includes:

a. Physical layout of each piece of hardware.

b. Troubleshooting and diagnostics procedures.

c. Component repair and replacement procedures.

d. Maintenance procedures and schedules to include system testing after repair.

e. Calibration procedures. Upon course completion, the students are to be proficient in system maintenance.

f. Review of site-specific drawing package, device location, communication, topology, and flow.

3.5.6 Follow-up Training

a. Provide One hour training session each month for two months after initial training.

b. Follow-up training is to begin one month after initial training.

c. Training is to include testing for system competence.

3.6 NAMEPLATE MOUNTING

Provide nameplate number, location, and letter designation as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or rivets.

-- End of Section --

To be updated to Rev 02/21

SECTION 31 10 00

CLEARING FOR CIVIL WORKS
08/08

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Clearing (Timber and Structure)

1.1.1.1 Payment

Payment will be made for costs associated with furnishing plant, labor, materials and equipments, and performing all operations necessary for clearing (timber and structures) as specified.

1.2 DEFINITIONS

1.2.1 Trees

The line of demarcation between brush and trees, for the purpose of distinguishing clearing requirements, is that trees, as used, will be considered as that woody growth not falling within the limits of brush as defined below.

1.2.2 Brush

Brush is that growth which is less than 2 inches in diameter measured 6 inches from the ground on the uphill side and is less than 6 feet in height measured from the ground on the uphill side.

1.3 PROJECT/SITE CONDITIONS

1.3.1 Aesthetics and Pollution Control

1.3.1.1 Ground Areas

All ground areas in the zone of normal pool level fluctuations which are disturbed by clearing operations and which would become subject to erosion will be protected or restored.

1.3.1.2 Construction Roads

All construction roads proposed for use by the Contractor for removing salvaged timber or for access to the work area shall be approved, as to location and alignment, prior to construction. Where such roads are determined to be of no value to project operation or will not serve recreational access needs after project construction, the areas occupied by these roads will be restored as nearly as possible to pre-construction conditions by reasonable grading and seeding along with the planting of seedling trees if in a tree cover area.

1.3.2 Existing Conditions

1.3.2.1 Boundaries

The area to be cleared under this section is indicated on the drawings, which form a part of this contract.

1.3.2.2 Fences

All fences in the area of proposed work shall be cleared.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 CLEARING REQUIREMENTS

3.1.1 Brush

The cutting of brush is required in areas of regrading.

3.1.2 Existing Site Clearing

Remove all trees and stumps, not falling within the classification of brush, to a height not exceeding 6 inches above the ground surface measured on the uphill side. Strip grass and 2" of topsoil in areas of new pavement and within the building footprint.

3.1.3 Equipment

A tree crushing machine may be used at the option of the Contractor in all clearing operations.

3.2 DISPOSAL OF MATERIAL

3.2.1 General

The material cleared from the areas shall be completely removed by transporting from the Government property unless otherwise approved by the Remedial Project Manager. All timber from which saw logs, posts, ties or cordwood can be produced will become the property of the Contractor and in the interest of conservation it is required that the Contractor make a reasonable effort to dispose of material for these purposes. The Contractor may cut timber into convenient lengths at the site but approval must be secured prior to the operation of saw mills within the Government lands. In no case shall cleared material be thrown into or left in the -basin. All felled timber shall be completely removed. However, it is intended that all existing down timber shall be disposed of in the manner prescribed for cleared material. Clean-up of floatable debris shall be accomplished by any practical means. The cutting of branches and debris remaining after clean-up, to reduce their length in order to avoid removal, will not be permitted.

3.2.2 Removal from Site

Except as otherwise provided, the Contractor will be permitted to remove felled and trimmed timber from the site of the work. The Contractor will

be allowed to stockpile salvaged timber at approved locations. The Government will assume no responsibility for the protection and safekeeping of such material. All stockpiled timber must be removed from Government lands before final acceptance of the work will be made.

3.3 DEBRIS

Debris shall be disposed of off site as may be designated by the Remedial Project Manager. Debris shall include trash of all kinds.

3.4 MARKETABLE MATERIALS

Any of the cleared materials which the Contractor considers marketable shall become its property and shall be removed from the project area.

3.5 LOCATIONS

The locations of structures and debris to be cleared are shown on the drawings .

-- End of Section --

To be replaced with 31 00 00 Earthwork

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	(2015) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2016) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	(1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils
ASTM D698	(2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D1140	(2017) Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2321	(2018) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2017) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3786/D3786M	(2018) Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011; R 2018) Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833/D4833M	(2007; E 2013; R 2013) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan; G

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Select material test

Porous fill test for capillary water barrier

Density tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5035/8260B. Perform complete TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring material onsite until tests results have been received and approved by the Remedial Project Manager.

1.6 QUALITY ASSURANCE

1.6.1 Shoring and Sheeting Plan

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan

if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Remedial Project Manager of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Remedial Project Manager at any time throughout the contract duration.

1.6.2 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Engineer. Report damage to utility lines or subsurface construction immediately to the Remedial Project Manager.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 12 inches. The Remedial Project Manager shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Soils that have a plasticity index equal to or greater than 50 when tested

in accordance with ASTM D4318.

2.1.5 Nonfrost Susceptible (NFS) Material

A uniformly graded washed sand with a maximum particle size of 2.00 and less than 5 percent passing the/ No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

2.1.6 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.7 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, SW, SP, SM, with a maximum ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.8 Topsoil

Provide as specified in Section 32 92 19 SEEDING.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, and no more than 2 percent by weight passing the No. 4 size sieve and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2.3.1 Sand

Clean, coarse-grained sand classified per the New York State DOT Standard for bedding and backfill .

2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof of the New York State DOT Standard for bedding and backfill. Maximum particle size shall not exceed 3 inches.

2.4 SEWAGE ABSORPTION TRENCHES OR PITS

2.4.1 Porous Fill

Backfill material consisting of clean crushed rock or gravel having a gradation such that 100 percent passes the 2 inch sieve and zero percent passes the 1/2 inch sieve.

2.4.2 Cover

Filter fabric as indicated.

2.5 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property. Dispose of materials from clearing and grubbing operations off Government property.

2.6 BACKFILL FOR UNDERDRAINAGE SYSTEMS

Clean sand, crushed rock, or gravel meeting the following requirements:

a. Perforated or Slotted-Wall Pipe: Backfill meeting requirements of Type I material as specified in Table 1.

b. Open Joint Pipe: Backfill consisting of both Type I and Type II materials as specified in Table 1.

c. Any Type Drain Used With Filter Fabric: fill consisting of Type II material as specified in Table 1.

TABLE 1

	Type I Gradation E 11 ASTM C33/C33M	Type II Gradation 57 ASTM C33/C33M	
ASTM D422 Sieve Size	Percent Passing	Percent Passing	
1.5 inches	--	100	
1 inch	--	90 - 100	
3/8 inch	100	25 - 60	

TABLE 1			
	Type I Gradation E 11 ASTM C33/C33M	Type II Gradation 57 ASTM C33/C33M	
ASTM D422 Sieve Size	Percent Passing	Percent Passing	
No. 4	95 - 100	5 - 40	
No. 8	--	0 - 20	
No. 16	45 - 80	--	
No. 50	10 - 30	--	
No. 100	0 - 10	--	

2.7 FILTER FABRIC

Provide a pervious sheet of polyester, nylon, glass or polypropylene filaments woven, spun bonded, fused, or otherwise manufactured into a nonraveling fabric with uniform thickness and strength. Fabric shall have the following manufacturer certified minimum average roll properties as determined by ASTM D4759:

	Class A	Class B
a. Grab tensile strength (ASTM D4632/D4632M) machine and transversed direction	min. 180	80 lbs.
b. Grab elongation (ASTM D4632/D4632M) machine and transverse direction	min. 15	15 percent
c. Puncture resistance (ASTM D4833/D4833M)	min. 80	25 lbs.
d. Mullen burst strength (ASTM D3786/D3786M)	min. 290	130 psi
e. Trapezoidal Tear (ASTM D4533/D4533M)	min. 50	25 lbs.

	Class A	Class B
f. Apparent Opening Size (ASTM D4751)	See Criteria Below	
(1) Soil with 50 percent or less particles by weight passing US No. 200 Sieve, AOS less than 0.6 mm (greater than #30 US Std. Sieve)		
(2) Soil with more than 50 percent particles by weight passing US No. 200 Sieve, AOS less than 0.297 mm (greater than #50 US Std. Sieve)		
g. Permeability (ASTM D4491/D4491M)	k fabric greater than k Soil	

2.8 MATERIAL FOR PIPE CASING

2.8.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Casing size shall be of the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

2.8.2 Wood Supports

Treated Yellow Pine or Douglas Fir, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P5 and AWPA C2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

2.9 MATERIAL FOR RIP-RAP

Bedding material, Grout Filter fabric and rock conforming to New York State DOT Standard for construction indicated.

2.9.1 Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Material shall be composed of tough, durable particles. Fines passing the No. 200 standard sieve shall have a plasticity index less than six.

2.9.2 Grout

Composed of cement, water, an air-entraining admixture, and sand mixed in proportions of one part portland cement to two parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air to produce durable grout, as determined by the Engineer. Mix grout in a concrete mixer. Mixing time shall be sufficient to produce a mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming.

2.9.3 Rock

Rock fragments sufficiently durable to ensure permanence in the structure

and the environment in which it is to be used. Rock fragments shall be free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. The size of the fragments shall be such that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Specific gravity of the rock shall be a minimum of 2.50. The inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines will not be permitted.

2.10 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes	
Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Potable Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air
Purple:	Non Potable, Reclaimed Water, Irrigation and Slurry lines

2.10.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.10.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring, bracing, cribbing, trench boxes, underpinning and sheeting where indicated. In addition to Section 25 A and B of EM 385-1-1 , include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least two feet below the working level.

Operate dewatering system continuously until construction work below

existing water levels is complete. Submit performance records weekly.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to 95 percent of ASTM D1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material and compact to 95 percent of ASTM D1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Engineer,

shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Engineer.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Engineer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.3 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.4 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Engineer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the

equipment used. Minimum subgrade density shall be as specified herein.

3.4.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the building with six passes of a 15 ton, pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Remedial Project Manager a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Engineer. Rutting or pumping of material shall be undercut as directed by the Engineer to a depth of 12 inches and replaced with fill and backfill material.

3.5 SUBGRADE FILTER FABRIC

Place synthetic fiber filter fabric as indicated directly on prepared subgrade free of vegetation, stumps, rocks larger than 2 inches diameter and other debris which may puncture or otherwise damage the fabric. Repair damaged fabric by placing an additional layer of fabric to cover the damaged area a minimum of 3 feet overlap in all directions. Overlap fabric at joints a minimum of 3 feet. Obtain approval of filter fabric installation before placing fill or backfill. Place fill or backfill on fabric in the direction of overlaps and compact as specified herein. Follow manufacturer's recommended installation procedures.

3.6 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.6.1 Common Fill Placement

Provide for general site .Use satisfactory materials. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.6.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.6.3 Select Material Placement

Provide under porous fill of structures not pile supported. Place in 6 inch lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and

compact material to avoid loading upon or against structure.

3.6.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.6.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.6 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 8 inch lifts to top of trench and in 8 inch lifts to one foot over pipe outside structures and paved areas.

3.7 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.8 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.9 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.10 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.10.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 90 percent of ASTM D1557.

3.10.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill material to 95 percent of ASTM D1557.

3.10.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D1557.

3.10.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill materials to 95 percent of ASTM D1557.

3.11 SPECIAL EARTHWORK REQUIREMENTS FOR SUBSURFACE DRAINS

Excavate to dimensions indicated. Provide a bedding surface of no more than one inch of Type I subdrain backfill material and place on compacted native soil as indicated. Backfill around and over the pipes after pipe installation has been approved. Place special granular filter material in 6 inch lifts and compact with mechanical, vibrating plate tampers or rammers until no further consolidation can be achieved. Compact backfill overlying the special granular filter material as specified for adjacent or overlying work.

3.11.1 Granular Backfill Without Filter Fabric

3.11.1.1 Perforated or Slotted Wall Pipe

Place granular material as pipe is laid and extend fit for a minimum of one pipe diameter on each side of and 18 inches above the top of the pipe.

3.11.2 Granular Backfill Using Filter Fabric

3.11.2.1 Perforated or Slotted Wall Pipes

Wrap one layer of filter fabric around pipe in such a manner that longitudinal overlaps are in unperforated or unslotted quadrants of the pipe. Overlap fabric a minimum of 2 inches. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material and extend it for one pipe diameter, minimum of 6 inches on each side of and 18 inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.12 RIP-RAP CONSTRUCTION

Construct rip-rap on filter fabric in accordance with New York State DOT Standard in the areas indicated.

3.12.1 Preparation

Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.12.2 Bedding Placement

Spread bedding material uniformly to a thickness of at least 3 inches on prepared subgrade as indicated.

3.12.3 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.13 FINISH OPERATIONS

3.13.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.13.2 Topsoil and Seed

Provide as specified in Section 32 92 19 SEEDING.

3.13.3 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.14 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.15 FIELD QUALITY CONTROL

3.15.1 Sampling

Take the number and size of samples required to perform the following tests.

3.15.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.15.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.15.2.2 Select Material Testing

Test select material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.15.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136/C136M for conformance to gradation specified in ASTM C33/C33M.

3.15.2.4 Density Tests

Test density in accordance with ASTM D1556/D1556M, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556/D1556M density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556/D1556M density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

Bedding and backfill in trenches: One test per 200 linear feet in each lift.

3.15.2.5 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D2216. Include moisture content test results in daily report.

-- End of Section --

To be updated with Rev 05/22

SECTION 32 11 20

SUBBASES FOR FLEXIBLE PAVING
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131/C131M	(2014) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D2487	(2017) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM E11	(2016) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.2 DEGREE OF COMPACTION

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools; G

SD-06 Test Reports

Initial Tests; G

In-Place Tests; G

1.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Remedial Project Manager before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Use equipment capable of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved in accordance with Section 01 45 00.00 20 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Engineer may specify the time and location of the tests. Furnish copies of test results to the Remedial Project Manager within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Remedial Project Manager or Engineer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Perform sieve analysis in conformance with ASTM C117 and ASTM C136/C136M using sieves conforming to ASTM E11.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture in accordance with paragraph DEGREE OF COMPACTION.

1.5.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938. For the method presented in ASTM D1556/D1556M, use the base plate, as shown in the drawing. For the method presented in ASTM D6938, check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil and ASTM D6938 will be used to determine the moisture content of the soil. Also check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. Make the calibration checks of both the density and moisture gauges using the prepared containers of material method, as described in paragraph Calibration, in ASTM D6938, on each different type of material to be tested at the beginning of a job and at intervals as directed. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

1.5.2.5 Wear Test

Perform wear tests on subbase course material in conformance with ASTM C131/C131M.

1.5.2.6 Weight of Slag

Determine weight per cubic foot of slag in accordance with ASTM C29/C29M.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Subbase Course

Provide aggregates consisting of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Provide aggregates which are free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. The percentage of loss of material retained on the No. 4 sieve must not exceed 50 percent after 500 revolutions when tested in accordance with ASTM C131/C131M. Provide aggregate that is reasonably uniform in density and quality. Provide slag that is an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf. Provide aggregates within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	No. 1	No.2	No. 3
No. 10	50	80	100
No. 200	8	8	8

The portion of any blended component and of the completed course passing the No. 40 sieve must be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.1.2 Select-Material Subbase Course

Provide materials consisting of selected soil or other materials from field excavation, stockpiles, or other sources and free from lumps and balls of clay and from organic and other objectionable matter. Provide materials with not more than 25 percent by weight passing the No. 200 sieve. The portion of material passing the No. 40 sieve must have a liquid limit less than 35 and a plasticity index less than 12. Provide materials having a maximum particle size not exceeding 3 inches.

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.1 Initial Tests

Perform one of each of the following tests on the proposed material prior to commencing construction to demonstrate that the proposed material meets

all specified requirements prior to installation. Complete this testing for each source if materials from more than one source are proposed.

a. Sieve Analysis.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

2.2.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area.

3.2 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Stockpile aggregates on the cleared and leveled areas designated by the Engineer to prevent segregation. Stockpile materials obtained from different sources separately.

3.3 PREPARATION OF UNDERLYING COURSE OR SUBGRADE

Clean the underlying course or subgrade of all foreign substances prior to constructing the subbase or select-material subbase course. Do not construct subbase or select-material subbase course on underlying course or subgrade that is frozen. Construct the surface of the underlying course or subgrade to meet specified compaction and surface tolerances. Correct ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the specified requirements set forth herein by loosening and removing soft or unsatisfactory material and adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, stabilize the surface prior to placement of the overlying course. Stabilize by mixing the overlying course material into the underlying course and compacting by approved methods. Consider the stabilized material as part of the underlying course and meet all requirements of the underlying course. Do not allow traffic or other operations to disturb the finished underlying course and maintain in a satisfactory condition until the overlying course is placed.

3.4 GRADE CONTROL

Provide a finished and completed subbase and select-material subbase course s conforming to the lines, grades, and cross sections shown. Place line and grade stakes as necessary for control.

3.5 MIXING AND PLACING MATERIALS

Mix and place the materials to obtain uniformity of the material at the water content specified. Make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.6 LAYER THICKNESS

Compact the completed course to the thickness indicated. No individual layer may be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. Compact the course(s) to a total thickness that is within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 1/4 inch of the thickness indicated.

3.7 COMPACTION

Compact each layer of the material, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Slightly vary the length of alternate trips of the roller. Adjust speed of the roller as needed so that displacement of the aggregate does not occur. Compact mixture with hand-operated power tampers in all places not accessible to the rollers. Continue compaction of the rigid base course until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. Make such adjustments in compacting or finishing procedures as may be directed by the Engineer to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase select-material subbase course. Remove any materials that are found to be unsatisfactory and replace with satisfactory material or rework, as directed, to meet the requirements of this specification.

3.8 PROOF ROLLING

In addition to the compaction specified, proof roll subbase course in areas designated on the drawings by application of coverages of a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 30,000 pounds and inflated to a minimum of 125 psi. A coverage is defined as the application of one tire print over the designated area. In the areas designated, apply proof rolling to the top layer of the completed subbase course. Maintain water content of the top layer of the subbase course as specified in paragraph COMPACTION from start of compaction to completion of proof rolling. Remove any subbase course materials that produce unsatisfactory results by proof rolling and replace with satisfactory materials. Then recompact and proof roll to meet specifications.

3.9 EDGES OF SUBBASE AND SELECT-MATERIAL SUBBASE

Place approved material along the outer edges of the subbase and select-material subbase course in sufficient quantity to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, simultaneously roll and compact at least a 2 foot width of this shoulder material with the rolling and compacting of each layer of the subbase and select-material subbase course, as directed.

3.10 FINISHING

Finish the surface of the top layer of rigid pavement base course after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Do not add thin layers of material to the top layer of rigid pavement base course to meet grade. If the elevation of the top layer of rigid pavement base course is 1/2 inch or more below grade, scarify the top layer to a depth of at least 3 inches and blend new material in and compact and proof roll to bring to grade. Make adjustments to rolling and finishing procedures as directed by the Engineer to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable rigid pavement base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, scarify the unsatisfactory portion and rework and recompact it or replace as directed.

3.11 FIELD QUALITY CONTROL

3.11.1 In-Place Tests

Perform one of each of the following tests on samples taken from the placed and compacted subbase and rigid pavement base course. Take samples and test at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 500 square yards, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 1,000 quare yards, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the thickness of each course at intervals providing at least one measurement for each 500 square yards or part thereof. Measure the thickness using test holes, at least 3 inches in diameter through the course.

3.11.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and fully compacted course(s).

3.12 TRAFFIC

Completed portions of the rigid pavement base course may be opened to

limited traffic, provided there is no marring or distorting of the surface by the traffic. Do not allow heavy equipment on the completed rigid pavement base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed rigid pavement base course, protect the area against marring or damage to the completed work.

3.13 MAINTENANCE

Maintain the completed course in a satisfactory condition until the full pavement section is completed and accepted. Immediately repair any defects and repeat repairs as often as necessary to keep the area intact. Retest any course that was not paved over prior to the onset of winter to verify that it still complies with the requirements of this specification. Rework or replace any area that is damaged as necessary to comply with this specification.

3.14 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that have been removed as directed. No additional payments will be made for materials that have to be replaced.

-- End of Section --

SECTION 32 11 26

HOT-MIX BITUMINOUS BASE COURSE FOR ROADS AND STREETS
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 156	(2013; R 2017) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

ASPHALT INSTITUTE (AI)

AI MS-2	(2015) Asphalt Mix Design Methods

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	(2018) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131/C131M	(2014) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C183/C183M	(2015) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates

ASTM D140/D140M	(2016) Standard Practice for Sampling Asphalt Materials
ASTM D242/D242M	(2009; R 2014) Mineral Filler for Bituminous Paving Mixtures
ASTM D1856	(2009; R 2015) Recovery of Asphalt from Solution by Abson Method
ASTM D2041/D2041M	(2011) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	(2017; E 2018) Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2726/D2726M	(2019) Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D3665	(2012; R 2017) Standard Practice for Random Sampling of Construction Materials
ASTM D3666	(2016) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4791	(2019) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867/D4867M	(2009; R 2014) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5821	(2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6373	(2016) Standard Specification for Performance Graded Asphalt Binder
ASTM D6925	(2014) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sources of Aggregates

Job Mix Formula;

SD-06 Test Reports

Sources of Aggregates

Bituminous Materials

Test Section; G

1.3 QUALITY CONTROL

1.3.1 Qualifications

Perform sampling and testing using an approved commercial testing laboratory or on-site facilities. Submit accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM D3666, including all applicable test procedures. Do not start work requiring testing until the facilities have been inspected and approved. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. Maintain this certification for the duration of the project.

1.3.2 Aggregates

Select sources of aggregates and submit a plan for operation of a new source of aggregates at least 45 days in advance of starting production. If a previously developed source is selected, submit test results with evidence that central plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least 5 years under similar climatic conditions. Include in the service record a tabulation of aggregate gradation and quality test results, typical hot-mix asphalt mix design using the aggregate, and a list of representative paving projects using the aggregate. Make such tests and other investigations as necessary to determine whether or not aggregates meeting the requirements specified can be produced from the proposed sources. Sample aggregates in accordance with ASTM D75/D75M and test them at the start of production.

1.3.3 Mineral Filler

Sample mineral filler in accordance with ASTM C183/C183M.

1.3.4 Bituminous Materials

Select sources where bituminous materials are obtained in advance of time

when materials will be required in the work. Sample bituminous materials in accordance with ASTM D140/D140M. Submit test results not less than 30 days before such material is required for use in the work.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not construct bituminous courses when the underlying course contains free surface water, or when temperature of the surface of the underlying course is below 40 degrees F, unless otherwise directed.

1.5 ACCEPTANCE

1.5.1 Tolerances

Acceptance of bituminous base course is based on compliance with the tolerances presented in Table 1. Remove and replace bituminous base course represented by the failing tests or submit repair plan for approval.

TABLE 1	
Attribute	Measurement
Plant Mixture	
Delivery to Laydown Machine	Minimum 250 deg F
Laboratory Air Voids	3 to 5 percent
Finished Mat	
Mat Density (avg of 4 cores/lot)	Minimum 92 percent of TMD
Joint Density (avg of 4 cores/lot)	Minimum 90.5 percent of TMD
Grade	plus/minus 0.05 foot
Smoothness	plus/minus 3/8 inch
Longitudinal Joint Offset	Minimum 1 foot
Transverse Joint Offset	Minimum

1.5.2 Test Section

At the start of plant operation, prepare a quantity of the mixture sufficient to construct a test section at least 100 feet long and two spreader widths wide. Place, spread, and compact the mixture with equipment to be used in the project and in accordance with requirements specified herein. Construct a cold joint between spreader widths. Test and evaluate the test section and conform to all specified requirements. If tests indicate that the pavement does not conform to the tolerances of Table 1, remove and construct additional test sections and sample for conformance to specification requirements. Do not start production of the bituminous base course mixture without approval.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of crushed stone, crushed slag, crushed gravel screenings, sand, and mineral filler, as required. The portion of these materials retained on the No. 4 sieve is classified as coarse aggregate; the portion passing the No. 4 sieve and retained on the No. 200 sieve, as fine aggregate; and the portion passing the No. 200 sieve, as mineral filler.

2.1.1 Coarse Aggregates

Provide coarse aggregates consisting of clean, sound, durable fragments of crushed stone, crushed slag, or crushed gravel meeting the following requirements:

2.1.1.1 Aggregate Wear

Percentage of wear not exceeding 40 after 500 revolutions, as determined in accordance with ASTM C131/C131M.

2.1.1.2 Aggregate Loss

Percentage of loss not exceeding 18 after five cycles performed in accordance with ASTM C88, using magnesium sulfate.

2.1.1.3 Fractured Faces

At least 75 percent by weight of coarse aggregate containing two or more fractured faces produced by crushing when tested in accordance with ASTM D5821.

2.1.1.4 Flat and Elongated Pieces

Particle shape essentially cubical and containing not more than 20 percent, by weight, of flat particles and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D4791.

2.1.1.5 Dry Weight of Crushed Slag

Dry weight of crushed slag not less than 75 pcf as determined in accordance with ASTM C29/C29M.

2.1.2 Fine Aggregates

Provide fine aggregates consisting of clean, durable natural sands; manufactured sands prepared by crushing stone, slag, or gravel, or any combination of natural and manufactured sands. Natural sands consist of grains of clean, hard, durable rock. Limit the quantity of uncrushed material to a maximum of 25 percent by weight of total aggregate.

2.1.3 Mineral Filler

Mineral filler conforming to ASTM D242/D242M.

2.1.4 Liquid Limit and Plasticity Index

Measure liquid limit and plasticity index on the portion of the aggregate

passing the No. 40 sieve in accordance with ASTM D4318. Requirements apply to the individual aggregate fractions and the combined blend in the completed base course. Provide aggregates classified as either nonplastic or having a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.2 BITUMINOUS MATERIALS

2.2.1 Asphalt Cement

Provide asphalt cement binder conforming to ASTM D6373 Performance Grade (PG)

2.3 AGGREGATE GRADATION

Provide mineral aggregate of such size that percentage composition by weight, as determined by ASTM C136/C136M, conforms to the gradation specified in TABLE 2, and does not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

TABLE 2. AGGREGATE GRADATION

Percent Passing			
Sieve Size	Gradation 1	Gradation 2	Gradation 3
1 inch	100	---	---
3/4 inch	90-100	100	---
1/2 inch	68-88	90-100	100
3/8 inch	60-82	72-88	90-100
No. 4	45-67	53-73	58-78
No. 8	32-54	38-60	40-60
No. 16	22-44	26-48	28-48
No. 30	15-35	18-38	18-38
No. 50	9-25	11-27	11-27
No. 100	6-18	6-18	6-18
No. 200	3-6	3-6	3-6

2.4 COMPOSITION OF MIXTURE

2.4.1 Job-Mix Formula (JMF)

2.4.1.1 Develop the JMF

Provide an asphalt mix composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt binder. Size the aggregate fractions, handle in separate size groups, and combine in such proportions that the resulting mixture meets the grading requirements of Table 2. Submit proposed JMF; do not produce hot-mix asphalt for payment until a JMF has been approved. Design the hot-mix asphalt in accordance with Marshall or Superpave procedures and the criteria shown in Table 3. Use the hand-held hammer to compact the specimens for Marshall mix design. Design Superpave mixes with the number of gyrations specified in Table 3, unless the DOT option is chosen. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D4867/D4867M, is less than 75, reject the aggregates or treat the asphalt mixture with an approved anti-stripping agent. Add the amount of anti-stripping agent sufficient to produce a TSR of not less than 75. Provide an antistrip agent, if required, at no additional cost. Provide sufficient materials to produce 200 pound of blended mixture for verification of mix design at least 14 days prior to construction of test section.

2.4.1.2 Option

A currently used DOT Superpave hot mix may be used in lieu of developing a Marshall hot mix design as described herein. Design the Superpave volumetric mix in accordance with AI MS-2 and ASTM D6925. Provide a nominal maximum aggregate size (NMAS) of 1 inch. Other DOT hot mix design methods may be suitable, as approved.

2.4.2 JMF Requirements

Submit in writing the job mix formula for approval at least 30 days prior to the start of the test section including as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt binder.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt performance grade.

e. Number of blows of hand-held hammer per side of molded specimen. (NA for Superpave)

f. Number of gyrations of Superpave gyratory compactor, (NA for Marshall mix design)

g. Laboratory mixing temperature.

h. Lab compaction temperature.

i. Temperature-viscosity relationship of the asphalt cement.

j. Plot of the combined gradation on the 0.45 power gradation chart,

stating the nominal maximum size.

k. Graphical plots of stability (NA for Superpave), flow (NA for Superpave), air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

l. Specific gravity and absorption of each aggregate.

m. Percent natural sand.

n. Percent particles with 2 or more fractured faces (in coarse aggregate).

o. Fine aggregate angularity.

p. Percent flat or elongated particles (in coarse aggregate).

q. Tensile Strength Ratio(TSR).

r. Antistrip agent (if required) and amount.

s. List of all modifiers and amount.

t. Correlation of hand-held hammer with mechanical hammer (NA for Superpave).

u. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Mix Design Criteria

Test Property	50 Blows or Mix Gyrations	75 Blows or Mix Gyrations
Stability, pounds, minimum (NA for Superpave)	*1350	*1800
Flow, 0.01 inch, (NA for Superpave)	8-18	8-16
Air voids, percent	3-5	3-5
Percent Voids in mineral aggregate (VMA),(minimum)		
Gradation 1	14.0	14.0
Gradation 2	15.0	15.0
Gradation 3	16.0	16.0
TSR, minimum percent	75	75

* This is a minimum requirement.

Table 3. Mix Design Criteria		
Test Property	50 Blows or Mix Gyrations	75 Blows or Mix Gyrations
** Calculate VMA in accordance with AI MS-2, based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate.		

2.4.2.1 Adjustment to JMF

The JMF for each mixture is in effect until a new formula is approved in writing. Should a change in sources of any materials be made, perform a new mix design and obtain approval before the new material is used. Make minor adjustments within the specification limits to the JMF to optimize mix volumetric properties. Adjustments to the original JMF are limited to plus or minus 4 percent on the No. 4 and coarser sieves; plus or minus 3 percent on the No. 8 to No. 50 sieves; and plus or minus 1 percent on the No. 100 sieve. Adjustments to the JMF are limited to plus or minus 1.0 percent on the No. 200 sieve. Asphalt content adjustments are limited to plus or minus 0.40 from the original JMF. If adjustments are needed that exceed these limits, develop a new mix design.

2.5 RECYCLED ASPHALT PAVEMENT

RAP is not permitted.

2.6 EQUIPMENT, TOOLS, AND MACHINES

2.6.1 Bituminous Plant

Provide a bituminous plant of such capacity to produce the quantities of bituminous mixtures required for the project within the completion time of the contract. Provide hauling equipment, paving machines, rollers, miscellaneous equipment, and tools in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output. Provide a sufficient number of adequately trained personnel during paving operations to produce a pavement meeting the requirements in this specification.

2.6.2 Mixing Plants

Provide mixing plants in accordance with AASHTO M 156 which are automatic or semiautomatic controlled, commercially manufactured units designed, coordinated, and operated to consistently produce a mixture within the job-mix formula (JMF). Prequalify drum or batch mixers at the production rate to be used during actual mix production. The prequalification tests include extraction in accordance with ASTM D2172/D2172M and recovery of the asphalt binder in accordance with ASTM D1856.

2.6.3 Asphalt Paver

Provide asphalt pavers which are self-propelled, with an activated screed, heated as necessary, and capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and

grade, with sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. Provide a receiving hopper of sufficient capacity to permit a uniform spreading operation and equipped with a distribution system to place the mixture uniformly in front of the screed without segregation and produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. If screed extensions are used to increase the paving width, provide auger extensions to distribute the hot mix along the additional screed length. Equip the paver with a control system capable of automatically maintaining the specified screed elevation. Automatically actuate the control system from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface.

2.6.4 Hauling Equipment

Provide trucks for hauling hot-mix asphalt having tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a release agent specifically designed for use with hot mix asphalt. Provide each truck with a suitable cover to protect the mixture from adverse weather. When necessary to maintain the mixture at the specified temperature, insulate or heat truck beds and securely fasten covers (tarps).

2.6.5 Rollers

Provide the number, type, and weight of rollers sufficient to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate or displacement of the asphalt mixture.

2.6.6 Straightedge

Furnish and maintain at the site, in good condition, one 12 foot straightedge for each bituminous paver for use in testing the finished surface. Construct straightedges of aluminum with blades of box or box-girder cross section and a flat bottom reinforced to insure rigidity and accuracy. Provide handles to facilitate movement on pavement.

PART 3 EXECUTION

3.1 CONDITIONING OF UNDERLYING COURSE

Prior to placing the bituminous base course, clean the underlying surface of foreign or objectionable matter. Apply a tack coat in accordance with 32 12 13 BITUMINOUS TACK AND PRIME COATS.

3.2 MIXING

3.2.1 Preparation of Mineral Aggregates

Place and maintain each aggregate stockpile in such a manner to prevent segregation. Regulate rates of feed of aggregates so that the moisture content and temperature of aggregates will be within tolerances specified herein. Provide dry storage for mineral filler.

3.2.2 Preparation of Bituminous Mixtures

Convey aggregates, mineral filler, and bitumen into the mixer in proportionate quantities required to meet the JMF. Set the mixing time as required to obtain a uniform coating of the aggregate with the bituminous material. Limit the temperature of bitumen at time of mixing not to exceed 300 degrees F.

3.2.3 Water Content of Aggregates

Perform drying operations to reduce the water content of mixture to less than 0.75 percent. Conduct the water content test in accordance with ASTM D2216. If the water content is determined on individual hot bin samples, calculate the water content as a weighted average based on composition of blend.

3.2.4 Storage of Bituminous Paving Mixture

Store the mixture according to the requirements of AASHTO M 156. Empty uninsulated surge bins at the end of each working day. If excessive heat loss, segregation,or oxidation of the stored asphalt mixture is observed, discontinue the use of the surge bin.

3.3 TRANSPORTATION OF BITUMINOUS MIXTURE

Transport the bituminous mixture from the paving plant to the site in trucks having tight, clean, smooth beds lightly coated with an approved release agent to prevent adhesion of mixture to truck bodies. Drain excessive release agent prior to loading. Cover each load with canvas or other approved material of ample size to protect mixture from weather and prevent loss of heat. Reject loads that have crusts of cold, unworkable material or have become wet by rain. Do not haul over freshly placed material.

3.4 PLACING

Do not place bituminous mixtures without ample time to complete placement and compaction during daylight hours, unless artificial lighting is provided.

3.4.1 Tack Coat

Spray contact surfaces of previously constructed pavement, curbs, manholes, and similar structures with a tack coat conforming to the requirements of Section 32 12 13 BITUMINOUS TACK AND PRIME COATS.

3.4.2 Offsetting Joints in Bituminous Base Course

Place the bituminous base course so that longitudinal joints are offset from joints in the underlying course by at least 1 foot. Offset transverse joints by at least 2 feet from transverse joints in the underlying course.

3.4.3 Use of Laydown Machine

Reject mixtures having temperatures less than 250 degrees F when delivered to the laydown machine. Adjust the laydown machine and regulate the speed so that the surface of the course being laid will be smooth and continuous

without tears and pulls, and of such depth that, when compacted, the surface conforms to the cross section, grade, and contour indicated. Begin placement of the mixture along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture as nearly continuous as possible, and adjust the speed of placing to permit proper compaction. When segregation occurs in the mixture during placing, suspend the laydown operation until the cause is determined and corrected. Correct irregularities in alignment of the course left by the laydown machine by trimming directly behind machine. Immediately after trimming, thoroughly compact the edges of the course by tamping laterally with a lute. Do not permit distortion of the course during tamping.

3.4.4 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after the initial strip has been spread and compacted as specified below, overlap the screed of the laydown machine 1/2 to 1 inch over the previously placed strip and sufficiently high so that compaction will produce a smooth, dense joint. Use a lute to push back the mixture placed on the edge of the previously placed strip to the edge of the strip being placed. Do not broadcast material onto the mat. Remove and waste excess mixture.

3.4.5 Hand Spreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, spread the mixture by hand. Prevent segregation during spreading. Do not broadcast material onto the mat. Remove and waste excess mixture. Maintain grade and smoothness tolerances presented in Table 1.

3.5 COMPACTION OF MIXTURE

Begin compaction as soon after placing as the mixture will bear roller without undue displacement. Do not permit delays in compacting the freshly placed mixture. After the initial rolling, perform preliminary tests of the crown, grade, and smoothness. Correct deficiencies so that the finished course will conform to requirements for the grade and smoothness specified in subpart: ACCEPTANCE. After meeting crown, grade, and smoothness requirements, continue rolling until a mat density of at least 92 percent of the theoretical maximum density (TMD) determined in accordance with ASTM D2041/D2041M is obtained. Roll the joints until until a joint density of at least 90.5 percent of the theoretical maximum density (TMD) determined in accordance with ASTM D2041/D2041M is obtained. Thoroughly compact areas inaccessible to rollers with hot hand tampers.

3.5.1 Correcting Deficient Areas

Remove mixtures that become contaminated or are defective. Do not permit skin patching of an area that has been rolled. Cut holes the full thickness of the base course so that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Spray sides with tack coat conforming to requirements of Section 32 12 13 BITUMINOUS TACK AND PRIME COATS. Place hot mix asphalt in the holes in sufficient quantity so that the finished surface will conform to grade, smoothness, and density requirements.

3.6 JOINTS

3.6.1 General

Carefully construct joints between old and new pavements or between successive day's work or joints that have become cold to establish a continuous bond between old and new sections of the course. Construct joints having the same texture, density, and smoothness as other sections of the course. Clean contact surfaces of previously constructed pavements that have become coated with dust, sand, or other objectionable material by brushing or cut back with approved power saw, as approved. Spray the surface against which new material is placed with a thin, uniform coat of tack coat conforming to requirements of Section 32 12 13 BITUMINOUS TACK AND PRIME COATS. Apply the material far enough in advance of placement of the fresh mixture to insure adequate curing. Take care to prevent damage or contamination of sprayed surface.

3.6.2 Transverse Joints

Pass the roller over the unprotected end of freshly placed mixture only when placing of the course is discontinued or when delivery of the mixture is interrupted to the extent that the unrolled material may become cold. In all cases, cut back the edge of the previously placed course a mimimum of 2 inches to expose an even, straight, vertical surface for the full thickness of the course. In continuing placement of the strip, position the mechanical spreader on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

3.6.3 Longitudinal Joints

Cut back edges of a previously placed strip that have cooled or are irregular, honeycombed, poorly compacted, damaged, or otherwise defective. In all cases, cut back the edge of the previously placed course a mimimum of 2 inches to expose an even, straight, vertical surface for the full thickness of the course.

3.7 EDGES OF PAVEMENT

Neatly trim outside edges adjacent to shoulders.

3.8 QUALITY CONTROL

Perform tests in sufficient numbers and at the locations and times directed to ensure that materials, mixtures and compaction meet specified requirements. Obtain samples of finished pavement, including samples that span the longitudinal joint. Sample bituminous materials during construction when shipments of bituminous materials are received or when necessary to assure that some condition of handling or storage has not been detrimental to the bituminous material.

3.8.1 Sampling

Obtain plant mix and in-place samples on a lot and sublot basis. Each full day's production or a maximum of 1000 tons is considered a lot. Divide the lot into four (4) equal sublots and obtain random samples in accordance with ASTM D3665 within each sublot. Obtain plant mix samples from the haul truck or from behind the paver. Test for grade and smoothness on a total lot basis.

3.8.2 In-Place Density

Take one random core (4 inches or larger in diameter) from the mat (interior of the lane) of each sublot, and one random core from the joint (immediately over joint) of each sublot, with each random core the full thickness of the layer being placed. When the random core is less than 1 inch thick, do not include in the analysis. In this case, take another random core. After air drying to a constant weight, determine the density of each core in accordance with ASTM D2726/D2726M. Determine percent compaction using the TMD. Evaluate for acceptance in accordance with subpart: ACCEPTANCE. Remove and replace unacceptible lots.

3.8.3 Laboratory Air Voids and Theoretical Maximum Density

Calculate laboratory air voids by determining the bulk density of each lab compacted specimen using the laboratory-prepared, thoroughly dry method of ASTM D2726/D2726M and determining the theoretical maximum density of each sublot sample using ASTM D2041/D2041M. Use the latest theoretical maximum density value to calculate the laboratory air voids for each sublot. Evaluate for acceptance in accordance with subpart: ACCEPTANCE. Complete and report all laboratory air void tests within 24 hours after completion of construction of each lot.

3.8.4 Plan Grade

Provide finished surfaces conforming, within tolerances specified, to the lines, grades, and cross sections indicated. Do not permit finished surfaces to vary more than the tolerances provided in subpart: ACCEPTANCE from the plan gradeline and elevation established and approved at the site. Maintain finished surfaces flush with finished surfaces of abutting pavements. Do not permit deviations from the plan gradeline and elevation in areas of pavements where closer conformance with plan grade and elevation is required for the proper functioning of drainage and other appurtenant structures involved.

3.8.5 Surface Smoothness

Provide finished surfaces not deviating from the testing edge of a straightedge more than the tolerances of subpart: ACCEPTANCE in any direction.

3.8.6 Temperatures

Check temperatures at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.9 PROTECTION OF PAVEMENT

After final rolling of the pavement, do not permit vehicular traffic of any kind until the pavement has cooled to ambient temperature.

-- End of Section --

To be updated with Rev 05/24

SECTION 32 12 13

BITUMINOUS TACK AND PRIME COATS
05/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D140/D140M	(2016) Standard Practice for Sampling Asphalt Materials
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors
ASTM D6373	(2016) Standard Specification for Performance Graded Asphalt Binder
ASTM D946/D946M	(2015) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D977	(2017) Standard Specification for Emulsified Asphalt

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing

1.3 QUALITY ASSURANCE

Certificates of compliance for asphalt materials delivered will be obtained and checked to ensure that specification requirements are met. Quantities of applied material will be determined. Payment will be for amount of residual asphalt applied. Tack coat materials will not be diluted. Prime coat materials when emulsions are used can be diluted on site with potable water up to 1 part emulsion to 1 part water.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

1.5 EQUIPMENT, TOOLS AND MACHINES

1.5.1 General Requirements

Equipment, tools and machines used in the work are subject to approval. Maintain in a satisfactory working condition at all times. Calibrate equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment within 12 months of there use. If the calibration expires during project, recalibrate the equipment before work can continue.

1.5.2 Bituminous Distributor

Provide a self propelled distributor with pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the surface being sprayed. Calibrate the distributer in accordance with ASTM D2995. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled total liquid rates from 0.03 to 1.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor will be capable of circulating and agitating the bituminous material during the heating process.

1.5.3 Heating Equipment for Storage Tanks

Use steam, electric, or hot oil heaters for heating the bituminous material. Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot come in contact with the bituminous material. Fix an armored thermometer to the tank with a temperature range from 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times.

1.5.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.6 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. A limited amount of moisture (approximately 0.03 gallon/square yard) can be sprayed on the surface of unbound material when prime coat is used to improve coverage and penetration of asphalt material. Apply bituminous coat only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application, unless otherwise directed.

PART 2 PRODUCTS

2.1 PRIME COAT

Provide asphalt conforming to one of the following grades:

2.1.1 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D977, Type SS-1. Asphalt emulsion can be diluted up to 1 part water to 1 part emulsion for prime coat use. Do not dilute asphalt emulsion for tack coat use.

2.2 TACK COAT

2.2.1 Asphalt Cement

Provide asphalt cement conforming to ASTM D946/D946M or ASTM D6373 Grade 64.

2.2.2 Local/Regional Materials

Use Local/Regional Materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. Apply treatment only when the surface is dry and clean.

3.2 APPLICATION RATE

3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.03 gallons nor more than 0.10 gallons per square yard of residual asphalt onto the pavement surface as approved by the Engineer. Do not dilute asphalt emulsion when used as a tack coat.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 0.05 gallons nor more than 0.12 gallons per square yard of residual asphalt for asphalt emulsion up to a 1 to 1 dilution rate or for residual asphalt for cutback asphalt.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Apply asphalt at a temperature that will provide a viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. Furnish the temperature viscosity relation to the Remedial Project Manager.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

Asphalt Emulsion	
All Grades	70-160 degrees F
Asphalt Cement	
All Grades	275-350 degrees F

Some of these temperatures for rapid cure cutbacks are above the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the bituminous distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots, not capable of being sprayed with the distributor, with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 25 feet of heating, distributing, and transferring operations of cutback materials. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat requirements are described herein.

3.4.2 Prime Coat

The prime coat is required if it will be at least 7 days before the asphalt mixture is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. Protect the underlying layer from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Repair (recompact or replace) damage to the underlying material caused by lack of, or inadequate, protection by approved methods at no additional cost to the Government. If the Contractor opts to use the prime coat, apply as soon as possible after consolidation of the underlying material. Apply the bituminous material uniformly over the surface to be treated at a pressure range of 25 to 75 psi; the rate will be as specified above in paragraph APPLICATION RATE. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application remove and destroy the building paper.

3.4.3 Tack Coat

Apply tack coat at the locations shown on the drawings. A tack coat should be applied to every bound surface (asphalt or concrete pavement)

that is being overlaid with asphalt mixture and at transverse and longitudinal joints. Apply the tack coat when the surface to be treated is clean and dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate as specified above in paragraph APPLICATION RATE. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor by spraying with a hand wand or using other approved method. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of asphalt mixture allow the bituminous coat to cure and water or volatiles to evaporate prior to overlaying. Maintain the tacked surface in good condition until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas.

3.6 FIELD QUALITY CONTROL

Obtain certificates of compliance for all asphalt material delivered to the project. Obtain samples of the bituminous material under the supervision of the Remedial Project Manager. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Furnish certified copies of the manufacturer's test reports indicating temperature viscosity relationship for asphalt cement, compliance with applicable specified requirements, not less than 5 days before the material is required in the work.

3.7.1 Sampling

Unless otherwise specified, sample bituminous material in accordance with ASTM D140/D140M.

3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibrate using the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibrate the bituminous distributor in accordance with ASTM D2995.

3.7.3 Trial Applications

Before applying the spray application of tack or prime coat, apply three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.05 gallons per square yard. Make other trial applications using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.15 gallon per square yard. Make other trial applications using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

-- End of Section --

SECTION 32 16 19

CONCRETE CURBS, GUTTERS AND SIDEWALKS
05/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2017) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2019) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2016) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants

ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

SD-06 Test Reports

Field Quality Control

1.3 EQUIPMENT, TOOLS, AND MACHINES

1.3.1 General Requirements

Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Remedial Project Manager access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.3.2 Slip Form Equipment

Slip form paver or curb forming machines, will be approved based on trial use on the job and must be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air

temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. Prepare and protect the underlying material so that it is entirely free of frost when the concrete is deposited. Heat mixing water and aggregates as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating must be approved. Use only aggregates that are free of ice, snow, and frozen lumps before entering the mixer. Provide covering or other means as needed to maintain the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 85 degrees F except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete must have a minimum compressive strength of 3500 psi at 28 days. Size of aggregate must not exceed 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Use concrete mixtures that have an air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

Use concrete with a slump of 3 inches plus or minus 1 inch for hand placed concrete or 1 inch plus or minus 1/2 inch for slipformed concrete as determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel

Use reinforcement bars conforming to ASTM A615/A615M. Use wire mesh reinforcement conforming to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Use impervious sheet materials conforming to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 Burlap

Use burlap conforming to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

Use white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Use hard-pressed fiberboard contraction joint filler for curb and gutter.

2.4.2 Expansion Joint Filler, Premolded

Onless otherwise indicated, use 1/2 inch thick premolded expansion joint filler conforming to ASTM D1751 or ASTM D1752.

2.5 JOINT SEALANTS

Use cold-applied joint sealant conforming to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

2.6.1 Wood Forms

Use forms that are surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.

2.6.2 Steel Forms

Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 10 feet and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.3 Sidewalk Forms

Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

2.6.4 Curb and Gutter Forms

Use curb and gutter outside forms that have a height equal to the full depth of the curb or gutter. Use rigid forms for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Construct subgrade to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

Place and compact the subgrade in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. Test the subgrade for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

Place and compact the subgrade in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. Test the subgrade for grade and cross section by means of a template extending the full width of the curb and gutter. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil or biodegradable form release agent each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment must be checked with a 10 foot straightedge. Sidewalks must have a transverse slope of 1/4 inch per foot. Do not remove side forms less than 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

Remove forms used along the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Do not remove forms used along the back of curb until the face and top of the curb have been finished, as specified for concrete finishing. Do not remove gutter forms while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

Finish all slab edges, including those at formed joints, with an edger having a radius of 1/8 inch. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter to grade with a wood float.

3.4.4 Joint Finishing

Finish curb edges at formed joints as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Construct sidewalk joints to divide the surface into rectangular areas. Space transverse contraction joints at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and continuous across the slab. Construct longitudinal contraction joints along the centerline of all sidewalks 10 feet or more in width. Construct transverse expansion joints at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, install transverse expansion joints as indicated. Form expansion joints around structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 1/8 inch blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Form expansion joints using 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752

or building paper. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 1/8 inch. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 50 degrees F. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces.

3.5.3 Reinforcement Steel Placement

Accurately and securely fasten reinforcement steel in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Construct curb and gutter joints at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Construct contraction joints directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Construct contraction joints (except for slip forming) by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Remove separators as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, cut the contraction joints in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. Cut the contraction joint to a depth of at least one-fourth of the gutter/curb depth using a 1/8 inch saw blade.

3.6.2 Expansion Joints

Form expansion joints by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Construct expansion joints in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement using the same type and thickness of joints as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, provide expansion joints at least 1/2 inch in width at intervals not less than 30 feet nor greater than 120 feet. Seal expansion joints immediately following curing of the concrete or as soon thereafter as weather conditions permit. Seal expansion joints and the top 1 inch depth of curb and gutter contraction-joints with joint sealant. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 50 degrees F

at the time of application of joint sealing material. Immediately remove excess material on exposed surfaces of the concrete and clean concrete surfaces.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 6 inches. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. Use sheeting that is not less than 18-inches wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

Apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Do not allow concrete surface to dry before application of the membrane. If drying has occurred, moisten the surface of the concrete with a fine spray of water and apply the curing compound as soon as the free water disappears. Apply curing compound in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. Apply the second coat in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied by the method and at the coverage specified above. Respray areas where the curing compound is damaged by subsequent construction operations within the curing period. Take precautions necessary to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. Tightly

seal the top of the joint opening and the joint groove at exposed edges before the concrete in the region of the joint is resprayed with curing compound. Use a method used for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Adequately protect concrete surfaces to which membrane-curing compounds have been applied during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

3.7.4 Protective Coating

Apply a protective coating of linseed oil mixture to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Moist cure concrete to receive a protective coating.

3.7.4.1 Application

Complete curing and backfilling operation prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Spray apply at a rate of not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Do not heat protective coating by direct application of flame or electrical heaters and protect the coating from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Do not apply material at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Take concrete samples in accordance with ASTM C172/C172M not less than once a day nor less than once for every 250 cubic yards of concrete placed. Mold cylinders in accordance with ASTM C31/C31M for strength testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Use ASTM C231/C231M with concretes and mortars made with relatively dense natural aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing forman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Perform two slump tests on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, reduce high areas either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed 1/4 inch. Remove and replace pavement areas requiring grade or surface smoothness corrections in excess of the limits specified.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Engineer and/or Remedial Project Manager and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.

-- End of Section --

To be replaced with Section 32 17 23.16

SECTION 32 17 23

PAVEMENT MARKINGS
08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D476	(2015) Dry Pigmentary Titanium Dioxide Pigments
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2010) Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D711	(2010; R 2015) No-Pick-Up Time of Traffic Paint
ASTM D1652	(2011; E 2012) Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	(2007; R2013) Standard Test Methods for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D4060	(2019) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4505	(2012; R 2017) Standard Specification for Preformed Retroflective Pavement Marking Tape for Extended Service Life
ASTM D6628	(2003; R 2015) Standard Specification for Color of Pavement Marking Materials
ASTM D7234	(2012) Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM E1347	(2006; R 2011) Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete

	Surface Preparation for Sealers, Coatings, and Polymer Overlays

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5370-10	(2018; Rev H; Errata 1 2019) Standard Specifications for Construction of Airports

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2015) Manual on Uniform Traffic Control Devices

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325	(Rev D; Notice 1; Notice 2 2017) Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	(2015; Rev F; Notice 1) Paint, Traffic and Airfield Markings, Waterborne

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Application Equipment List; G

Exterior Surface Preparation

Safety Data Sheets; G

Waterborne Paint; G

SD-06 Test Reports

Waterborne Paint; G

SD-07 Certificates

Qualifications; G

Waterborne Paint

Volatile Organic Compound, (VOC); G

SD-08 Manufacturer's Instructions

Waterborne Paint; G

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Submit certificate stating that the proposed pavement marking paint meets the Volatile Organic Compound, (VOC) regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located. Submit Safety Data Sheets for each product.

1.3.2 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of applicable chemicals. The documentation should include experience on five projects of similar size and scope with references for all personnel.

1.4 DELIVERY AND STORAGE

Deliver paint materials, thermoplastic compound materials, and reflective media in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer.

Provide storage facilities at the job site, only in areas approved by the Remedial Project Manager, for maintaining materials at temperatures recommended by the manufacturer.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements

1.5.1.1 Weather Limitations for Application

Apply pavement markings to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees F above the dew point and the air and pavement temperatures are within the limits recommended by the pavement marking manufacturer. Allow pavement surfaces to dry after water has been used for cleaning or rainfall has occurred prior to striping or marking. Test the pavement surface for moisture before beginning work each day and after cleaning. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Remedial Project Manager's representative. Employ the "plastic wrap method" to test the pavement for moisture as specified in paragraph TESTING FOR MOISTURE.

1.5.2 Traffic Controls

Place warning signs conforming to MUTCD near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Place small markers along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation.

When traffic must be rerouted or controlled to accomplish the work,

provide necessary warning signs, flag persons, and related equipment for the safe passage of vehicles.

1.5.3 Lighting

When night operations are necessary, provide all necessary lighting and equipment. The Government reserves the right to accept or reject night work on the day following night activities by the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Surface Preparation and Paint Removal

2.1.2 Application Equipment

Submit application equipment list appropriate for the material(s) to be used. Include manufacturer's descriptive data and certification for the planned use that indicates area of coverage per pass, pressure adjustment range, tank and flow capacities, and all safety precautions required for operating and maintaining the equipment. Provide and maintain machines, tools, and equipment used in the performance of the work in satisfactory operating condition, or remove them from the work site. Provide mobile and maneuverable application equipment to the extent that straight lines can be followed and normal curves can be made in a true arc.

2.1.2.1 Paint Application Equipment

2.1.2.1.1 Hand-Operated, Push-Type Machines

Provide hand-operated push-type applicator machine of a type commonly used for application of water based paint or two-component, chemically curing paint, thermoplastic, or preformed tape, to pavement surfaces for small marking projects, such as legends and cross-walks, automotive parking areas, or surface painted signs. Provide applicator machine equipped with the necessary tanks and spraying nozzles capable of applying paint uniformly at coverage specified. Hand operated spray guns may be used in areas where push-type machines cannot be used.

2.1.2.1.2 Self-Propelled or Mobile-Drawn Spraying Machines

Provide self-propelled or mobile-drawn spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. Provide machine having a speed during application capable of applying the stripe widths indicated at the paint coverage rate specified herein and of even uniform thickness with clear-cut edges.

2.1.2.1.2.1 Road Marking

Provide equipment used for marking roads capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines, or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified.

2.1.2.1.2.2 Hand Application

Provide spray guns for hand application of paint in areas where the mobile paint applicator cannot be used.

2.1.2.2 Preformed Tape Application Equipment

Provide and use mechanical application equipment for the placement of preformed marking tape which is a mobile pavement marking machine specifically designed for use in applying pressure-sensitive pavement marking tape of varying widths. Equip the applicator with rollers, or other suitable compaction device to provide initial adhesion of the material with the pavement surface. Use additional tools and devices as needed to properly seat the applied material as recommended by the manufacturer.

2.2 MATERIALS

Use waterborne paint, epoxy paint, or preformed tape for roads. The maximum allowable VOC content of pavement markings is 150 grams per liter. Color of markings are indicated on the drawings and must conform to ASTM D6628 for roads and automotive parking areas and SAE AMS-STD-595A for airfields. Provide materials conforming to the requirements specified herein.

2.2.1 Waterborne Paint

FS TT-P-1952, Type I or II.

2.2.2 Methacrylate Paint

Formulate methacrylate paint to meet the requirements of FAA AC 150/5370-10, Item P-620.2, Methacrylate.

2.2.3 Epoxy Paint

2.2.3.1 Formulation

Epoxy pavement marking material will be a two component, 100 percent solids, material formulated to provide simple volumetric mixing ratio of two volumes of component A and one volume of component B unless otherwise recommended by the manufacturer.

2.2.3.2 Composition

The component A of both white and yellow must be within the following limits:

TABLE I		
	White	Yellow
Pigments	Minimum 18 percent by weight Titanium Dioxide (ASTM D476, Type II)	21-27 percent by weight
Epoxy Resin	75-82 percent	73-79 percent

The epoxy resin must be free of lead, cadmium, mercury, hexavalent chromium and other toxic heavy metals as defined by the Environmental Protection Agency. Submit a manufacturer's certification of compliance

with this requirement.

2.2.3.3 Epoxide Value

Determine epoxide epoxy number of the epoxy resin in accordance with ASTM D1652 for white and yellow component A on pigment free basis. The epoxide number must be within plus or minus 50 of the published manufacturer's standard.

2.2.3.4 Total Amine Value

Determine the amine number on the curing agent (component B) in accordance with ASTM D2074. The amine number must be within plus or minus 50 of the published manufacturer's standard.

2.2.3.5 Toxicity

Upon heating to application temperature, the material must not produce fumes which are toxic or injurious to persons or property.

2.2.3.6 Daylight Directional Reflectance

Directional reflectance of white and yellow paint (without glass beads) in accordance with ASTM E1347: White 84 percent Yellow 55 percent.

2.2.3.7 Laboratory Drying Time

The epoxy pavement marking material must have a maximum no-pick-up time of 30 minutes when tested in accordance with ASTM D711.

2.2.3.8 Curing

The epoxy material must be capable of fully curing under a constant surface temperature of 45 Degrees F or above.

2.2.3.9 Adhesion to Concrete

The catalyzed epoxy pavement marking material must have a high degree of adhesion to the specified concrete surface (100 percent concrete failure) when tested according to ASTM D7234. The concrete substrate must have a minimum compressive strength of 4,000 psi. Condition prepared specimens at a temperature of 75 plus or minus 2 Degrees F for a minimum of 24 hours and a maximum of 72 hours prior to performance of the test.

2.2.3.10 Hardness

Epoxy pavement marking materials must have a Shore D Hardness between 75 and 100 when tested in accordance with ASTM D2240. Cure the samples at 75 plus or minus 2 Degrees F for a minimum of 72 hours and a maximum of 96 hours prior to performing the tests.

2.2.3.11 Abrasion Resistance

The wear index for a catalyzed sample must not exceed 82 when tested in accordance with ASTM D4060 using a 1000 gram load, CS-17 wheels and a test duration of 1000 cycles. Run the test on cured samples of material which have been applied at a film thickness of 15 plus or minus 0.5 mils to code S-16 stainless steel plates. Cure the samples at 75 plus or minus 2 Degrees F for a minimum of 48 hours prior to performing the tests.

2.2.3.12 Tensile Strength

Epoxy pavement marking materials must have a tensile strength of at least 6,000 psi when tested in accordance with ASTM D638. Cast the Type IV specimens in a suitable mold and pull at the rate of 1/4 inch per minute using a suitable dynamic testing machine. Cure the samples at 75 plus or minus 2 Degrees F for a minimum of 12 hours and a maximum of 48 hours prior to performing the tests.

2.2.3.13 Compressive Strength

Catalyzed epoxy pavement marking materials must have a compressive strength of at least 12,000 psi when tested in accordance with ASTM D695. Condition the cast sample at 75 plus or minus 2 Degrees F for a minimum of 12 hours and a maximum of 48 hours prior to performing the tests. The rate of compression of these samples must not exceed 1/4 inch per minute.

2.2.4 Preformed Tape

Provide adherent reflectorized strip preformed tape in accordance with ASTM D4505 Retroreflectivity Level II, Class 1, 2 or 3, Skid Resistance Level B.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Testing for Moisture

Test the pavement surface for moisture before beginning pavement marking after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Remedial Project Manager or authorized representative.

Employ the "plastic wrap method" to test the pavement for moisture as follows: Cover the pavement with a 12 inch by 12 inch section of clear plastic wrap and seal the edges with tape. After 15 minutes, examine the plastic wrap for any visible moisture accumulation inside the plastic. Do not begin marking operations until the test can be performed with no visible moisture accumulation inside the plastic wrap. Re-test surfaces when work has been stopped due to rain.

3.1.2 Surface Preparation Demonstration

Prior to surface preparation, demonstrate the proposed procedures and equipment. Prepare areas large enough to determine cleanliness, adhesion of remaining coating and rate of cleaning. .

3.1.3 Test Stripe Demonstration

Prior to paint application, demonstrate test stripe application within the work area using the proposed materials and equipment. Apply separate test stripes in each of the line widths and configurations required herein using the proposed equipment. Make the test stripes long enough to determine the proper speed and operating pressures for the vehicle(s) and machinery, but not less than 50 feet long.

3.1.4 Application Rate Demonstration

During the Test Stripe Demonstration, demonstrate compliance with the application rates specified herein. Document the equipment speed and operating pressures required to meet the specified rates in each configuration of the equipment and provide a copy of the documentation to the Remedial Project Manager prior to proceeding with the work.

3.1.5 Level of Performance Demonstration

The Remedial Project Manager's representative will be present at the application demonstrations to observe the results obtained and to validate the operating parameters of the vehicle(s) and equipment. If accepted by the Remedial Project Manager's representative, the test stripe is the measure of performance required for this project. Do not proceed with the work until the demonstration results are satisfactory to the Remedial Project Manager's representative.

3.2 EXTERIOR SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required.

a. For Portland Cement Concrete pavement, grinding, light shot blasting, or light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting on most pavements, to either remove existing coatings, or for surface preparation.

3.2.1 Early Painting of Rigid Pavements

Pretreat rigid pavements that require early painting with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride. Apply the solution to the areas to be marked.

3.2.2 Early Painting of Asphalt Pavements

For asphalt pavement systems requiring painting application at less than 30 days, apply the paint and beads at half the normal application rate, followed by a second application at the normal rate after 30 days.

3.3 APPLICATION

Apply pavement markings to dry pavements only.

3.3.1 Paint

Apply paint with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, painting operations

must cease until the cause of the slow drying is determined and corrected.

3.3.1.1 Waterborne Paint

3.3.1.1.1 Roads

Apply paint at a rate of 105 plus or minus 5 square feet per gallon. Apply FS TT-B-1325 Type I (Gradation A) beads at a rate of 7 plus or minus 0.5 pounds of glass spheres per gallon.

3.3.1.2 Methacrylate Paint

Apply paint evenly to the pavement surface at a maximum rate of 45 square feet per gallon. Apply glass spheres conforming to FS TT-B-1325 uniformly to the wet paint on airfield pavement. Use either Type I (Gradation A), Type III, or Type IV (Gradation A or B) beads. Apply Type I (Gradation A) beads at a minimum rate of 15 pounds of glass spheres per gallon. Apply Type III beads at a minimum rate of 20 pounds of glass spheres per gallon. Apply Type IV (Gradation A or B) beads at a minimum rate of 16 pounds of glass spheres per gallon.

3.3.2 Preformed Tape

The pavement surface and ambient air temperature must be a minimum of 60 degrees F and rising. Place the preformed markings in accordance with the manufacturer's written instructions.

3.3.3 Cleanup and Waste Disposal

Keep the worksite clean and free of debris and waste from the removal and application operations. Dispose of debris at approved sites.

3.4 FIELD QUALITY CONTROL

3.4.1 Sampling and Testing

As soon as the paint materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch.. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved.

3.4.2 Material Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. Provide test results substantiating conformance to the specified requirements with each certificate of compliance.

3.4.3 Dimensional Tolerances

Apply all markings in the standard dimensions provide in the drawings. New markings may deviate a maximum of 10 percent larger than the standard dimension. The maximum deviation allowed when painting over an old marking is up to 20 percent larger than the standard dimensions.

-- End of Section --

To be updated with Rev 11/21

SECTION 32 31 13

CHAIN LINK FENCES AND GATES
11/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A90/A90M	(2013; R 2018) Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(2013) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C94/C94M	(2018) Standard Specification for Ready-Mixed Concrete
ASTM F567	(2014a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2014) Standard Specification for Fence Fittings
ASTM F883	(2013) Padlocks
ASTM F1043	(2018) Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191	(Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)

FS RR-F-191/1	(Rev F) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)
FS RR-F-191/2	(Rev E) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)
FS RR-F-191/3	(Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
FS RR-F-191/4	(Rev F) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly; G

Location of Gate, Corner, End, and Pull Posts; G

Gate Assembly; G

Gate Hardware and Accessories; G

Erection/Installation Drawings; G

SD-03 Product Data

Fence Assembly; G

Gate Assembly; G

Gate Hardware and Accessories; G

Zinc Coating; G

PVC Coating; G

Aluminum Alloy Coating; G

Fabric; G

Stretcher Bars; G

Concrete; G

SD-04 Samples

Fabric; G

Posts; G

Braces; G

Line Posts; G

Sleeves; G

Top Rail; G

Bottom Rail; G

Tension Wire; G

Stretcher Bars; G

Gate Posts; G

Gate Hardware and Accessories; G

Padlocks; G

Wire Ties; G

SD-07 Certificates

Certificates of Compliance

SD-08 Manufacturer's Instructions

Fence Assembly

Gate Assembly

Hardware Assembly

Accessories

SD-11 Closeout Submittals

Recycled Material Content

1.3 QUALITY CONTROL

1.3.1 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

a. Zinc coating

b. Fabric

c. Stretcher bars

d. Gate hardware and accessories

e. Concrete

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F626.

Submit reports of listing chain-link fencing and accessories regarding weight in ounces for zinc coating, thickness of PVC coating, and chemical composition and thickness of aluminum alloy coating.

Submit manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

2.2 COMPONENTS

2.2.1 Fabric

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

FS RR-F-191/1; Type I, zinc-coated steel, 9 gage. Mesh size, 2 inches. Provide selvage knuckled at both selvages. Height of fabric, as indicated.

Provide fabric consisting of No. 9-gage wires woven into a 2 inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, with 2.0 ounces per square foot zinc galvanizing.

Provide one-piece fabric widths for fence heights up to 12 feet.

2.2.1.1 Top and Bottom Selvages

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and up to 60 inches high.

2.2.2 Posts , Rails and Braces

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade B. End, corner, and pull posts; Class 1, steel pipe, Grade B. Braces and rails; Class 1, steel pipe, Grade B, in minimum sizes listed in FS RR-F-191/3 for each class and grade. Steel pipe, Class 1, Grade B meeting the following performance criteria when subjected to salt spray testing in accordance with ASTM B117:

a. Exterior 1,000 hours with maximum 5 percent red rust.

2.2.3 Line Posts

Minimum acceptable line posts are as follows:

Up to 6 feet high:

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6 feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.2.4 End, Corner, and Pull Posts

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6 feet high:

Grade B: 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

2.2.5 Sleeves

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1 inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.2.6 Top Rail

Provide top rails with a minimum of 1.660 inches O.D. pipe rails.Grade B weighing 1.82 pounds per linear foot. Provide expansion couplings 6 inches long at each joint in top rails.

2.2.7 Center Rails Between Line Posts

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails, Grade B weighing 1.82 pounds per linear foot.

2.2.8 Bottom Rail

Provide bottom rail conforming to minimum sizes specified in FS RR-F-191/3 for each class and grade unless members are to be oversized.

2.2.9 Post-Brace Assembly

Provide bracing consisting of 1.660 inches O.D. pipe and 3/8 inch adjustable truss rods and turnbuckles.

2.2.10 Stretcher Bars

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM F626.

2.2.11 Stretcher Bar Bands

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.2.12 Post Tops

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.2.13 Gate Posts

Provide a gate post for supporting each gate leaf as follows:

Over 6 feet wide and up to 13 feet wide:

2.875 inch O.D. pipe

Over 13-feet and up to 18-feet wide:

Provide 6.625 inch O.D. pipe weighing 18.97 pounds per linear foot.

2.2.14 Gates

FS RR-F-191/2; Type I, single swing II, double swing. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, . Provide gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade, except that steel pipe frames are a minimum of 1.90 inches o.d., 0.120 inches minimum wall thickness , 0.940 lb/ft of length. Gate fabric, is as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, is galvanized Provide fork type gate latches. Provide intermediate members as necessary for gate leaves more than 8 feet wide, to provide rigid construction, free from sag or twist. Provide truss rods or intermediate braces for gate leaves less than 8 feet wide. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

For gate leaves up to 6 feet high or 6 feet wide, provide perimeter gate frames of 1.66 inch O.D. pipe Grade B weighing 1.82 pounds per linear foot.

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade B weighing 2.28 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8 inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.2.15 Gate Hardware and Accessories

Provide gate hardware and accessories that conforms to ASTM A116 and ASTM F626, and be as specified:

Provide forged steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

2.2.16 Miscellaneous Hardware

Provide miscellaneous hot-dip galvanized hardware as required.

2.2.17 Wire Ties

Provide 9-gage galvanized steel wire for tying fabric to line posts,spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.2.18 Padlocks

Provide padlocks conforming to ASTM F883, with chain.

2.3 MATERIALS

2.3.1 Zinc Coating

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

a. Pipe: FS RR-F-191/3 Class 1 Grade B in accordance with ASTM F1043.

b. Hardware and accessories: ASTM A153/A153M, Table 1

c. Surface: ASTM F1043

d. External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3.2 Tension Wire

Provide galvanized, coiled spring wire, No. 7-gage. Provide zinc coating that weighs not less than 2.0 ounces per square foot.

2.3.3 Concrete

Provide concrete conforming to ASTM C94/C94M, and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.3.4 Grout

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

PART 3 EXECUTION

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Provide complete installation conforming to ASTM F567.

3.1 PREPARATION

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.1.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing for a distance of one three feet inside; and one three feet outside the fence. Establish a graded, compacted fence line prior to fencing installation.

3.2 INSTALLATION

3.2.1 Security

Install new chain link fencing, remove existing fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with Remedial Project Manager and cognizant Security Officer.

3.2.2 Fence Installation

Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.2.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts.

Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Submit drawings showing location of gate, corner, end, and pull posts.

3.2.2.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.2.3 Excavation

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3 inches below the bottoms of the posts. Set bottom of each post not less than 36 inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Uniformly spread soil from excavations adjacent to the fence line or on areas of Government property, as directed.

When solid rock is encountered near the surface, drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.2.4 Setting Posts

Remove loose and foreign materials from holes and moisten the soil prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts in concrete construction until concrete has set.

3.2.4.1 Earth

Provide concrete bases of dimensions indicated on the manufactures installation drawings. Compact concrete to eliminate voids, and finish to a dome shape.

3.2.4.2 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and two diagonal tension rods.

a. Tolerances

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.2.5 Concrete Strength

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.2.6 Top Rails

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.2.7 Brace Assembly

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.2.8 Tension Wire Installation

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.2.9 Fabric Installation

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2 inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.2.10 Stretcher Bar Installation

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.2.11 Gate Installation

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.2.12 Tie Wires

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.2.13 Fasteners

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.2.14 Accessories Installation

3.2.14.1 Post Caps

Install post caps as recommended by the manufacturer.

3.2.14.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.2.15 Grounding

Ground fencing as indicated on drawings.

Ground all fences crossed by overhead power lines in excess of 600 volts, and all electrical equipment attached to the fence. Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations can not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by power lines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Provide ground conductor consisting of No. 6 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms.

3.3 CLOSEOUT ACTIVITIES

Remove waste fencing materials and other debris from the work site.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

-- End of Section --

SECTION 32 92 19

SEEDING
08/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C602	(2019) Agricultural Liming Materials
ASTM D4972	(2018) Standard Test Methods for pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 10 00 Site Clearing and 31 23 00.00 20 Excavation and Fill, applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wood Cellulose Fiber Mulch

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil Composition Tests (reports and recommendations).

SD-07 Certificates

State Certification and Approval for Seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizerand Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-approved seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Engineer.

2.1.2 Planting Dates

Refer to NYSDEC seeding requirements for planting dates.

2.1.3 Seed Mixture by Weight

Refer to NYSDEC seeding requirements for seed mixtures.

Proportion seed mixtures by weight.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph COMPOSITION. When available topsoil must be existing surface soil stripped and stockpiled on-site in accordance with Section 31 10 00 Site Clearing.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph COMPOSITION. Additional topsoil must be furnished by the Contractor.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH must be tested in accordance with ASTM D4972. Topsoil must be free of sticks, stones, roots, and other debris and objectionable materials. Other components must conform to the following limits:

Silt	7 to 17 percent
Clay	4 to 12 percent
Sand	70 to 82 percent
pH	5.5 to 7.0

Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C602.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Sand

Clean and free of materials harmful to plants.

2.3.6 Perlite

Horticultural grade.

2.3.7 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.7.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.7.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.8 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 80 percent, calcium 18 percent, sulfur 14 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.9 Calcined Clay

Calcined clay must be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent must pass a No. 8 sieve; a minimum 99 percent must be retained on a No. 60 sieve; and material passing a No. 100 sieve must not exceed 2 percent. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer.

2.5 MULCH

Mulch must be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw must contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay must be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent post-consumer content) or wood-based (100 percent total recovered content) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water must be approved by Remedial Project Manager and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material must conform to the following:

2.7.1 Erosion Control Blanket

70 percent agricultural straw/30 percent coconut fiber matrix stitched with a degradable nettings, designed to degrade within 18 months.

2.7.2 Erosion Control Fabric

Fabric must be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper.

Filler paper strips must have a minimum life of 6 months.

2.7.3 Erosion Control Net

Net must be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately one inch square.

2.7.4 Hydrophilic Colloids

Hydrophilic colloids must be physiologically harmless to plant and animal life without phytotoxic agents. Colloids must be naturally occurring, silicate powder based, and must form a water insoluble membrane after curing. Colloids must resist mold growth.

2.7.5 Erosion Control Material Anchors

Erosion control anchors must be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation prior to planting (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of off-site topsoil or existing soil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Engineer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Remedial Project Manager stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method must be broadcasted and drop seeding.

3.2.2.1 Broadcast and Drop Seeding

Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch must be spread uniformly at the rate of 2 tons per acre. Mulch must be spread by hand, blower-type mulch spreader, or other approved method. Mulching must be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch must not be bunched or clumped. Sunlight must not be completely excluded from penetrating to the ground surface. All areas installed with seed must be mulched on the same day as the seeding. Mulch must be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor must be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Engineer.

3.2.6 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

To be updated to Rev 08/24

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING
02/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B1.20.3	(1976; R 2013) Dryseal Pipe Threads (Inch)
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B18.2.2	(2015) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.5.2.1M	(2006; R 2011) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2010) Metric Round Head Square Neck Bolts

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2010; Addenda 2011) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C509	(2015) Resilient-Seated Gate Valves for

	Water Supply Service
AWWA C515	(2015) Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C605	(2014) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C655	(2009) Field Dechlorination
AWWA C800	(2014) Underground Service Line Valves and Fittings
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
AWWA C909	(2016) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger
AWWA M9	(2008; Errata 2013) Manual: Concrete Pressure Pipe
AWWA M11	(2016) Steel Pipe: A Guide for Design and Installation
AWWA M23	(2002; 2nd Ed) Manual: PVC Pipe - Design and Installation
AWWA M55	(2006) PE Pipe - Design and Installation

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B61	(2015) Standard Specification for Steam or Valve Bronze Castings
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	(2016) Standard Specification for Seamless

	Copper Water Tube
ASTM C94/C94M	(2018) Standard Specification for Ready-Mixed Concrete
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2774	(2012) Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F402	(2005; R 2012) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F1483	(2017) Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe
ASTM F2164	(2018) Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(10th Edition) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2016; ERTA 2016) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NSF INTERNATIONAL (NSF)

NSF 372	(2016) Drinking Water System Components - Lead Content
NSF/ANSI 14	(2019) Plastics Piping System Components and Related Materials
NSF/ANSI 61	(2019) Drinking Water System Components - Health Effects

UNDERWRITERS LABORATORIES (UL)

UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service

1.2 DEFINITIONS

1.2.1 Water Transmission Mains

Water transmission mains include water piping having diameters greater than 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.2 Water Mains

Water mains include water piping having diameters 4 through 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.3 Water Service Lines

Water service lines include water piping from a water main to a building service at a point approximately 5 feet from building or the point indicated on the drawings, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.4 Additional Definitions

For additional definitions refer to the definitions in the applicable referenced standard.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Connections; G

SD-03 Product Data

Pipe, Fittings, Joints and Couplings; G

Ball And Socket Joint; G

Valves; G

Valve Boxes; G

Corporation Stops; G

Disinfection Procedures; G

SD-06 Test Reports

Bacteriological Samples; G

Post-Construction Fusion Report; G

Hydrostatic Sewer Test

Leakage Test

Hydrostatic Test

SD-07 Certificates

Pipe, Fittings, Joints and Couplings

Shop-Applied Lining and Coating

Lining

Lining for Fittings

Valves

Fusion Technician Qualifications; G

SD-08 Manufacturer's Instructions

PVC Piping

Concrete Pressure Pipe

Prestressed Concrete Pressure Pipe

Reinforced Concrete Cylinder Pipe

PVC Piping For Service Lines

Copper Pipe For Service Lines

1.4 QUALITY CONTROL

1.4.1 Regulatory Requirements

Comply with NSF/ANSI 14 or NSF/ANSI 61 and NSF 372 for materials for potable water systems; comply with lead content requirements for "lead-free" plumbing as defined by the U.S. Safe Drinking Water Act effective January 2014. Provide materials bearing the seal of the National Sanitation Foundation (NSF) for potable water service.

Comply with NFPA 24 for materials, installation, and testing of fire main piping and components.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, fire hydrants, and other accessories free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, fire hydrants, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place other material, hooks, or pipe inside a pipe or fitting after the coating has been applied. Inspect the pipe for defects before installation. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging. Replace defective material without additional expense to the Government. Store rubber gaskets, not immediately installed, under cover or out of direct sunlight.

Handle PVC and PVCO pipe, fittings, and accessories in accordance with AWWA C605. Handle PE pipe, fittings, and accessories in accordance with AWWA M55.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all materials in accordance with AWWA C800 and as indicated herein. Provide valves and fittings with pressure ratings equivalent to the pressure ratings of the pipe.

2.1.1 Pipe, Fittings, Joints And Couplings

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning

gaskets with submittal for joints and couplings.

2.1.1.1 Plastic Piping

2.1.1.1.1 PVC and PVCO Piping

2.1.1.1.1.1 PVC Piping

AWWA C900 plain end or gasket bell end pipe meeting or exceeding ASTM D1784 cell class 12454, with a minimum Pressure Class 150 (DR27.5) with ductile iron outside diameter (DIOD).

2.1.1.1.1.2 PVCO Piping

AWWA C909, ASTM F1483 plain end or gasket bell end pipe meeting or exceeding ASTM D1784 cell class 12454, Pressure Class 165 PVCO pressure pipe, with ductile iron outside diameter (DIOD).

2.1.1.1.1.3 Fittings for PVC and PVCO Pipe

Gray iron or ductile iron fittings, AWWA C110/A21.10 with special fittings in accordance with Appendix B or AWWA C153/A21.53, with cement-mortar lining for fittings, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends are to conform to the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design compatible for use with PVC pipe as specified.

2.1.1.1.1.4 Joints and Jointing Material for PVC and PVCO Piping

a. Push-on joints: Use jointing material in accordance with ASTM D3139 and AWWA C111/A21.11 between pipes, pipes and metal fittings, valves, and other accessories or compression-type joints/mechanical joints. Provide each joint connection with an elastomeric gasket compatible for the bell or coupling used. Gaskets for push-on joints for pipe, ASTM F477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints.

b. Mechanical Joint: Use mechanically coupled joints having a sleeve-type mechanical coupling, as specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS, as an optional jointing method for plain-end PVC pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling as specified for compression-type joints in ASTM D3139. Provide jointing material in accordance with AWWA C111/A21.11 between pipe and sleeve-type mechanical couplings.

2.1.1.1.2 PVC Piping for Service Lines

2.1.1.1.2.1 Pipe and Fittings

Provide ASTM D1784 cell class 12454 pipe and fittings of the same PVC material.

a. ASTM D1785, Schedule 40 with ASTM D2466 Schedule 40 or ASTM D2467 Schedule 80 fittings.

b. ASTM D2241 pipe and fittings with SDR as necessary to provide 150 psi

minimum pressure rating with ASTM D2466 Schedule 40 or ASTM D2467 Schedule 80 fittings.

2.1.1.1.2.2 Joints and Connections

Fittings may be joined by the solvent-cement method or threading.

2.1.1.1.2.3 Solvent Joining

Provide solvent joints in accordance with ASTM D2855.

2.1.1.2 Copper Pipe For Service Lines

2.1.1.2.1 Copper Tubing and Associated Fittings

Provide ASTM B88, Type K copper tubing. Provide AWWA C800 fittings. AWWA C800 includes ASME B1.20.3, ASME B1.20.1, ASME B16.18 solder-type joint fittings.

2.1.2 Valves

2.1.2.1 Water Service Valves

2.1.2.1.1 Gate Valves Smaller than 3 Inch in Size on Buried Piping

Gate valves smaller than 3 inch size on Buried Piping MSS SP-80, Class 150, solid wedge, nonrising stem, with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.

2.1.2.1.2 Gate Valves Smaller Than 3 Inch Size in Valve Pits

MSS SP-80, Class 150, solid wedge, inside screw, rising stem. Provide valves with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.

2.1.2.1.3 Check Valves Smaller than 2 Inch in Size

Provide check valves with a minimum working pressure of 150 psi or as indicated with a clear waterway equal to the full nominal diameter of the valve. Valves open to permit flow when inlet pressure is greater than the discharge pressure, and close tightly to prevent return flow when discharge pressure exceeds inlet pressure. Cast the size of the valve, working pressure, manufacturer's name, initials, or trademark on the body of each valve.

Provide valves for screwed fittings, made of lead-free bronze and in conformance with MSS SP-80, Class 150, Types 3 and 4 compatible for the application.

2.1.3 Disinfection

Chlorinating materials are to conform to: Chlorine, Liquid: AWWA B301; Hypochlorite, Calcium and Sodium: AWWA B300.

2.2 ACCESSORIES

2.2.1 Pipe Restraint

2.2.1.1 Thrust Blocks

Use ASTM C94/C94M concrete having a minimum compressive strength of 2,500 psi at 28 days.

2.2.1.2 Precast Thrust Blocks

Provide precast concrete thrust blocks.

2.2.1.3 Joint Restraint

Provide restrained joints in accordance with NFPA 24, Chapter 10

Provide mechanical joint restraint, restraint devices with gripper wedges incorporated into a follower gland and specifically designed for the pipe material and meeting the requirements of AWWA C110/A21.10, or metal harness fabricated by the pipe manufacturer.

2.2.2 Tapping Sleeves

Provide cast gray, ductile, malleable iron or stainless steel, split-sleeve type tapping sleeves of the sizes indicated for connection to existing main with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Utilize similar metals for bolts, nuts, and washers to minimize the possibility of galvanic corrosion. Provide dielectric gaskets where dissimilar metals adjoin. Provide a tapping sleeve assembly with a maximum working pressure of 150 psi. Provide bolts with square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, utilize an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 50 foot-pound.

2.2.3 Sleeve-Type Mechanical Couplings

Use couplings to join plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling consists of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. Provide true circular middle ring and the follower rings sections free from irregularities, flat spots, and surface defects; provide for confinement and compression of the gaskets. Use gaskets for resistance to set after installation and to meet the requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Provide track-head type bolts ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Shape bolt holes in follower rings to hold fast to the necks of the bolts used. Do not use mechanically coupled joints using a sleeve-type mechanical coupling as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Provide a tight flexible joint with mechanical couplings under

reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Match coupling strength to that of the adjoining pipeline.

2.2.4 Insulating Joints

Provide a rubber-gasketed insulating joint or dielectric coupling between pipe of dissimilar metals which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.5 Dielectric Fittings

Install dielectric fittings between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains to prevent metal-to-metal contact of dissimilar metallic piping elements and compatible with the indicated working pressure.

2.2.6 Tracer Wire for Nonmetallic Piping

Provide a continuous bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length over each separate run of nonmetallic pipe.

2.2.7 Water Service Line Appurtenances

2.2.7.1 Corporation Stops

Ground key type; lead-free bronze, ASTM B61 or ASTM B62; compatible with the working pressure of the system and solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.7.2 Curb or Service Stops

Ground key, round way, inverted key type; made of lead-free bronze, ASTM B61or ASTM B62; and compatible with the working pressure of the system. Provide compatible ends for connection to the service piping. Cast an arrow into body of the curb or service stop indicating direction of flow.

2.2.7.3 Service Clamps

Provide single or double flattened strap type service clamps used for repairing damaged cast-iron, steel or PVC pipe with a pressure rating not less than that of the pipe being repaired. Provide clamps with a galvanized malleable-iron body with cadmium plated straps and nuts and a rubber gasket cemented to the body.

2.2.7.4 Goosenecks

Manufacture goosenecks from Type K copper tubing; provide joint ends for goosenecks compatible with connecting to corporation stop and service line.

2.2.7.5 Curb Boxes

Provide a curb box for each curb or service stop manufactured from cast

iron, size capable of containing the stop where it is used. Provide a round head. Cast the word "WATER" on the lid. Factory coat the box with a heavy coat of bituminous paint.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Connections to Existing System

Perform all connections to the existing water system in the presence of the Remedial Project Manager's representative.

3.1.2 Operation of Existing Valves

Do not operate valves within or directly connected to the existing water system unless expressly directed to do so by the Engineer.

3.1.3 Earthwork

Perform earthwork operations in accordance with 31 23 00.00 20 EXCAVATION AND FILL.

3.2 INSTALLATION

Install all materials in accordance with the applicable reference standard, manufacturers instructions and as indicated herein.

3.2.1 Piping

3.2.1.1 General Requirements

Install pipe, fittings, joints and couplings in accordance with the applicable referenced standard, the manufacturer's instructions and as specified herein.

3.2.1.1.1 Termination of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building, unless otherwise indicated.

Do not lay water lines in the same trench with gas lines, fuel lines, electric wiring, or any other utility. Do not install copper tubing in the same trench with ferrous piping materials. Where nonferrous metallic pipe (i.e., copper tubing) crosses any ferrous piping, provide a minimum vertical separation of 12 inches between pipes.

3.2.1.1.2 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Under no circumstances is it permissible to drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe cleanly, squarely, and accurately to the length established at the site and work into place without springing or forcing. Replace a pipe or fitting that does not allow sufficient space for installation of jointing material. Blocking or wedging between bells and spigots is not permitted. Lay bell-and-spigot pipe with the bell end pointing in the

direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at the design elevation and grade. Secure firm, uniform support. Wood support blocking is not permitted. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports for fastening work into place. Make provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been assembled. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Provide a minimum of 4 feet depth of cover over top of pipe.

3.2.1.1.3 Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.2.1.1.4 Connections to Existing Water Lines

Make connections to existing water lines after coordination with the facility and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped and as indicated, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.2.1.1.5 Sewer Manholes

No water piping is to pass through or come in contact with any part of a sewer manhole.

3.2.1.1.6 Water Piping Parallel With Sewer Piping

Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer than 10 feet, horizontally, from any sewer line.

a. Normal Conditions: Lay water piping at least 10 feet horizontally from sewer or sewer manhole whenever possible. Measure the distance from outside edge to outside edge of pipe or outside edge of manhole. When local conditions prevent horizontal separation install water piping in a separate trench with the bottom of the water piping at least 18 inches above the top of the sewer piping.

b. Unusual Conditions: When local conditions prevent vertical separation, construct sewer piping of AWWA compliant ductile iron water piping and perform hydrostatic sewer test, without leakage, prior to backfilling. When local conditions prevent vertical separation, test the sewer manhole in place to ensure watertight construction.

3.2.1.1.7 Water Piping Crossing Sewer Piping

a. Normal Conditions: Provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping in cases where water piping crosses above sewer piping.

b. Unusual Conditions: When local conditions prevent a vertical

separation described above, construct sewer piping passing over or under water piping of AWWA compliant ductile iron water piping and perform hydrostatic sewer test, without leakage, prior to backfilling. Construct sewer crossing with a minimum 20 feet length of the AWWA compliant ductile iron water piping, centered at the point of the crossing so that joints are equidistant and as far as possible from the water piping. Protect water piping passing under sewer piping by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on or damage to the water piping.

3.2.1.1.8 Penetrations

Provide ductile-iron or Schedule 40 steel wall sleeves for pipe passing through walls of valve pits and structures. Fill annular space between walls and sleeves with rich cement mortar. Fill annular space between pipe and sleeves with mastic.

3.2.1.1.9 Flanged Pipe

Only install flanged pipe aboveground or with the flanges in valve pits.

3.2.1.2 Metallic Piping for Service Lines

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

3.2.1.2.1 Screwed Joints

Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only or with PTFE Tape, for use with threaded pipe. Threads are to be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

3.2.1.2.2 Joints for Copper Tubing

Cut copper tubing with square ends; remove fins and burrs. Replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B32, 95-5 tin-antimony or Grade Sn96 solder. Use solder and flux containing less than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

3.2.1.2.3 Flanged Joints

Make flanged joints up tight, avoid undue strain on flanges, valves, fittings, and accessories.

3.2.1.3 Plastic Service Piping

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of ASTM D2774, unless

otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F402.

3.2.1.3.1 Jointing

Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.3.2 Plastic Pipe Connections to Appurtenances

Connect plastic service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.4 Water Service Piping

3.2.1.4.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the points indicated; close such water service lines with plugs or caps.

3.2.1.4.2 Water Service Line Connections to Water Mains

Connect water service lines to the main by a corporation stop and gooseneck and install a service stop below the frostline as indicated. Connect water service lines to steel water mains in accordance with the recommendations of the steel water main pipe manufacturer and with the recommendations for special and valve connections and other appurtenances in AWWA M11, Chapter 13, "Supplementary Design Data and Details."

3.2.2 Disinfection

Disinfection of systems supplying non-potable water is not required.

3.2.3 Flushing

Perform bacteriological tests prior to flushing. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, the residual chlorine content of the distribution system, or acceptable for domestic use. Use AWWA C655 neutralizing chemicals.

3.2.4 Pipe Restraint

3.2.4.1 Concrete Thrust Blocks

Install concrete thrust blocks where indicated.

3.2.4.2 Restrained Joints

Install restrained joints in accordance with the manufacturer's instructions where indicated.

3.2.5 Valves

3.2.5.1 Gate Valves

Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509 or AWWA C515, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509 or AWWA C515. Install gate valves on PVC and PVCO water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.5.2 Check Valves

Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation. Make and assemble joints to check valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.5.3 Air Release, Air/Vacuum, and Combination Air Valves

Install pressure vacuum assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to the requirements of plumbing and health department and authorities having jurisdiction. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.2.6 Blowoff Valve Assemblies

Install blowoff valve assemblies as indicated on the drawings or in accordance with the manufactures recommendations. Install discharge fitting on the end of riser pipe to direct the flow of water so as to minimize damage to surrounding areas.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

Notify the Remedial Project Manager a minimum of five days in advance of hydrostatic testing. Coordinate the proposed method for disposal of waste water from hydrostatic testing. Perform field tests, and provide labor, equipment, and incidentals required for testing. Provide documentation that all items of work have been constructed in accordance with the Contract documents.

3.3.1.1 Hydrostatic Test

Test the water system in accordance with the applicable AWWA standard specified below. Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints is not to exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other methods. Test PVC and PVCO plastic water systems made with PVC pipe in accordance with the requirements of AWWA C605 for pressure and leakage tests. The amount of leakage on pipelines made of PVC water main

pipe is not to exceed the amounts given in AWWA C605, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test concrete water mains in accordance with the recommendations in AWWA M9, "Hydrostatic Testing and Disinfection of Mains." The amount of leakage on concrete pipelines is not to exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline. Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints is not to exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. To stop leakage, repair welded joints only by welding. Test water service lines in accordance with requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, flanged joints, and screwed joints. Do not backfill utility trench or begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 7 days after placing of the concrete.

3.3.1.2 Leakage Test

For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

For PE perform leak testing in accordance with ASTM F2164.

3.3.1.3 Bacteriological Testing

Perform bacteriological tests in accordance with AWWA C651. Analyze samples by a certified laboratory, and submit the results of the bacteriological samples.

3.3.1.4 Backflow Preventer Tests

After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the FCCCHR Manual Standards.

3.3.1.5 Special Testing Requirements for Fire Service

Test water mains and water service lines providing fire service or water and fire service in accordance with NFPA 24. The additional water added to the system must not exceed the limits given in NFPA 24

3.3.1.6 Tracer Wire Continuity Test

Test tracer wire for continuity after service connections have been completed and prior to final pavement or restoration. Verify that tracer wire is locatable with electronic utility locating equipment. Repair breaks or separations and re-test for continuity.

3.4 SYSTEM STARTUP

Water mains and appurtenances must be completely installed, disinfected, flushed, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Obtain approval by the Remedial Project Manager prior to the new water piping being placed into service.

3.5 CLEANUP

Upon completion of the installation of water lines and appurtenances, remove all debris and surplus materials resulting from the work.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERAGE
05/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C972	(2000; R 2011) Compression-Recovery of Tape Sealant
ASTM C1644	(2006; R 2017) Standard Specification for Resilient Connectors Between Reinforced Concrete On-Site Wastewater Tanks and Pipes
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D624	(2000; R 2020) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D2321	(2018) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2412	(2011) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and

	Fittings
ASTM F1417	(2011a; R 2019) Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor's License; G

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Gravity Pipe

SD-06 Test Reports

Precast Concrete Sewer Manhole Test; G

SD-07 Certificates

Gaskets

Pre-Installation Inspection Request; G

Post-Installation Inspection; G

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Verify installing Contractor's License is current and state certified or state registered.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Check upon arrival; identify and segregate as to types, functions, and

sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe in accordance with the manufacturer's recommendation and discard those materials if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Sanitary Sewer Gravity Pipeline

Provide laterals inch lines of polyvinyl chloride (PVC) plastic pipe. Provide building connections 6 inch lines of polyvinyl chloride (PVC) plastic pipe. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

2.2 MATERIALS

Provide materials conforming to the respective specifications and other requirements specified below. Submit manufacturer's product specification,standard drawings or catalog cuts.

2.2.1 Gravity Pipe

2.2.1.1 PVC Gravity Sewer Piping

2.2.1.1.1 PVC Gravity Pipe and Fittings

ASTM D3034, SDR 35, or ASTM F949 with ends suitable for elastomeric gasket joints.

2.2.1.1.2 PVC Gravity Joints and Jointing Material

Provide joints conforming to ASTM D3212. Gaskets are to conform to ASTM F477.

2.2.2 Gaskets and Connectors

Provide gaskets for joints between manhole sections conforming to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole are to conform to ASTM C1644.

2.2.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal is an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" are to be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal is to be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit is to consist of a top and bottom section and have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic is to be a non-hardening butyl rubber sealant and seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections are to cover up to two more adjusting rings. Properties and values are listed in the following table:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals				
Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tensile, psi	ASTM D412	1840	2195	--
Elongation, percent	ASTM D412	553	295	350
Tear Resistance, ppi	ASTM D624 (Die B)	280	160	--
Rebound, percent, 5 minutes	ASTM C972 (mod.)	--	--	11
Rebound, percent, 2 hours	ASTM C972	--	--	12

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Installation Drawings

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

3.2 INSTALLATION

Backfill after inspection by the Engineer. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all

times and follow these instructions unless directed otherwise by the Engineer.

3.2.1 Connections to Existing Lines

Obtain approval from the Remedial Project Manager before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.2.2 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.2.2.1 Location

Terminate the work covered by this section at a point approximately 5 feet from the building. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. When these separation distances can not be met, contact the Remedial Project Manager for direction.

3.2.2.1.1 Sanitary Piping Installation Parallel with Water Line

3.2.2.1.1.1 Normal Conditions

Install sanitary piping or manholes at least 10 feet horizontally from a water line whenever possible. Measure the distance from edge-to-edge.

3.2.2.1.1.2 Unusual Conditions

When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

a. The top (crown) of the sanitary piping is to be at least 18 inches below the bottom (invert) of the water main.

b. Where this vertical separation cannot be obtained, construct the sanitary piping with AWWA-approved ductile iron water pipe pressure and conduct a hydrostatic sewer testwithout leakage prior to backfilling.

c. The sewer manhole is to be of watertight construction and tested in place.

3.2.2.1.2 Installation of Sanitary Piping Crossing a Water Line

3.2.2.1.2.1 Normal Conditions

Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

3.2.2.1.2.2 Unusual Conditions

When local conditions prevent a vertical separation described above, use the following construction:

a. Construct sanitary piping passing over or under water lines with AWWA-approved ductile iron water pressure piping and conduct a hydrostatic sewer testwithout leakage prior to backfilling.

b. Protect sanitary piping passing over water lines by providing:

(1) A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

(2) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

(3) That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints are equidistant and as far as possible from the water line.

3.2.2.1.3 Sanitary Sewer Manholes

No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.2.2.2 Earthwork

Perform earthwork operations in accordance with 31 23 00.00 20 EXCAVATION AND FILL.

3.2.2.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Construct branch connections by use of regular fittings or solvent cemented saddles as approved. Provide saddles for PVC pipe conforming to Table 4 of ASTM D3034.

3.2.3 Special Requirements3.2.3.1 Installation of PVC Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.3.2 Installation of Dual Wall and Triple Wall Polypropylene

Install pipe in accordance with "General Requirements for installation of Pipelines" of this section, with the polypropylene pipe manufacturer's

recommendations, and with the requirements of ASTM D2321 for laying and joining pipe and fittings. Place a minimum of 6 inches of Class 1 or Class 2 backfill over the crown of the pipe with minimum 90 percent compaction.

3.2.4 Miscellaneous Construction and Installation

3.2.4.1 Connecting to Existing Manholes

Connect pipe to existing manholes such that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Center the connection on the manhole. Holes for the new pipe are be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that will cause the least damage to the walls.

3.2.5 Installations of Wye Branches

Install wye branches in an existing sewer using a method which does not damage the integrity of the existing sewer. Do not cutinto piping for connections except when approved by the Engineer. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, support on a concrete cradle as directed by the Engineer. Provide and install concrete required because of conditions resulting from faulty construction methods or negligence without any additional cost to the Government. Do not damage the existing sewer when installing wye branches in an existing sewer.

3.3 FIELD QUALITY CONTROL

The Engineer will conduct field inspections and witness field tests specified in this section. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.3.1 Tests

Perform field tests and provide labor, equipment, and incidentals required for testing.

3.3.1.1 Hydrostatic Sewer Test

When unusual conflicts are encountered between sanitary sewer and waterlines a hydrostatic pressure sewer test will be performed in accordance with the applicable AWWA standard for the piping material or AWWA C600.

3.3.1.2 Leakage Tests for Nonpressure Lines

Test lines for leakage by low-pressure air tests. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

3.3.1.2.1 Low-Pressure Air Tests

3.3.1.2.1.1 PVC Pipelines

Test PVC pipe in accordance with UBPPA UNI-B-6. The allowable pressure drop is located in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.3.1.2.1.2 Dual Wall and Triple Wall Polypropylene

Test polypropylene pipe in accordance with ASTM F1417 or UBPPA UNI-B-6. The allowable pressure drop is located in ASTM F1417 or UBPPA UNI-B-6 depending on the chosen test procedure. Make calculations in accordance with the Appendix to ASTM F1417 or UBPPA UNI-B-6 depending on the chosen test procedure.

3.3.1.3 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D2412. Deflection of pipe in the installed pipeline under external loads is not to exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

3.3.2 Inspection

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; the light must show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.3.2.1 Pre-Installation Inspection

Prior to connecting the new service, perform pre-installation inspection after trenching and layout is complete. Submit pre-installation inspection request for field support at least 14 days in advance. The Installation's Utilities Field Support personnel will perform the pre-installation inspection.

3.3.2.2 Post-Installation Inspection

Perform a post-installation inspection after connection has been made and before the connection is buried. Submit post-installation inspection request for field support at least 14 days in advance. The Installation's Utilities Field Support personnel will perform the post-connection inspection. -- End of Section --

SECTION 33 31 23.00 10

SANITARY SEWER FORCE MAIN PIPING
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2015) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2011) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C200	(2012) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C207	(2018) Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)
AWWA C210	(2007) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C500	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C508	(2017) Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50-mm Through 1,200-mm) NPS

ASTM INTERNATIONAL (ASTM)

ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2657	(2007; R 2015) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D3139	(1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM D4161	(2014) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA TRD	(2016) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Disposal of Waste Water

Final Test Report

1.3 DELIVERY, STORAGE, AND HANDLING

Do not damage pipe, fittings and accessories, and pipe coatings during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 JOINTS

2.1.1 PE Piping

2.1.1.1 Heat Fusion Joints

ASTM D2657.

2.1.1.2 Flanged Joints

ASME B16.1 or AWWA C207.

2.1.1.3 Mechanical Joints

ASME B16.1.

2.1.2 Polypropylene Piping

Heat Fusion Joints: ASTM D2657.

2.1.3 PVC Piping

Provide centering rings or stops to ensure couplings used with plain end pipe are centered on the joint.

2.1.3.1 Screw Joint Fittings

ASTM D2464, Schedule 80

2.1.3.2 Push-On Joint Fittings

ASTM D3139, with ASTM F477gaskets

2.1.3.3 Solvent Cement

ASTM D2564

2.1.4 PVCO Pipe

Provide joints conforming to ASTM D3139 and elastomeric gaskets conforming to ASTM F477.

2.1.5 Ductile Iron Piping

2.1.5.1 Push-on Joints

AWWA C111/A21.11.

2.1.5.2 Mechanical Joints

AWWA C111/A21.11 as modified by AWWA C151/A21.51.

2.1.5.3 Flanged Joints

AWWA C115/A21.15.

2.1.6 Steel Piping

2.1.6.1 Push-on Joints

AWWA C200.

2.1.6.2 Mechanical Joints

AWWA C200.

2.1.6.3 Flanged Joints

AWWA C207.

2.1.7 RPMP Piping

Provide bell and spigot gasket coupling joints utilizing an elastomeric gasket in accordance with ASTM D4161 and ASTM F477.

2.2 VALVES

2.2.1 Gate Valves

Provide gate valves 3 inches and larger in compliance with AWWA C500. Provide non-rising stem (NRS) valves for buried service, 2 inch square nut operated with joints applicable to the pipe or installation. Furnish buried valves with extension stems comprising socket, extension stem and operating nut, and of an appropriate length to bring operating nut to within 6 inches of grade. Provide one 4 foot "T" handle valve wrench for each quantity of 6 buried valves. Provide outside screw and yoke (OS&Y), handwheel operated with flange ends for gate valves that are exposed or installed inside unless otherwise indicated. Cast an arrow and the word "OPEN" on all gate valve operating nuts and handwheels in raised letters to indicate the direction of opening. Equip gate valves 14 inches and larger with gearing to reduce operating effort. Equip gate valves 14 inches and larger, installed in horizontal lines in horizontal position with stems horizontal, with bronze track, roller and scrapers to support the weight of the gate for its full length of travel. Fit gate valves 14 inches and larger installed in vertical pipe lines with stems horizontal with slides to assist the travel of the gate assembly.

2.2.2 Check Valves

Provide iron-bodied check valves that permit free flow of sewage forward and provide a positive check against backflow. Design check valves for a minimum working pressure of 150 psi or as indicated. Directly cast the manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow on the body.

2.2.2.1 Ball Check Valves

Provide iron-bodied ball check valves, with flanged ends, that are of the non-slam type. Provide 125 pound type flanges complying with ASME B16.1 with stainless steel ball unless otherwise specified.

2.2.2.2 Swing Check Valves

Comply with AWWA C508. Provide with iron body, bronze mounted, and flanged ends. Provide 125 pound type flanges, complying with ASME B16.1.

2.2.3 Plug Valves

Provide cast iron valves complying with MSS SP-78 or steel plug valves in compliance with API Spec 6D.

2.2.4 Pinch Valves

Provide double acting, jam-proof type pinch valves with unobstructed streamlined flows and built-in operator. Provide iron bodied valves with a non-rising handwheel. Provide a sleeve of pure gum rubber, neoprene, Buna N or hypalon as required for service. Provide a valve with flanged ends of 125 pound type in compliances with ASME B16.1.

2.2.5 Air Release Valves

Provide air release valves designed to permit release of air from an empty pipe during filling and capable of discharging accumulated air in the line while the line is in operation and under pressure. Attach valves by means of threaded pipe connections. Vent valves to the atmosphere.

2.2.5.1 Manual Air Release Valves

Consisting of an 3 inch gate valve and 3 inch ductile iron pipe and fittings. Install the valve with its line of flow in the horizontal position.

2.2.5.2 Automatic Air Release Valve

Compound lever type capable of withstanding operating pressures of 150 psi, with a 1/2 inch outlet. Provide with iron body and cover of the valve and a stainless steel float. Provide internal parts made entirely of stainless steel or bronze. Provide valve specifically adapted for use with sewage and complete with hose and blow-off valves to permit backflushing without dismantling the valve.

2.3 MISCELLANEOUS MATERIALS

Provide miscellaneous materials in compliance with the following requirements:

2.3.1 Pipe Coatings and Linings

a. Steel, interior: AWWA C203 or AWWA C210.

b. Steel, exterior, buried: AWWA C203.

c. Steel, exterior, exposed: AWWA C210.

2.3.2 Joint Lubricants

Provide joint lubricants as recommended by the pipe manufacturer.

2.3.3 Bolts, Nuts and Glands

AWWA C111/A21.11.

2.3.4 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.3.5 Joint Tape

ASTM D3308.

2.3.6 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

PART 3 EXECUTION

3.1 INSTALLATION

Install pipe, pipe fittings, and appurtenances at the locations indicated. Perform excavation, trenching, and backfilling as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.1.1 Cutting

Cut pipe in a neat manner with mechanical cutters. Use wheel cutters where practicable. Grind sharp and rough edges smooth and remove loose material from the pipe before laying.

3.1.2 Laying

Except where otherwise authorized, lay pipe with bells facing the direction of laying. Before lowering and while suspended, inspect the pipe for defects. Reject defective material.

3.1.3 Jointing

3.1.3.1 Joints for PE Pipe

Provide heat fusion joints that comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time. Make flanged and mechanical joints in compliance with the manufacturer's instructions.

3.1.4 Installation of Valves

Prior to installation, clean valves of all foreign matter and inspect for damage and then fully open and close valves to ensure that all parts are properly operating. Install valves with the stem in the vertical position. .

3.1.5 Installation of Valve Vaults

Install valve vaults as indicated.

3.1.6 Thrust Restraint

Provide thrust restraint as specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. Provide plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, with thrust restraint. Securely anchor valves or provide with thrust restraints to prevent

movement. Install thrust restraints made from either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.6.1 Thrust Blocks

Provide concrete thrust blocking of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Place blocking between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, place the base and thrust bearing sides of thrust blocks directly against undisturbed earth. Place the side of thrust blocks not subject to thrust against forms, if applicable. Provide the area of bearing as shown or as directed. Place blocking so that the fitting joints are accessible for repair. Use steel rods and clamps, protected by galvanizing or by coating with bituminous paint, to anchor vertical down bends into gravity thrust blocks.

3.1.6.2 Restrained Joints

For ductile iron pipe, design restrained joints in accordance with DIPRA TRD.

3.1.7 Grout

Provide grout mix for exterior joint protection on concrete pipes of 1 part portland cement, 2 parts sand, and of sufficient liquid consistency to flow into the joint recess beneath the diaper. Provide grout mix for interior joint protection of 1 part portland cement and 1 part sand. Substitute a polyurethane foam loop, impregnated with portland cement, in lieu of grout for exterior joints, if directed.

3.1.8 Bonded Joints

Where indicated, provide a thermally welded metallic bond at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity.

3.2 FIELD QUALITY CONTROL

Perform both a pressure test and a leakage test on all pipelines. Obtain the Remedial Project Manager's Technical Respresentative's approval of the method proposed for disposal of waste water from hydrostatic tests. The Contractor is responsible for all testing. Notify the Remedial Project Manager at least 7 days in advance of equipment tests. Submit the final test report to the Remedial Project Manager within 30 days after the test.

3.2.1 Pressure Test

After installing the pipe, joints, and thrust blocks, wait at least five days before pressure testing. For the pressure test, partially backfill the trench but leave the joints exposed for examination, then fill the pipe with water to expel all air. Subject the pipeline to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least one hour. Open and close each valve several times during the test. Examine the exposed pipe, joints, fitting, and valves for leaks. Stop visible leaks or replace defective pipe, fittings, joints, or valves.

3.2.2 Leakage Test

Conduct the leakage test subsequent to or concurrently with the pressure test. Place the amount of water permitted as leakage for the line in a sealed container attached to the supply side of the test pump. Apply no other source of supply to the pump or line under test. Pump the water into the line by the test pump as required to maintain the specified test pressure as described for a 2 hour period. The test will be considered a failure upon exhaustion of the supply or the inability to maintain the required pressure. PE pipe experiences diametric expansion and pressure elongation during initial testing. Consult the manufacturer prior to testing for special testing considerations. Determine allowable leakage by the following I-P formula:

L = NDP/K Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

At the conclusion of the test, measure the amount of water remaining in the container and record the results in the test report.

Test plastic pressure lines in accordance with the recommendations of AWWA C605.

3.2.3 Retesting

If any deficiencies are revealed during any test, correct such deficiencies and repeat the tests until the results of the tests are within specified allowances, without additional cost to the Government.

-- End of Section --

To be updated with Rev 11/21

SECTION 33 40 00

TREATMENT PLANT DISCHARGE
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A536	(1984; R 2014) Standard Specification for Ductile Iron Castings
ASTM A929/A929M	(2018) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C76	(2019) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C425	(2004; R 2013) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2012; R 2017) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

ASTM C969	(2019) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1103	(2019) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM F1417	(2011a; R 2019) Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Pipe for System Discharge

SD-07 Certificates

Oil Resistant Gasket

Leakage Test

Frame and Cover for Gratings

Post-Installation Inspection Report

SD-08 Manufacturer's Instructions

Placing Pipe

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Remedial Project Manager. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR SYSTEM DISCHARGE

Pipe for system discharge shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class I.

2.2 DRAINAGE STRUCTURES

2.2.1 Headwall

Sections shall be of a precast concrete meeting the requirements of standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3,000 psi concrete. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231/C231M. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated

fiberboard conforming to the physical requirements of ASTM D1752.

2.3.2 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure.

2.3.3 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.O-T6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4 Joints

2.3.4.1 Flexible Watertight Joints

a. Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Remedial Project Manager before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.4.2 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.6 EROSION CONTROL RIP RAP

Provide non-erodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 6 inches.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPES FOR SYSTEM DISCHARGE

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section , 31 23 00.00 20 EXCAVATION AND FILL and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 6 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Engineer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established grade line, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes

Construction shall be of reinforced concrete, plain concrete, or precast reinforced concrete; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of concrete pipe or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 3 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.3 Compaction

3.7.3.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.3.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to

the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.8 FIELD QUALITY CONTROL

3.8.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.8.1.1 Leakage Test

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate, prior to completing backfill. Low pressure air testing for concrete pipes shall conform to ASTM C969. Low pressure air testing for plastic pipe shall conform to ASTM F1417. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Engineer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour.

3.8.2 Inspection

3.8.2.1 Post-Installation Inspection

Visually inspect each segment of concrete pipe for alignment, settlement, joint separations, soil migration through the joint, cracks, buckling, bulging and deflection. An engineer must evaluate all defects to determine if any remediation or repair is required.

3.8.2.1.1 Concrete

Cracks with a width greater than 0.01 inches. An engineer must evaluate all pipes with cracks with a width greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required.

3.8.2.1.2 Post-Installation Inspection Report

The deflection results and final post installation inspection report must include: pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.8.3 Repair Of Defects

3.8.3.1 Leakage Test

When leakage exceeds the maximum amount specified, correct source of excess leakage by replacing damaged pipe and gaskets and retest.

3.8.3.2 Inspection

Replace pipe or repair defects indicated in the Post-Installation Inspection Report.

3.8.3.2.1 Concrete

Replace pipes having cracks with a width greater than 0.1 inches.

3.9 PROTECTION

Protect storm piping and adjacent areas from superimposed and external loads during construction.

3.10 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

-- End of Section --

SECTION 33 61 13.19

VALVES, PIPING, AND EQUIPMENT IN VALVE MANHOLES
02/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA H35.1/35.1M	(2017) American National Standard Alloy and Temper Designation Systems for Aluminum

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B31.1	(2018) Power Piping
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-45	(2003; R 2008) Bypass and Drain Connections
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-80	(2013) Bronze Gate, Globe, Angle and Check Valves

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Support of the Equipment

Piping and Fittings

Valves

SD-10 Operation and Maintenance Data

Valve Manholes and Accessories; G

Data Package 2; G

1.3 QUALITY ASSURANCE

1.3.1 Detail Drawings

Submit detail drawings 30 days after notice to proceed for valve manholes including a complete list of equipment and materials, manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Show on the drawings pipe anchors and guides, and layout and anchorage of equipment and appurtenances in valve manholes, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all materials and equipment delivered and placed in storage from the weather, excessive humidity, and excessive temperature variation; dirt, dust, or other contaminants.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

Equipment items must be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products are not allowed.

2.3 PIPING AND FITTINGS

2.3.1 General Requirements

Provide piping, fittings and piping accessories inside the valve manholes suitable for the working pressure and temperature requirements of the system conforming to ASME B31.1. To the greatest extent possible, match the piping and fittings inside the valve manholes to the piping and fittings located on the outside of the valve manhole. Provide steel piping in valve manholes with joints welded except that joints 3/4 inch and smaller may be threaded.

2.3.2 Fittings

Provide fittings, valves, flanges and unions with the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.3.2.1 Welded Fittings

Provide welded fittings to match connecting pipes with butt welded fittings, conforming to ASME B16.9, and socket welded fittings, conforming to ASME B16.11.

2.4 VALVES

Provide valves that conform to the material, fabrication, and operating requirements of ASME B31.1, unless otherwise specified. Provide valves suitable for the service temperatures and pressures utilized. Valves 3/4 inch and smaller may be bronze where seal welding is not required. Provide valves 6 inches and larger with a 1 inch minimum gate or globe bypass valve sized in conformance with MSS SP-45.

2.4.1 Steel Valves

Provide steel globe, gate, angle, and check valves that conform to the requirements of ASME B16.34 and ASME B31.1 for the service temperatures and pressures utilized. Provide gate valves 2-1/2 inches and smaller with a rising stem. Provide gate valves 3 inches and larger with an outside screw and yoke.

2.4.2 Bronze Valves

2.4.2.1 Globe, Gate, and Angle Valves

Provide bronze globe, gate, and angle valves that conform to MSS SP-80, union bonnet type.

2.4.2.2 Check Valves

Provide bronze check valves that conform to MSS SP-80.

2.4.3 Packing

Provide asbestos free valve packing. Provide die-formed, ring type specifically designated valve stem packing suitable for service temperatures and pressures utilized. Provide polytetrafluoroethylene packing that has a with minimum 50 percent graphite filament. Provide valves 1-1/2 inches and smaller with four or five packing rings and provide valves 2 inches and larger with at least six packing rings. Spiral or continuous packing will not be acceptable. Provide a metal insert having proper clearance around the valve stem at the bottom of the stuffing box and acting as a base for the packing material. Provide one piece construction with provisions for not less than two bolts for packing adjustment, with a liner of noncorrosive material for packing glands.

2.5 CONCRETE VALVE MANHOLES AND ACCESSORIES

2.5.1 Manhole Supported Cover(s)

Install an 5/16 inch thick checker pattern, aluminum solid plate cover that conforms to AA H35.1/35.1M on top of the open grating. Attach the checkered plate to the grating with removable, galvanized steel fasteners.

2.5.2 Concrete Cover

Provide a 6 inches thick cast concrete cover designed to support loads up to 150 psf. 30 inch diameter standard cast iron manhole frame and removable cover.

2.5.3 Ladders

Provide steel valve manhole ladders, with nonslip surfaces, and consisting of uprights with steps or rungs. fabricate ladders with two stringers a minimum 3/8 inch thick and 2-1/2 inches wide, and rungs not be less than 16 inches in width, 3/4 inch diameter, spaced 12 inches apart. Anchor the ladders to the wall by means of steel inserts spaced not more than 6 feet apart vertically, and install to provide at least 6 inches of space between the wall and rungs. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

2.5.4 Pipe Supports

Provide pipe supports in accordance with MSS SP-58. Galvanize all pipe supports, including structural cross support members. Chains, straps, or single point supports are not allowed.

2.6 MISCELLANEOUS METAL

Hot-dip galvanize miscellaneous metal bolted together, shop welded, or assembled in the field, and pipe supports, including structural cross support members and anchors.

2.7 PRECAST CONCRETE VALVE VAULT

Precast Concrete Vaults are to be manufactured by a firm, which has a minimum of 5 years successful experience in fabrication of Precast Concrete units such as those required on this project. Precast Concrete Vaults to be manufactured by Long Island Precast Inc, Old Castle Infrastructure, or Approved equal.

The pre-cast vaults shall be fabricated to meet the structure dimensions as shown on contract drawing. The structure shall be fabricated to include all the wall piping, conduit and cable penetrations as shown on contract drawings. Reinforcing shall meet ASTM C-478 for H20 loading. The pre-cast vault shall be designed to handle medium to heavy loading with a concrete rating of 5000 psi. The minimum 12" structure walls and minimum 10" top slab thickness shall be designed to meet the H20 load requirements. Provide Link seal for wall penetrations as shown on contract drawings. Provide butyl joint sealant and water stop at joints. The precast reinforced structure should have flat top meeting ASTM C-478. The hinged access covers shall be per the details shown on contract drawings with primer required all around. and capable of H20 loading. Pre-cast vault shall be fabricated with provision to connect the air intake and exhaust piping as shown on contract drawings.

Provide standard galvanized steel steps, with nonslip surfaces. The steps shall be 12" installed at 1' O.C. Provide galvanized pipe supports in accordance with MSS SP-58.

The precast manufacturer shall submit shop drawings, structural design calculations performed by a registered PE in state of New York and material certifications to verify all products used in manufacturing meet the design requirements. Production of precast units shall not begin until the design engineer reviews and approves all submittals. Compressive strength test results for the precast units must be supplied prior to their delivery to verify that the strength requirements were met.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Remedial Project Manager of any discrepancy before performing the work.

3.2 SITE WORK

3.2.1 Excavation, Trenching, and Backfilling

Excavate, trench, and backfill the valve manholes as indicated and in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

3.3 PIPING

3.3.1 General

Cut pipe to measurements established at the site and work into place without springing or forcing. Clear all openings and equipment, and avoid cutting or other weakening of structural members to facilitate piping installation. Remove burrs from ends of pipe by reaming. Install to permit free expansion and contraction without damage to joints or hangers and in accordance with ASME B31.1. Do not attach supports, anchors, or stays where either expansion or the weight of the pipe could cause damage to permanent construction. The method of attaching supports must not interfere with the operation of the cathodic protection system.

3.3.2 Welded Joints

Weld all pipe joints for piping in valve manholes. Conform welding to the requirements specified in paragraph WELDING.

3.3.3 Flanged and Threaded Joints

3.3.3.1 Flanged Joints

Construct flanged joints to be faced true, provided with gaskets, and made perfectly square and tight. Use flanged joints only for electrical isolation and in other special cases where connected equipment is available with only flanged joints, or when specifically indicated. Provide electrically isolated flange joints at all connections to or from the heat distribution system and between dissimilar metals.

3.3.3.2 Threaded Joints

Apply graphite or inert filler and oil, graphite compound, or polytetrafluoroethylene tape to the male threads only. Provide unions at all screwed valves, strainers and connections to equipment 3/4 inch and smaller. Use dielectric unions at connections of dissimilar metals in 3/4 inch and smaller piping. When used on High Temperature Water Systems, seal weld threaded joints.

3.3.4 Reducing Fittings

3.3.5 Branch Connections

Branch off top of mains as indicated providing unrestricted circulation, elimination of air pockets, and permitting the complete drainage of the system. Branch connections may be made with either welding tees or forged branch outlet fittings. If branch outlet fittings are used, provide forged fittings no larger than two nominal pipe sizes smaller than the main run. Reinforce branch outlet fittings to withstand external strains and designed to withstand full pipe bursting strength.

3.3.6 Pipe Supports in Valve Manholes

Securely support horizontal and vertical runs of pipe in valve manholes.

3.4 WELDING

Weld pipe in accordance with qualified procedures, using performance qualified welders and welding operators. Procedures and welders must be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. Notify the Remedial Project Manager 24 hours in advance of tests and perform the tests at the work site. The welder or welding operator must apply his assigned symbol near each weld he makes as a permanent record.

3.5 VALVE MANHOLES AND ACCESSORIES

3.5.1 Piping and Equipment in Valve Manholes

Provide easy access in valve manholes without stepping on piping or equipment, and allow sufficient working area for maintenance work. Refer to drawings of piping and equipment in valve manholes for installation and

support details. Install all globe, angle and gate valves with the stems horizontal or above.

Submit Data Package 2 as related to all equipment provided for the project in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Detail in the operation manuals the step-by-step procedures required for equipment startup, operation, and shutdown. Include in the operation manuals the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. List in the maintenance manuals routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Include in the maintenance manuals piping and equipment layout and simplified wiring and control diagrams indicating location of electrical components with terminals designated for wiring, as installed.

3.6 TESTS

Perform tests of piping in the valve manholes as part of the testing of the direct buried conduit system. Iinclude the piping in the valve manhole in these tests and perform in accordance with the system supplier's Approved Brochure or the contract specifications.

-- End of Section --

SECTION 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION
02/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8	(2013) Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B496	(2016) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM C32	(2013; R 2017) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C857	(2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM F512	(2019) Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 400.2	(2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2017; Errata 2017) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2016) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI/NEMA WC 71/ICEA S-96-659	(2014) Standard for Nonshielded Cables

	Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA C119.4	(2011) Electric Connectors - Connectors for Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Conductors Designed for Normal Operation at or Below 93 Degrees C and Copper-to-Copper Conductors Designed for Normal Operation at or Below 100 Degrees C
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6 & 8	(2013) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation
NEMA WC 74/ICEA S-93-639	(2012) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS (SCTE)

ANSI/SCTE 77	(2013) Specification for Underground Enclosure Integrity

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005	(Basic; Notice 2) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

UNDERWRITERS LABORATORIES (UL)

UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 44	(2018) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 94	(2013; Reprint Sep 2017) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018) UL Standard for Safety Wire Connectors
UL 510	(2017) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint Nov 2014) Conduit, Tubing and Cable Fittings
UL 651	(2011; Reprint Nov 2018) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 854	(2020) Standard for Service-Entrance Cables
UL 1072	(2006; Reprint Jun 2013) Medium-Voltage Power Cables
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Medium voltage cable; G

Medium voltage cable joints; G

Medium voltage cable terminations; G

Precast concrete structures; G

Sealing Material

Pulling-In Irons

Manhole frames and covers; G

Handhole frames and covers; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

SD-06 Test Reports

Medium voltage cable qualification and production tests; G

Field Acceptance Checks and Tests; G

Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure; G

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Separate sections by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

SD-07 Certificates

Cable splicer/terminator; G

Cable Installer Qualifications; G

Directional Boring Certificate of Conformance; G

1.5 QUALITY ASSURANCE

1.5.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.5.2 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers. Cable installer must demonstrate experience with a minimum of three medium voltage cable installations. The RPM, FEAD CM or Engineer" reserves the right to require additional proof of competency or to reject the individual and call for an alternate qualified cable installer.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FEAD CM or Engineer" . Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of IEEE C2 and NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory

commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.2 Intermediate Metal Conduit

UL 1242.

2.1.2.1 Intermediate Metal Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.3 Plastic Conduit for Direct Burial and Riser Applications

UL 651 and NEMA TC 2, as indicated.

2.1.4 Plastic Duct for Concrete Encasement

Provide Type EB-35 per UL 651, ASTM F512, and NEMA TC 6 & 8 or Type EPC-40 per UL 651 and NEMA TC 2, as indicated.

2.1.5 Innerduct

Provide corrugated or solid wall polyethylene (PE) or PVC innerducts, or fabric-mesh innerducts, with pullwire. Size as indicated.

2.1.6 Duct Sealant

UL 94, Class HBF. Provide high-expansion urethane foam duct sealant that expands and hardens to form a closed, chemically and water resistant, rigid structure. Sealant must be compatible with common cable and wire jackets and capable of adhering to metals, plastics and concrete. Sealant must be capable of curing in temperature ranges of 35 degrees F to 95 degrees F. Cured sealant must withstand temperature ranges of -20 degrees F to 200 degrees F without loss of function.

2.1.7 Fittings

2.1.7.1 Metal Fittings

UL 514B.

2.1.7.2 PVC Conduit Fittings

UL 514B, UL 651NEMA TC 3.

2.1.7.3 PVC Duct Fittings

NEMA TC 9.

2.1.7.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit must be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and must conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors must be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 12 months prior to date of delivery to the site are not acceptable. Service entrance conductors must conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller must be solid. Conductors No. 8 AWG and larger must be stranded. All conductors must be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, must be 600-volt, Type XHHW or RHW conforming to UL 44. Copper conductors must be annealed copper complying with ASTM B3 and ASTM B8.

2.2.3 Cable Marking

Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Identify each cable by means of a fiber, laminated plastic, or non-ferrous

metal tags in each manhole, handhole, junction box, and each terminal. Each tag must contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors must be color coded. Provide conductor identification within each enclosure where a tap, splice, or termination is made. Conductor identification must be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations must be properly identified. Color must be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals must be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems must be as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Must provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation must not require heat or

flame, or any additional materials such as covering or adhesive. It must be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 MEDIUM VOLTAGE CABLE

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site are not acceptable. Provide single conductor type cables unless otherwise indicated.

2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072. Provide cables manufactured for use in duct applications as indicated. Cable must be rated as indicated with 133 percent insulation level.

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B compact round conductors. Provide soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659 and AEIC CS8.

2.5.4 Shielding

Cables rated for 2 kV and above must have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape or wire shield for each phase.

2.5.5 Neutrals

Neutral conductors must be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.2.5.6 Jackets

Provide cables with a PVC jacket.

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, must be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations must be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation.

Terminations must be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator must be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination must not require heat or flame for installation. Termination kit must contain all necessary materials (except for the lugs). Termination must be designed for installation in low or highly contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator must consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Termination must be designed for installation in low or highly contaminated indoor or outdoor locations.

2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints must be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint must be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 Heat-Shrinkable Joint

Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.

2.7.2 Cold-Shrink Rubber-Type Joint

Joint must be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket must be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice must be packaged three splices per kit, including complete installation instructions.

2.8 TELECOMMUNICATIONS CABLING

Provide telecommunications cabling in accordance with Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.9 TAPE

2.9.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.9.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

2.9.3 Fireproofing Tape

Provide tape composed of a flexible, conformable, unsupported intumescent elastomer. Tape must be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, adhesive-free, and must not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.10 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Provide solid copper ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.11.2 Grounding Conductors

Stranded-bare copper conductors must conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors must conform to ASTM B1 for sizes No. 8 and smaller. Insulated conductors must be of the same material as phase conductors and green color-coded, except that conductors must be rated no more than 600 volts. Aluminum is not acceptable.

2.12 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts must be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.13 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C857 and ASTM C478. Top, walls, and bottom must consist of reinforced concrete. Walls and bottom must be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers must fit the frames without undue play. Form steel and

iron to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, must be adequate to accommodate the cable.

2.13.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.13.2 Precast Concrete Structures, Risers and Tops

Precast concrete underground structures may be provided in lieu of cast-in-place subject to the requirements specified below. Precast units must be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.13.2.1 General

Precast concrete structures must have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures must have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction must be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work must have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures must be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.13.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

a. Angle of Internal Friction (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 0.33

d. Ground Water Level = 3 feet below ground elevation

e. Vertical design loads must include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads must consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load must be for H20 highway loading per AASHTO HB-17.

f. Horizontal design loads must include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of

installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, must be considered, along with a pulling-in iron design load of 6000 pounds.

g. Each structural component must be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

h. Design must also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.13.2.3 Construction

Structure top, bottom, and wall must be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances are not permitted. Provide quantity, size, and location of duct bank entrance windows as directed, and cast completely open by the precaster. Size of windows must exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows must be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.13.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to ASTM C990. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.13.3 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.13.4 Handhole Frames and Covers

Frames and covers of steel must be welded by qualified welders in accordance with standard commercial practice. Steel covers must be rolled-steel floor plate having an approved antislip surface. Hinges must be of stainless steel with bronze hinge pin , 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and must be for full surface application by fillet welding. Hinges must have nonremovable pins and five knuckles. The surfaces of plates under hinges must be true after the removal of raised antislip surface, by grinding or other approved method.

2.13.5 Brick for Manhole Collar

Provide sewer and manhole brick conforming to ASTM C32, Grade MS.

2.13.6 Composite/Fiberglass Handholes and Covers

ANSI/SCTE 77. Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass with a design load (Tier rating) appropriate for or greater than the intended use. All covers are required to have the Tier level rating embossed on the surface and this rating must not exceed the design load of the box.

2.14 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms must be zinc-coated after fabrication.

2.14.1 Cable Rack Stanchions

The wall bracket or stanchion must be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, or 4 inches by approximately 1 inch glass-reinforced nylon with recessed bolt mounting holes, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms must be spaced at 8 inch intervals.

2.14.2 Rack Arms

Cable rack arms must be steel or malleable iron or glass reinforced nylon and must be of the removable type. Rack arm length must be a minimum of 8 inches and a maximum of 12 inches.

2.14.3 Insulators

Insulators for metal rack arms must be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.15 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags must be polyethylene. Do not provide handwritten letters. The first position on the power cable tag must denote the voltage. The second through sixth positions on the tag must identify the circuit. The next to last position must denote the phase of the circuit and include the Greek "phi" symbol. The last position must denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.15.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties must have a minimum loop tensile strength of 175 pounds. The cable tags must have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols must not fall off or change

positions regardless of the cable tags' orientation.

2.16 LOW VOLTAGE ABOVE GROUND TERMINATION PEDESTAL

Provide copolymer polypropylene, low voltage above ground termination pedestal manufactured through an injection molding process. Pedestals must resist fertilizers, salt air environments and ultra-violet radiation. Pedestal top must be imprinted with a "WARNING" and "ELECTRIC" identification. Pedestal must contain four lay-in six port connectors. Connectors must be NEMA C119.4, Class "A", dual rated for aluminum or copper, and capable of terminating conductors ranging from 10 AWG to 500 kcmil. Protect each connector with a clear, hard lexan (plastic) cover. Pedestal must be provided with rust-free material and stainless steel hardware. Pedestal must be lockable.

2.17 SOURCE QUALITY CONTROL

2.17.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer must test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing tape per manufacturer's instructions. The arc and fireproofing tape must withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode must be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc must be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly must be tested at three unrelated points. Start time for tests must be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time must be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape must indicate that the test has been performed and passed by the manufacturer.

2.17.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 and CALPUC G.O.128 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Inspect each cable reel for correct storage positions, signs of physical damage, and broken end seals prior to installation. If end seal is broken,

remove moisture from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. Prepare a checklist of significant requirements and submit along with the manufacturer's instructions in accordance with SUBMITTALS. Install cable strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors must be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide PVC, Type EPC-40 conduit from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors must have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound must conform to ASTM C309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures must fit the frames without undue play. Steel and iron must be formed to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Manhole locations, as indicated, are approximate. Coordinate exact manhole locations with other utilities and finished grading and paving.

3.5.1 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation must additionally conform to the manufacturer's instructions.

3.5.2 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices must be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons must be a minimum of 6 inches from the edge of the sump, and in the walls the irons must be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron must not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner must be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons must have a clear projection into the structure of approximately 4 inches and must be designed to withstand a minimum pulling-in load of 6000 pounds. Irons must be hot-dipped galvanized after fabrication.

3.5.3 Cable Racks, Arms and Insulators

Cable racks, arms and insulators must be sufficient to accommodate the cables. Space racks in power manholes not more than 3 feet apart, and provide each manhole wall with a minimum of two racks. Space racks in signal manholes not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks must be as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel must be steel of the same length as "vertical rack channel;" channel insert must be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert must have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.4 Field Painting

Cast-iron frames and covers not buried in concrete or masonry must be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.6 DIRECT BURIAL CABLE SYSTEM

Cables must be buried directly in the earth below the frostline to the requirements of NFPA 70 and IEEE C2, whichever is more stringent.

3.6.1 Trenching

Excavate trenches for direct-burial cables to provide a minimum cable cover of 24 inches below finished grade for power conductors operated at 600 volts or less, and 30 inches below finished grade for over 600 volts in accordance with IEEE C2. When rock is encountered, remove to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Bottoms of trenches must be smooth and free of stones and sharp objects. Where materials in bottoms of trenches are other than sand, a 75 mm 3 inch layer of sand must be laid first and compacted to approximate densities of surrounding firm soil. Trenches must be not less than 8 inches wide, and must be in straight lines between cable markers. Cable plows must not be used. Bends in trenches must have a radius consistent with the cable manufacturer's published minimum cable bending radius for the cable installed.

3.6.2 Cable Installation

Unreel cables along the sides of or in trenches and carefully place on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position is not permitted, except as required to pull cables through conduits under paving or railroad tracks.

Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart, except that communication cable must be separated from power cable by a minimum distance of 12 inches.

Where direct-burial cables cross under roads or other paving exceeding5 feet in width, such cables must be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables must be installed in reinforced concrete-encased ducts. Ducts must extend at least 5 feet beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables must be centered in duct entrances, and a waterproof nonhardening mastic compound must be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Prevent damage to conduit coatings by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase must be restored to their original condition. Where cable is placed in duct(e.g. under paved areas, roads, or railroads), slope ducts to drain.

3.6.3 Splicing

Provide cables in one piece without splices between connections except

where the distance exceeds the lengths in which cables are manufactured. Where splices are required, install splices only in maintenance manholes/handholes or cabinets/pedestals.

3.6.4 Bends

Bends in cables must have an inner radius not less than those specified in NFPA 70 for the type of cable, or manufacturer's recommendation.

3.6.5 Horizontal Slack

Leave approximately 3 feet of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections. Enclose splices in lead-sheathed or armored cables in split-type cast-iron splice boxes; after completion of the connection, fill with insulating filler compound and tightly clamp the box.

3.6.6 Identification Slabs or Markers

Provide a slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways, and over each splice. Identification slabs must be of concrete, approximately 20 inches square by 6 inches thick and must be set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches above ground. Concrete must have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "telephone cable," "splice," or other applicable designation on the top surface of the slab before concrete hardens. Inscribe circuit identification symbols on slabs as indicated. Letters or figures must be approximately 2 inches high and grooves must be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top must include an arrow indicating the side nearest the cable. Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.7 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.7.1 Requirements

Run conduit in straight lines except where a change of direction is necessary. Provide numbers and sizes of ducts as indicated. Provide a 4/0 AWG bare copper grounding conductor above medium-voltage distribution duct banks. Bond bare copper grounding conductor to ground rings (loops) in all manholes and to ground rings (loops) at all equipment slabs (pads). Route grounding conductor into manholes with the duct bank (sleeving is not required). Ducts must have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 3 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Provide ducts with end bells whenever duct lines terminate in structures.

Perform changes in ductbank direction as follows:

a. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable.

b. The minimum manufactured bend radius must be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter.

c. As an exception to the bend radius required above, provide field manufactured longsweep bends having a minimum radius of 25 feet for a change of direction of more than 5 degrees, either horizontally or vertically, using a combination of curved and straight sections. Maximum manufactured curved sections: 30 degrees.

3.7.2 Treatment

Ducts must be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers must be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer must be used whenever an existing duct is connected to a duct of different material or shape. Ducts must be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts must be thoroughly cleaned before being laid. Plastic ducts must be stored on a flat surface and protected from the direct rays of the sun.

3.7.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.7.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, must be zinc-coated, rigid steel, jacked into place. Where ducts are jacked under existing pavement, rigid steel conduit must be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks must be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers.

3.7.5 Multiple Conduits

Separate multiple conduits by a minimum distance of 3 inches, except that light and power conduits must be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly must consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.7.6 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty must be provided with plugs on each end. Plugs must contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.7.7 Conduit and Duct Without Concrete Encasement

Depths to top of the conduit must be not less than 24 inches below finished grade. Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover must be sand compacted as previously specified. The rest of the excavation must be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.7.7.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement must extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Depths to top of the concrete envelope must be not less than 24 inches below finished grade, and under railroad tracks not less than 50 inches below the top of the rails.

3.7.8 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Depths to top of the concrete envelope must be not less than 18 inches below finished grade, except under roads and pavement, concrete envelope must be not less than 24 inches below finished grade, and under railroad tracks not less than 50 inches below the top of the rails. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank must be rectangular in cross-section and must provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring must be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.7.8.1 Connections to Manholes

Duct bank envelopes connecting to underground structures must be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section must be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure must be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.7.8.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7.8.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and extend into the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.

3.7.8.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks. Remove existing cables which constitute interference with the work.

3.7.8.5 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.7.8.6 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.7.9 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.8 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape or wire shield must have a bending radius not less than 12 times the overall

diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.8.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.9 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.9.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.10 CONDUCTORS INSTALLED IN PARALLEL

Conductors must be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.11 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes, handholes, or aboveground termination pedestals.

3.12 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.13 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original

cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods must be as specified elsewhere in this section. Wire must be trained to the sides of the enclosure to prevent interference with the working area.

3.14 CABLE END CAPS

Cable ends must be sealed at all times with coated heat shrinkable end caps. Cables ends must be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps must remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.15 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.15.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.16 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.16.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 12 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.
If the specified ground resistance is not met, an additional ground rod must be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, notify the RPM, FEAD CM or Engineer" immediately.

3.16.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies must be as recommended by the manufacturer. An embossing die code or other standard method must provide visible indication that a connector has been adequately compressed on the ground wire.

3.16.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.16.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.16.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.17 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 23 00.00 20 EXCAVATION AND FILL.

3.17.1 Reconditioning of Surfaces

3.17.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct . Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.17.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists , restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.18 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.18.1 Concrete Slabs (Pads) for Equipment

Unless otherwise indicated, the slab must be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab must be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab must be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade must have 1/2 inch chamfer. Slab must be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.18.2 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals must be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.19 FIELD QUALITY CONTROL

3.19.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.19.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) Visually inspect jacket and insulation condition.

(7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests must be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE 400.2. VLF test frequency must be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages must be as follows:

CABLE RATING AC TEST VOLTAGE for ACCEPTANCE TESTING	
5 kV	10kV rms(peak)
8 kV	13kV rms(peak)
15 kV	20kV rms(peak)
25 kV	31kV rms(peak)
35 kV	44kV rms(peak)

CABLE RATING AC TEST VOLTAGE for MAINTENANCE TESTING	
5 kV	7kV rms(peak)
8 kV	10kV rms(peak)
15 kV	16kV rms(peak)
25 kV	23kV rms(peak)
35 kV	33kV rms(peak)

3.19.1.2 Low Voltage Cables, 600-Volt

Perform tests after installation of cable, splices and terminations and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Verify tightness of accessible bolted electrical connections.

(4) Inspect compression-applied connectors for correct cable match and indentation.

(5) Visually inspect jacket and insulation condition.

(6) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 1000 volts dc for one minute.

(2) Perform continuity tests to insure correct cable connection.

3.19.1.3 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument must be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.19.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the RPM, FEAD CM or Engineer" must be given 5 working days advance notice of the dates and times of checking and testing.

.... -- End of Section --

SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(2016) Optical Fiber Outside Plant Communications Cable; 4th Edition
ICEA S-98-688	(2012) Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements
ICEA S-99-689	(2012) Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C62.61	(1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
TIA-455-78-B	(2002) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation
TIA-455-107	(1999a) FOTP-107 Determination of Component Reflectance or Link/System Return Loss using a Loss Test Set
TIA-472D000	(2007b) Fiber Optic Communications Cable for Outside Plant Use
TIA-492AAAB	(2009a) 50-Um Core Diameter/125-Um Cladding Diameter Class IA Graded-Index Multimode Optical Fibers
TIA-526-7	(2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-526-14	(2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.2	(2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard
TIA-569	(2015d) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-590	(1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-606	(2017c) Administration Standard for the Telecommunications Infrastructure
TIA-607	(2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding

	(Earthing) for Customer Premises
TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-455-204	(2000) Standard for Measurement of Bandwidth on Multimode Fiber
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755	Telecommunications Standards and Specifications for Materials, Equipment and Construction
RUS Bull 345-50	(1979) Trunk Carrier Systems (PE-60)
RUS Bull 345-65	(1985) Shield Bonding Connectors (PE-65)
RUS Bull 345-83	(1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
RUS Bull 1751F-630	(1996) Design of Aerial Plant
RUS Bull 1751F-640	(1995) Design of Buried Plant, Physical Considerations
RUS Bull 1751F-643	(2002) Underground Plant Design
RUS Bull 1751F-815	(1979) Electrical Protection of Outside Plant
RUS Bull 1753F-201	(1997) Acceptance Tests of Telecommunications Plant (PC-4)
RUS Bull 1753F-401	(1995) Splicing Copper and Fiber Optic Cables (PC-2)

UNDERWRITERS LABORATORIES (UL)

UL 83	(2017) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 497	(2001; Reprint Jul 2013) Protectors for Paired Conductor Communication Circuits
UL 510	(2017) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606, and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect - (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use. The telecommunications contractor must coordinate with the NMCI contractor concerning layout and configuration of the EF telecommunications and OSP. The telecommunications contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with the NMCI contractor.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the

following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications Outside Plant; G

Telecommunications Entrance Facility Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G

Cable splices, and connectors; G

Closures; G

Building protector assemblies; G

Protector modules; G

Cross-connect terminal cabinets; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

Outside Plant Test Plan; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Minimum Manufacturer's Qualifications; G

SD-08 Manufacturer's Instructions

Building protector assembly installation; G

Cable tensions; G

Fiber Optic Splices; G

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, and RUS Bull 1751F-643 for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband

cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the RPM, FED CM or Engineer.

Note that only the key personnel approved by the RPM, FED CM or Engineer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The RPM, FED CM or Engineer.

1.6.2.3 Minimum Manufacturer's Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the optical fiber cables, components, and accessories for approval by the RPM, FED CM or Engineer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for RPM, FED CM or Engineer approval. Provide outside plant testing and performance measurement criteria in accordance with TIA-568-C.1 and RUS Bull 1753F-201. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the

2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 3000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the RPM, FED CM or Engineer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the RPM, FED CM or Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 1000 feet length with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include only the required data fieldsin accordance with TIA-606. Include manufacture date of cable with submittal.

b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained 5 pin unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 12 pairs of outside cable. Building protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

Provide in accordance with UL 497 three-electrode gas tube or solid state type 5 pin rated for the application. Provide gas tube protection modules in accordance with RUS Bull 345-83 and shall be maximum duty, A>20kA, B>1000, C>200A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with

ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with UL 497. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

2.3 CLOSURES

2.3.1 Fiber Optic Closures

2.3.1.1 Direct Burial

Provide buried closure suitable to house splice organizer in protective housing into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried environment. Encapsulating compound shall be reenterable and shall not alter chemical stability of the closure.

2.3.1.2 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

2.4 CABLE SPLICES, AND CONNECTORS

2.4.1 Copper Cable Splices

Provide multipair, in-line splices of a moisture resistant, two-wire insulation displacement connector held rigidly in place to assure maximum continuity in accordance with RUS Bull 1753F-401. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.

2.4.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 22 to 26 AWG solid wire with a maximum insulation diameter of 0.065 inch. Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bull 1753F-401.

2.4.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber optic splice by

a splice kit specially designed for the splice.

2.4.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.4.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

2.5 CONDUIT

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 PLASTIC INSULATING TAPE

UL 510.

2.7 WIRE AND CABLE

2.7.1 Fiber Optic Cable

Provide multimode 50/125-um, 0.275 aperture fiber optic cable in accordance with TIA-492AAAB, TIA-472D000, and ICEA S-87-640 including any special requirements made necessary by a specialized design. Provide 12 optical fibers as indicated. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with TIA/EIA-598

2.7.1.1 Strength Members

Provide non-central, metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.7.1.2 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.7.2 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation

meeting the requirements of UL 83.

2.8 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with non-pressurized housings, sized as indicated and shall meet the requirements of RUS Bull 345-50.

2.9 POLES AND HARDWARE

Provide poles and hardware as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

2.10 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be polyethylene and labeled in accordance with TIA-606. Handwritten labeling is unacceptable.

2.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.11 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with TIA-590. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 23 00.00 20, Excavation and Fill.

2.12 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

2.13 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.14 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be

matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.15 TESTS, INSPECTIONS, AND VERIFICATIONS

2.15.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the RPM, FED CM or Engineer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the RPM, FED CM or Engineer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Direct Burial System

Installation shall be in accordance with RUS Bull 1751F-640. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 24 inches below finished grade. Trenches shall be not less than 6 inches wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space laterally at least 3 inches apart. When rock is encountered, remove it to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Do not unreel and pull cables into

the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 23 00.00 20 Excavation and Fill.

3.1.3.1 Cable Placement

a. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than 3 inches of well tamped earth. Do not install circuits for communications under or above traffic signal loops.

b. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.

c. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

d. Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections.

3.1.3.2 Identification Slabs Markers

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 20 inches square by 6 inches thick.

3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 2 inches thick on the floor of the trench before placing the cable or wire. The backfill for at least 4 inches above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 24 inches in depth, a protective cover of concrete shall be used.

3.1.4 Cable Protection

Provide direct burial cable protection in accordance with NFPA 70 and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 6 inches per 12 inches burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40 percent of cross-sectional area, or in concrete encased 4 inches PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 6 inches lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end

caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.5 Underground Duct

Provide underground duct and connections to existing manholes, and existing ducts as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein.

3.1.6 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.7 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.8 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the RPM, FED CM or Engineer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the RPM, FED CM or Engineer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.8.1 Cable Tensions

Obtain from the cable manufacturer and provide to the RPM, FED CM or Engineer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.8.2 Pulling Eyes

Equip cables 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.8.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.9 Cable Splicing

3.1.9.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.9.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices.

3.1.10 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of RUS Bull 1751F-815.

3.1.11 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.11.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.11.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground

shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.11.3 Campus Distributor Grounding

a. Protection assemblies: Mount CD protector assemblies directly in the telecommunications cabinet. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.

b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

3.1.12 Cut-Over

All necessary transfers and cut-overs, shall be accomplished by the telecommunications contractor.

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using thermal ink transfer process.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with TIA-606. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the RPM, FED CM or Engineer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the RPM, FED CM or Engineer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the RPM, FED CM or Engineer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the RPM, FED CM or Engineer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written RPM, FED CM or Engineer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758:

a. Wire map (pin to pin continuity)

b. Continuity to remote end

c. Crossed pairs

d. Reversed pairs

e. Split pairs

f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with TIA/EIA-455 and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 66 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber and TIA-526-14 for multimode fiber. Splice losses shall not exceed 0.3 db.

b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 1310 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-455-46A for multimode fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.

c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with TIA/EIA-455-204.

3.5.3 Soil Density Tests

a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.

-- End of Section --

SECTION 40 60 00

PROCESS CONTROL DESCRIPTION

PART 1. GENERAL

1.1 DESCRIPTION

This Section covers the operating functions of all equipment and controls of the instruments for the Groundwater Treatment Plant (GWTP).

The GWTP consists of various unit processes as listed below and as depicted on Contract Drawings MI601 thru MI621. Control descriptions for these processes are described herein (Para 3.2 thru 3.21).

A. Extraction/recovery Systems (MI602 THRU MI604)

B. Equalization Tank / Filter Feed System (MI605)

C. Multi-media Filtration (MMF) System (MI606)

D. Bag Filter System (MI606)

E. Ozone Generation System (MI607)

F. Advanced Oxidation Process (AOP) System (MI608)

G. Ozone Destruction System (MI608)

H. Liquid Phase Granular Activated Carbon (LGAC) Feed System (MI609)

I. Liquid Phase Granular Activated Carbon (LGAC)System (MI610)

J. Effluent System (MI612)

K. MMF/LGAC Backwash System (MI611)

L. Backwash Waste / Discharge System (MI621

M. Hypochlorite Feed System (MI613)

N. Caustic Feed System (MI614)

O. Hydrogen Peroxide System (MI615)

P. Building Sump (MI616)

Q. Process Tanks Venting System (MI617)

R. Non potable water system (MI617)

S. Air Compressor System (MI618)

T. Eyewash and Safety Showers System (MI619)

U. Utility Monitoring & Control System (UMCS) and Fire Alarm Panel (FAP) (MI620)

This Section also specifies following requirements:

A. Loss of Power Mode Operation

B. Restart Mode

C. E-Stop Operation

D. Human Machine Interface

E. Trending, Historical Archiving

F. Reporting

G. Web Interface

H. Alarming Software and Configuration

I. Loss of Communication

Operator controls and indications described herein shall be at the Supervisory Control and Data Acquisition (SCADA) System interface to the Programmable Logic Controller (PLC).

All PLC functions described herein refer to the process PLC located in the Operator Control Room.

CONTRACTOR shall be responsible for ensuring that all control loops operate properly and safely, regardless of equipment supplier, vendor, or subcontractor. CONTRACTOR shall coordinate repair or replacement of any faulty process equipment, control equipment, wiring, or other system components.

The Drawings and Specifications are intended to provide minimum process control requirements only. CONTRACTOR is responsible for determining the configuration, design, layout, and details of all control loops.

1.2 DEFINITIONS

A. Soft Controls: Software, or Soft, controls will be programmed controls available to the operator through four Human Machine Interface (HMI) terminals located within the Treatment Facility or two SCADA workstations located in the Operator Control Room.

B. Hard Controls: Hard controls refer to devices such as pushbuttons, hand switches, and potentiometers.

1.3 ABBREVIATIONS:

A. RW- Recovery Well

B. HMI – Human Machine Interface

C. LCS – Local Control Station

D. MCC – Motor Control Center

E. H-O-A – Hand-Off-Auto Selector Switch

F. PC – Personal Computer

G. PI – Proportional / Integral

H. PLC – Programmable Logic Controller

I. VFD - Variable Frequency Drive

J. SCADA – Supervisory Control and Data Acquisition

K. N.O. – Normally Open Contact

L. N.C. – Normally Closed Contact

1.4 SUBMITTALS

A. Reference Specification 40 60 00, Section 1.2 Submittals

B. An interlock list (table) for all non-vendor supplied equipment and instrumentation. The interlock list shall clearly define all interlocks, alarms, and outcomes with regard to process equipment.

PART 2. NOT USED

PART 3. EXECUTION

3.1 GENERAL OPERATING DISCRIPTION

A. Supervisory Control and Data Acquisition (SCADA) System:

a. The purpose of the process control system is to monitor and control a groundwater treatment process consisting of groundwater extraction, treatment, and discharge to outfall basins.

b. The SCADA System shall provide a graphical interface for monitoring, control, and alarming of the system. The SCADA System shall allow for

adjustment of set points and timers as applicable for alarms and control loops, trending of values, and historical archiving of parameter data.

c. Access to the SCADA System will be available to the operator either from all HMIs located within the Treatment Building, SCADA workstations located in the Operator Control Room, or portable HMI at Recovery Wells RW9 and RW-10A.

B. Motors: Unless otherwise noted herein, the following shall be true for all process motor driven devices:

a. Process motors shall be provided with a Hand-Off-Auto (H-O-A) selector switch mounted on the door of its respective Motor Control Center (MCC) compartment. There will be Start/Stop pushbuttons at the motors.

i. In HAND, the motor will operate manually in this mode using Start-Stop pushbuttons.

ii. Any motor utilizing a VFD will be configured to operate at a low speed (Hz) in HAND mode.

b. In OFF, motor operation shall be disabled, and the motor starter shall be de- energized.

c. In AUTO, the motor starter shall be under the control of the PLC. Both Manual and Auto mode will be provided at the HMI

i. In Manual Mode at HMI, equipment will be operated with interlocks or interlocks can be bypassed if required (with a list of active/bypassed interlocks that is operator selectable for each piece of equipment).

ii. In Auto mode at HMI, equipment will run in fully automatic mode with all interlocks in place (bypassing interlocks is not permissible).

d. All process motor starters shall have auxiliary contacts for “run” indication via Ethernet to the PLC. If a motor is called to start and the return input from the auxiliary contact is not made within 5 seconds, a mismatch alarm shall annunciate at the HMI. These Alarms are indicated as YA-xxx in the Alarm List.

e. All process motor driven devices under PLC control shall have a disconnect switch adjacent to the device. This shall interrupt power to the motor and lockout the device. An auxiliary contact shall provide a discrete input signal to the PLC indicating the disconnect switch position.

f. Unless otherwise noted, all process motors shall be furnished with a local control station that includes Start-Stop (S/S) pushbuttons. The Start-Stop pushbuttons shall be wired back to the motor control circuit and can only operate when a given motor's H-O-A switch is the "HAND" position.

C. Setpoints and Settings: All set points, settings and timers shown on the HMI shall be adjustable between +/100% of the initial setting listed. Limits to setting entries shall be refined in the field during startup and configured.

D. For each motor, graphically represent the physical position of its associated H-O-A selector switch. In addition, provide HMI Start/Stop and Auto/Manual buttons for all process pumps/motors. When an H-O-A selector switch is in the "Auto" position, the operator shall have the ability to select Auto/Manual on the HMI. HMI "Manual" allows the operator to Start/Stop the motor from the HMI. In addition, HMI "Manual" operation shall give an operator the ability to bypass certain interlocks if necessary. "Interlock Bypass" mode shall be achieved by giving an operator the ability to mouse click on a pump/motor, which will display its "Interlock List". The operator shall then have the ability to select which Interlocks to Bypass. Anytime a pump/motor has any Interlocks bypassed in the HMI "Manual" state, the HMI shall provide a visual indication of this state. HMI "Auto" allows automatic PLC control of the motor and shall not allow the bypass of any Interlocks.

E. For each valve, provide HMI Open/Close and Auto/Manual buttons. HMI Auto/Manual operation shall be identical to the description for the motors in Part D above.

F. Duplex pumping system: Various systems have two pumps. Generally, one pump is capable of handling the designed flow and the second pump is standby. If one pump fails to operate, a pump fail alarm shall be generated (YA-xxx) and the Operator will be notified to bring the second pump online manually. If necessary, the standby pump can be started manually from the HMI if the H-O-A selector switch is in "Auto" and the HMI selector is set to "Manual".

G. Variable Frequency Drive (VFD): Unless otherwise stated, all VFDs shall operate in proportional- integral (PI) algorithm to modulate the speed of the operating motors to meet and maintain the system setpoint. Operator shall have the capability at one of the two SCADA workstations or any of the HMI's located on the plant floor to monitor and adjust these parameters. All VFDs shall utilize Ethernet for communication with the treatment building PLC and shall be configured to enter a "Faulted" state in the event of Ethernet communication failure. Regardless of operating mode, all VFD's shall be programmed with a "one-shot" in the PLC program to initially start at 15Hz.

H. Mismatch alarms: All command outputs from SCADA, analog or discrete, shall have an associated "Mismatch Alarm." The mismatch alarm shall compare the

desired output (e.g., VFD speed, valve position, run command) to the measured variable (VFD speed, valve position, run status) and, if after an adjustable period of time the measured value is not within 5% of the desired value, annunciate an alarm. Valve Alarms are indicated as ZA-xxx in the Alarm List.

I. If a system shuts down due to a critical alarm and there is no operator present (e.g. - weekend or after normal working hours), the system shall not be restarted until someone is physically present at the site.

J. Out of Range Alarms: For all analog 4-20mA values, provide "Out of Range Alarms" if the signal value drops below 4ma or above 20mA for more than 5 seconds.

K. Trending: All analog values and controller setpoints shall be trended locally on the SCADA/Historian software. All pumps on/Off and valve Open/Close status shall also be trended.

L. Totalizations: Flows with an "FQI" designation (gallons) and motor runtimes (hours) shall be totalized and displayed on the screen. Provide runtime totalizations for all pumps and blowers. Provide "run time" values for each carbon vessel by monitoring valve positions to identify "run" status. Totalization values shall not be resettable.

3.2 GROUNDWATER EXTRACTION / RECOVERY SYSTEM (MI602 THRU MI604)

A. Three extraction wells RW-8, RW-9, and RW-10A, will be installed for the groundwater collection system, as follows:

a. Recovery Well RW-8 located approximately 8 feet to west of the Groundwater Treatment Plant (GWTP). RW-8 is approximately 120-feet below ground surface and is capable of pumping 450 to 650 gallons per minute (gpm).

b. Recovery Well RW-9 located approximately 2,500 feet east of the Groundwater Treatment Plant (GWTP) along Alken Avenue. RW-9 is approximately 120-feet below ground surface and is capable of pumping 450 to 650 gallons per minute (gpm).

c. Recovery Well RW-10A located approximately 4,000 feet east of the Groundwater Treatment Plant (GWTP) just south of N. Pine Street. RW-10A is approximately 120-feet below ground surface and is capable of pumping 600 to 700 gallons per minute (gpm).

B. All recovery wells have a submersible pump and a pressure transducer to indicate well level (LT-8, LT-9 & LT-10A), a pump discharge pressure transmitter (PIT-8, PIT-9 & {PIT-10A), and a valve vault high level switch (LSH-VV8, LSH-VV9 & LSH-VV10A). At RW -9 and RW-10A, a magnetic flow meter (FE/FIT-9 & FE/FIT-10A) monitors the pump flow rate and there is a manual sample point located in valve vault. RW-8 will have a magnetic flowmeter located inside the GWTP.

C. All recovery well pumps are operated in AUTO mode based on respective well level.

D. All piping inside well vault and manholes will be insulated and heat traced. Heat trace is monitored at PLC as failsafe discrete inputs.

E. High level alarms at all valve vaults are monitored at PLC as N.C. discrete inputs. Setpoint = 6” above finished floor.

F. Recovery wells RW-9 and RW-10A Recovery well RW-8 discharge line enter the GWTP thru south side and then manifold into one pipe with RW-8 (east side) before discharging into Equalization Tank T-100. Prior to discharging into Equalization Tank T-100, there is an influent flow meter FIT-100 to measure flow rate and totalized flow (FQ-100) of all wells as the combined “plant inflow”.

G. The treatment plant is designed to treat a maximum flow of 1500 gpm.

H. Analog Control Loops: See Table 1 (as attached) regarding Extraction Wells operating set points.

I. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

   b. Local Operation: Reference Section 3.1 (B) for motor control.

J. Automatic Operation:

   a. Recovery wells shall be allowed to operate when all of the following conditions are satisfied:

      i. EQ Tank level (LIT-100) is less than 16.0’ (EWs-Auto Level), and

      ii. Building sump level is not at high-high water level (LAHH-800 or LAHH-801).

   b. Each well pump will be operated at a constant well level in between respective LCH and LCL. Both flow and well level set points are pre-established based on the groundwater model data.

   c. Each well pump will start at pump on set point level (LCH-XX) and turnoff (LCL-XX) at pump-off set points.

   d. If a flow of less than 0.5 gpm is detected at a flow meter (RW-8, RW-9 or RW-10A) for more than 10 seconds, respective pump will be shut down, and a PUMP FAIL (FAL-XX) alarm will be generated. The

failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

e. If a pump discharge pipe has a heat trace power off at vault for >120 seconds, an alarm (TA-XX) will be generated. However, the pump will continue to operate in HMI "Auto" mode thus avoiding any pipe freezing issue. The alarm can be reset by the Operator once the condition is cleared.

K. Interlocks:

a. All recovery well pumps shall be interlocked (shutdown) and allowed to restart if any of the following non-critical conditions occur:

i. Equalization Tank T-100 High-Level (LAH-100) is ON for >30 seconds. The RW pumps will restart when EQ tank level drops below RWs-Auto OFF level for more than 5 minutes.

ii. The building sump High-High Level (LAH-800) is ON for >60 seconds. All of these pumps will restart when sump level drops to sump Low level for >30 seconds.

b. All recovery well pumps shall be interlocked (shutdown) and not allowed to restart if any of the following critical conditions occur. An operator must be present at the facility anytime a critical plant shutdown condition occurs in order to properly inspect and restart the equipment. <u>Under no circumstances shall any plant shutdown condition be reset remotely.</u>

i. Equalization Tank T-100 High-High Level (LAHH-100 or LAHH-101) is ON for >30 seconds.

ii. The building sump High-High Level (LAHH-800 OR LAHH-801) is ON for >30 seconds.

iii. If treatment building secondary containment High Level (LAH-991 or LAH-992) is ON.

iv. If high water level in any valve vault (LAH-VV8, LAH-VV9 or LAH-VV10A) is on for more than 10 seconds.

v. High level in any outfall basin (LAHH-OFB1, LAHH-OFB2, LAHH-OFB3 and LAHH-OFB4) for more than 60 seconds.

3.3 EQUALIZATION TANK / FILTER FEED SYSTEM (MI605)

A. All recovery wells will discharge groundwater in Equalization Tank T-100. This tank will also receive water from recycle of water from MMF feed pumps P-100A/B, MMF / Cartridge Filters outlet, AOP system outlet and plant effluent during recycle (startup/testing phase) or plant upset conditions.

This tank will have a continuous water level transmitter (LE/LIT-100) and a backup high-high-level switch (LSHH-101).

B. Tank T-100 has a side-mounted mixer (EQM-110) Mixer EQM-110 will have a single speed motor and will run continuously unless Tank T-100 level drops below X'.

C. Two MMF feed pumps (P-100A and P-100B) will be provided with VFDs. These pumps will transfer water from T-100 to MMF vessels. The common pump discharge line will have a slipstream to recycle line for pH and ORP probes (AE-101A & AE-101B) to measure pH, ORP and temperature, a flow meter (FIT-101) to measure MMF feed flow rate, a manual flow control valve (one per pump), and a recycle line back to T-100. Both flow control valves and recycle valve may need to be adjusted at start-up to establish a desired pre-treatment flow rate depending on the collection system flow.

D. One pump is capable of pumping up to 1500 gpm flow. This is based on a maximum estimated plant inflow of 1500 gpm flow. Thus, these pumps will operate as Primary and Standby.

E. Tank T-100 will receive caustic solution (refer to the respective chemical feed systems) based on MMF feed flow pH and oxidation-reduction potential (ORP) readings, respectively. This tank's pH will be maintained at 8.0 and ORP at approximately 300 (settings to be determined [TBD] at start-up). PLC will monitor and control pH and ORP (set points, control, and gain; Operator selectable).

F. MMF Feed Flow pH analyzer (AE-101A) will have low and high pH alarms as AAL-101A and AAH-101A, respectively. These will initially be set at ± 0.2 units of the pH setpoint.

G. MMF Feed Flow ORP analyzer (AE-101A) will have low and high ORP alarms as AAL-101B and AAH-101B, respectively. These will initially be set at ± 50 units of the ORP setpoint.

H. Analog Signal/Control Loops: LIT-100, FIT-101, SIC-100A/B, AIT-101A/B

I. Tank T-100 overflow pipe's bottom elevation is at 11.75' high. Level transmitter (LIT-100) set points are as follows:

   a. Low-Low level Alarm LALL-100 = 1.0'

   b. PUMPS P-100A/B OFF Level LCL-100 = 1.5'

   c. Eq Pump control initial set point = 10.0'

   d. Pumps P-100A/B On Level = 10.5'

   e. RWs-Auto OFF level = >9.0'

f. High level alarm LAH-100 = 15.5′.

g. High-High level alarm LAHH-100 = 16.5′.

J. Backup High-High level alarm LAH-101 is set at 16.5′.

K. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

b. Local Operation: Reference Section 3.1 (B) for motor control.

L. Automatic Operation

a. MMF Feed pumps shall be allowed to operate when all equipment has its respective H-O-A selector switch in the "Auto" position, and all of the following conditions are satisfied:

i. Tank T-100 level is not Low-Low, and

ii. Tank T-400 is not High, and

iii. Caustic (P-910A/B) and hypochlorite (P-920A/B) feed system H-O-A selector switches are in the "Auto" position, and

iv. LGAC feed pumps (P-400A/B) H-O-A selector switches are in the "Auto" position.

b. Normally primary pump (P-100A) starts at PUMP ON level, and VFD varies the speed to maintain T-100 level to an initial set point of "10" feet. This pump's speed can be lowered until the flow at FIT-101 reaches 600 gpm (or 40% of maximum VFD speed). If tank level starts dropping, pump will shut down at its OFF level.

c. The pumps will be manually alternated once per month by the operator. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

d. If a flow of <5 gpm is detected at flow meter FIT-101 for more than 10 seconds, the operating pump will be shut down, respective PUMP FAIL alarm (FAL-101A or 101B) will be generated, and the Operator will be alerted via the HMI to manually switch over and start the standby pump. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

M. Interlocks:

a. Equalization Tank system (P-100A/B, all chemical feed systems, and mixer) shall be interlocked (shut down) as follows:

i. Tank T-100 level is at Low-Low level Alarm LALL-100.

ii. Cartridge Filters CF-240/250 is at High Differential Pressure PDAH-240.

iii. Tank T-400 is at High-High level Alarm LAHH-400 or LAHH-401.

iv. The Equalization Tank/ Filter Feed system will not be allowed to restart until interlock conditions are cleared and alarms are reset by the Operator. Operator must be at the plant to clear the interlock conditions and re-start the plant. The system shall never be restarted remotely.

3.4 MULTI-MEDIA FILTRATION (MMF) SYSTEM (MI606)

A. Three MMFs (MMF-210, MMF-220 and MMF-230) on a skid will be provided. Two MMFs stay in operation while third is in standby mode.

B. A local PLC based control panel operates all the MMFs electric butterfly valves and allows an automatic backwash sequence based on either a high differential pressure, timer, or manual “backwash initiate” input. This panel also generates alarms and interlocks. This panel is monitored by plant PLC and sends signals for enable/disable for backwash cycle via Ethernet link to plant control system.

C. All three MMFs will have automated air operated ON/OFF valves on water inlet (YV-210A, YV-220A and YV-230A), water outlet (YV-210B, YV-220B and YV-230B), backwash inlet (YV-210, YV-220 and YV-230) and backwash water outlet (YV-210C, YV-220C and YV-230C).

D. Each vessel will have a local differential pressure indicator (PDI-210, PDI-220 and PDI-230). These instruments will send high pressure alarms (PDAH-210, PDAH-220 and PDAH-230), initially set at 20 psig, to the local panel. If the pressure drops across a MMF exceeds that set point, that filter goes in backwash mode and standby MMF goes in operation mode. In addition, a pressure transmitter will be installed on MMFs inlet and outlet lines (PIT-210 and PIT-230). All of these instruments send signals to a local control panel. In addition, plant PLC will compute a differential pressure reading (PIT-210 minus PIT-230) and trend and correlate with the operating MMF’s differential pressure.

E. Each MMF can also be operated in in a timer or manual mode, operator selected at the local panel.

F. All automated BFVs will have opened and closed limit switches sending status signals to the local panel. As described above, when MMF control panel sends a command to open or close a valve and the corresponding limit switch input

is not received within 5 seconds, a mismatch alarm will be generated from the PLC. These are indicated as ZA-xxx in the Alarm List.

G. Plant PLC monitors all signals and enables/disable this local control panel. In this mode, a MMF must remain in operation for at least 8 hours.

H. Analog Signals: PIT-210 and PIT-230

I. Manual Operation: MMF can be operated in manual mode for a short period for test purposes only.

J. Automatic Operation:

a. MMF can be operated when the MMF system is in “Auto” state as described below.

i. Any two MMF vessels water inlet valves (YV-210A & YV-210B, YV-220A & YV-220B, YV-230A & YV-230B) are positioned to process water and the other set is closed AND all backwash inlet/outlet automated valves on all MMFs are closed, OR

ii. At least two of the MMFs are available to process water (no high differential pressure alarm or being backwashed).

K. The MMFs are operated as follows:

a. Two MMFs are online while third one is on standby.

b. When the pressure drop across a filter exceeds a preset value (10 to 15) pounds per square inch gauge (psig), it will require backwashing.

c. Backwashing shall be initiated automatically based on one of three 3 modes (operator selectable): timer, pre-determined pressure drops, or total gallons of water treated.

d. One filter can proceed through its backwash cycle while the other two filters are in service. Refer to MMF/LGAC Backwash System for backwash operation details.

i. Thus, when MMF-210 goes in backwash mode, YV-210A and YV-210B are closed; YV-210 and YV-210C are open, thus bringing the standby MMF online automatically.

ii. Similarly, when MMF-220 goes in backwash mode, YV-220A and YV-220B are closed; YV-220 and YV-220C are open, bringing the standby MMF online automatically.

iii. Similarly, when MMF-230 goes in backwash mode, YV-230A and YV-230B are closed; YV-230 and YV-230C are open, bringing the standby MMF online automatically.

e. If a high-pressure alarm (PDAH-210, PDAH-220 or PDAH-230) is detected for >60 seconds, (either in timer mode or total water treated mode), the operating MMF shall be placed in backwash mode and the standby MMF shall be placed in service.

f. If one of the filters has a differential pressure high alarm while the second filter is being backwashed, shutdown P-100A/B. P-100A/B can be restarted when one of the filters is back in service.

g. Reinitiate backwash if backwash fails first time.

h. Trend MMF's pressure drop value as MMF-210-dP, MMF-220-dP and MMF-230-dP (PIT-210 minus PIT-230). Plant operator can then compare them with PDI-210, PDI-220 or PDI-230 readings (local display).

i. Provide selector switches at HMI for the operator to operate or backwash MMF.

L. Interlocks:

a. Refer to MMF system's submittal for related interlocks.

3.5 BAG FILTER SYSTEM (MI606)

A. There will be a duplex cartridge filter system. Only one bag filter stays in operation while second is in standby mode. The Operator will manually switch to the standby filter on a high pressure drop at DPIT-240 (initially set at 20 psi, to be finalized during startup).

3.6 ADVANCED OXIDATION PROCESS (AOP) SYSTEM (MI607 AND MI608)

A. There will be a Vendor supplied AOP reactor(s) sized for 500 – 1000 gpm flow, complete with ozone generation system, ozone injectors, hydrogen peroxide injector, static mixers, gas/liquid separator with ozone destructor automated forward / recycle valves, interconnecting piping, valves, and instrumentation.

B. The ozone generation system consists of an oxygen generator unit, ozone generation unit, water chiller, controls and instrumentation as required by the selected AOP System Vendor.

C. A local PLC based control panel operates the AOP system. This panel also generates alarms and interlocks. This panel is monitored by plant PLC and sends signals for enable/disable for AOP System via Ethernet I/P communications to plant control system. All monitored and alarm signals will be generated during discussions with the selected AOP Vendor.

D. Automated recycle (MOV-350A) and forward (MOV-350B) valves are provided with the AOP system so that no untreated water can be discharged to LGAC units.

a. Normally recycle valve MOV-350A stays closed while forward valve MOV-350B stays open (interlocked so that normally only one of them stays open). It is normal for both valves to be open for a short period of time during valve actuation to avoid dead heading pump P-100A or P-100B.

b. Whenever pump P-100A or 100B starts, the recycle valve (MOV-350A) opens and forward valve (MOV-350B) closes for approximately X minutes (selectable at AOP Control Panel). This is to allow AOP lamps to warm up, flow to establish through the AOP system, and hydrogen peroxide to react with water.

c. Recycle valve MOV-350A is interlocked with Eq. Tank T-100 level – if High-High tank level alarm (LAHH-100 or LAHH-101) exists do not allow recycle valve to open and shut down the Treatment Plant.

E. Automatic Operation:

a. The AOP can be operated when the AOP system is in “Auto” state as per the vendor supplied signal.

b. The AOPs will be controlled by a Vendor-supplied control panel. The treatment plant PLC will have hard-wired communication to both AOP PLCs for monitoring and control. The treatment plant PLC will control remote start/stop, system running, system shutdown, and system warning of the AOPs. In addition, the treatment plant PLC is connected to the AOP units via Ethernet in order to monitor various data and alarms generated within each AOP. Refer to AOP Specification Section 46 30 13 for additional details.

c. Monitor and trend each lamp run time, current, voltage and total wattage.

d. The above information is provided as a general guideline and shall be verified by the selected Vendor.

F. Interlocks:

a. The AOP system is designed for various interlocks within the Vendor-provided PLC software (refer to vendor’s manual). In addition, the AOP system shall be interlocked (shut down) as follows:

b. MMF feed flow is < X gpm, FSL-101 (hard-wired).

c. Hydrogen peroxide feed pump P-930A/B is not running or has a Low Flow alarm (FAL-934)

d. Hydrogen peroxide concentration is low.

e. Refer to AOP Feed system for related interlocks.

3.7 LIQUID PHASE GRANULAR ACTIVATED (LGAC) FEED SYSTEM (MI609)

A. The AOP reactor(s) will discharge treated water into LGAC Feed Tank T-400. This tank will have a continuous water level transmitter (LE/LIT-400) and a backup high-high-level switch (LSHH-401).

B. Two LGAC feed pumps (P-400A and P-400B) will be provided with VFDs. These pumps will transfer water from T-400 to the LGAC vessels. The common pump discharge line will have a flow meter (FIT-400) to measure LGAC feed flow rate, a manual flow control valve (one per pump). Both flow control valves may need to be adjusted at start-up to establish a desired flow rate depending on the feed tank influent flow.

C. One pump is capable of pumping up to 1800 gpm flow. Thus, these pumps will operate as Primary and Standby.

D. Analog Signal/Control Loops: LIT-400, FIT-400, SIC-400A/B

E. Tank T-400 overflow pipe’s bottom elevation is at 18’ high. Level transmitter (LIT-400) set points are as follows:

   a. Low-Low level Alarm LALL-400 = 1.0’

   b. PUMPS P-400A/B OFF Level LCL-400 = 1.5’

   c. LGAC Feed Pump control initial set point = 10.0’

   d. Pumps P-400A/B On Level = 10.5’

   e. High level alarm LAH-400 = 15.5’.

   f. High-High level alarm LAHH-400 = 16.5’.

F. Backup High-High level alarm LAH-401 is set at 16.5’.

G. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

   b. Local Operation: Reference Section 3.1 (B) for motor control.

H. Automatic Operation

   a. LGAC Feed pumps shall be allowed to operate when all equipment has its respective H- O-A selector switch in the “Auto” position and all of the following conditions are satisfied:

      i. Tank T-400 level is not Low-Low, and

      ii. Tank T-500 is not High, and

iii. Outfall Basins 1 thru 5 are not High-High.

b. Normally primary pump (P-400A) starts at PUMP ON level, and VFD varies the speed to maintain T-400 level to an initial set point of "10" feet. This pump's speed can be lowered until the flow at FIT-400 reaches 600 gpm (or 40% of maximum VFD speed). If tank level starts dropping, pump will shut down at its OFF level.

c. The pumps will be manually alternated once per month by the operator. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

d. If a flow of <5 gpm is detected at flow meter FIT-400 for more than 10 seconds, the operating pump will be shut down, respective PUMP FAIL alarm (FAL-400A or 400B) will be generated, and the Operator will be alerted via the HMI to manually switch over and start the standby pump. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

I. Interlocks:

a. LGAC Feed system (P-400A/B) shall be interlocked (shut down) as follows:

i. Tank T-400 level is at Low-Low level Alarm LALL-400.

ii. Tank T-400 is at High-High level Alarm LAHH-400 or LAHH-401.

iii. The LGAC Feed system will not be allowed to restart until interlock conditions are cleared and alarms are reset by the Operator. Operator must be at the plant to clear the interlock conditions and re-start the plant. The system shall never be restarted remotely.

3.8 LIQUID PHASE GRANULAR ACTIVATED (LGAC) CARBON SYSTEM (MI610)

G. Three LGAC filters will be provided.

H. LGAC-410, LGAC-420 and LGAC-430 have several manual operated valves so these can be operated as lead-lag mode based on differential pressure switch (PDSH-400).

I. When a differential pressure across a LGAC exceeds 15 psi, then it is the time to backwash that LGAC for 15 minutes (manual mode). During backwash mode, only one LGAC will stay in operation.

Refer to MMF/LGAC Backwash System for LGAC backwash operation.

3.9 PLANT EFFLUENT SYSTEM (MI610, MI611 & MI612)

A. Treated water from the LGAC system enters T-500. This tank will also serve as the Backwash Supply Tank, refer to MMF/LGAC Backwash System. This tank will have a continuous water level transmitter (LE/LIT-500) and a backup high-high level switch (LSHH-501).

B. A ON/OFF valve MOV-400 on the plant effluent and an ON/OFF valve MOV-400A on plant recycle line will be provided. This recycle line is provided to adjust the treatment system during startup and upset conditions.

C. Treated water from the LGAC system enters effluent piping where manual valves BFV-440A, 440B and BFV-440C are used to divert water to Outfall Basin 1, Basins 2 & 3, and Basins 4 & 5.

D. The water flow rate to each basin is measured through FIT-440A, FIT-440B, and FIT-440C.

E. Exiting the plant, the water will initially be discharged to five Outfall basins, configured as follows:

   a. Outfall Basin #1

   b. MH A-01 (Basins #2 & #3), equipped with High-High level alarms to control potential flooding of the drainage system.

   c. MH B-01 (Basins #4 & #5), equipped with High-High level alarms to control potential flooding of the drainage system.

F. Transmitters LT-OFB1, LT-OFB2, LT-OFB3, and LT-OFB4 monitor the water level in the five basins. Excessive water level in the basin trigger shutdown of the recovery well pumps RW-8, RW-9, and RW-10A.

G. If pH <6.0 or >9.0 is detected at AE-101A/AIT-101 (MMF feed flow) for >120 seconds, an alarm shall be generated (AAL/AAH-101). If this alarm stays on >5 minutes, plant recycle valve MOV-400A will open and effluent valve MOV-400 will close. Once this pH returns to 6.0-9.0 range for >5 minutes, recycle valve MOV-400A will close and effluent valve MOV-400 will open.

3.10 MMF/LGAC BACKWASH SYSTEM (MI611)

A. T-500 is also used to supply backwash water for backwashing the MMF and LGAC vessels. This tank’s maximum operating volume is about 9,950 gallons (below overflow pipe). A maximum of 5,000 gallons of water is needed to backwash one of the LGAC or MMF described under MMF/LGAC Backwash System. Thus, a minimum of 7’of water depth in this tank is needed for the backwash event.

B. To backwash either MMFs or LGACs, two pumps P-500A/B will be provided. Normally one pump will run while the other is a standby spare. These pumps

will receive water from T-500 and pump water through the MMFs or LGACs and discharge into the Backwash Waste Tank T-550.

C. Both MMFs and LGACs will require a backwash step procedure (flow and duration) to be provided by the respective equipment vendor. Flow rate will be set via the operating pump's (P-500A/B) VFD.

D. Only one MMF vessel can be backwashed at a time, and the backwash will depend on water levels in tanks T-500 and T-550. MMF and LGAC systems shall have an interlock prohibiting the simultaneous backwash of a vessel in both systems. This is due to the MMF backwash cycle being an Automatic function while the GAC backwash is manually initiated.

E. Analog Signal/Control Loops: LIT-500, FI-500, SC-500, LIT-550.

F. Tank T-500 overflow pipe's bottom elevation is at 13.5' high. Level transmitter (LIT-500) set points are as follows:

   a. Low-Low level Alarm LALL-500 = 1.0'

   b. Low level Alarm LAL-500 = 1.5'

   c. Pump P-500/A/B OFF Level = 7.0'

   d. Pump On Level = 9.5'

   e. High level alarm LAH-500 = 10.50'.

   f. High-High level alarm LAHH-500 = 11.50'.

G. Backup High-high level alarm switch LSHH-501 is set at 11.5'.

H. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

      i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

   a. Backwash Supply Pumps (P-500A/B) shall be operated when the MMF/LGAC Backwash system is in "Auto" state as described below.

      i. Backwash Waste Tank T-550 level LIT-550 is <2', and

      ii. T-500 level is >7.0' thus allowing sufficient backwash supply water for backwashing any one of the MMF or LGAC vessels.

   b. Only one of the backwash pumps operates at a time.

c. The backwash pump is operated when the MMF or LGAC requires backwash, as discussed previously. Backwash flow and duration will be as per the MMF and LGAC vendor submittals.

d. Provide MMF BW Ready and LGAC BW Ready status at PLC.

e. The Operator will alternate the pumps manually once per month. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

J. Interlocks:

a. Backwash pump shall be interlocked (not allowed to operate) as below:

i. Dirty Backwash Water Tank High-high level Alarm LAHH-550 or LAHH-551.

ii. T-500 level is <6.5’.

K. The LGAC backwash system is expected to be required only periodically (e.g., every three to six months) and will be conducted manually. During the backwash of an LGAC unit, the plant may continue to run, but at a reduced flowrate (e.g., 700 GPM to 1,400 GPM).

L. Pump P-500A or -500B is then used to provide low pressure water to backwash the LGACs. For the pump selected for operation, the corresponding suction and discharge valves should be opened. For example, for P-500A operation, open BFV-500A-1 and BFV-500A-2 and BFV-XXX (LGAC backwash supply valve).

M. During backwash of the selected LGAC, the process flow valves for that unit are first closed to isolate the LGAC from the process water and then the backwash valves are open. For example, for LGAC-410, BFV-400A and -400B are first closed, this isolates the unit from the process flow. Then BFV-400C and BFV-400D are opened. After backwash, the valve positions are reversed, isolating the backwash system first.

N. The backwash cycle normally lasts approximately 15 minutes but can be extended by allowing the Backwash Waste Tank to drain.

O. The Backwash Waste Tank T-550 receives backwash water from the MMF and LGAC units. The tank can handle 4-times the volume of the Backwash Supply Tank and thereby minimize potential overflow of the Backwash Waste Tank.

3.11 BACKWASH WASTE / DISCHARGE SYSTEM(MI621)

A. Backwash Waste Tank T-550 will receive backwash water from the MMFs and LGACs. This tank will have a continuous water level transmitter (LE/LIT-550) and a backup high-high level switch (LSHH-551).

B. Decanted water from T-550 will return to the treatment building sump via automated ball valve MOV-550A, while backwash wastewater is discharge to the local sewer system through automated ball valve MOV-550B. A Parshall flume flow meter FIT-550 monitors the wastewater flow to the sewer system.

C. Tank T-550 overflow pipe's bottom elevation is at 23.75' high. Level transmitter (LIT-550) set points are as follows:

a. Low-Low level Alarm LALL-550 = 0.75'

b. MOV-550A CLOSE Level = XX'

c. MOV-550A OPEN Level = XX'

d. MOV-550B CLOSE Level = XX'

e. MOV-550B OPEN Level = XX'

f. High level Alarm LAH-550 = 22'.

g. High-High level Alarm LAHH-550 = 25'.

D. Backup High-high level alarm switch LSHH-551 is set at 25.5'.

E. Interlocks:

a. MOV-550A shall be interlocked (not allowed to operate) as below:

i. Treatment Building Sump High-High level alarm LAHH-800 or LAHH-801

3.12 CAUSTIC FEED SYSTEM (MI614)

A. The caustic (25% sodium hydroxide) feed system will include a double wall feed tank (T-910) and two metering pumps (P-910 A/B). This pump will supply caustic to tank T-100 via secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-910), a level switch (LSH-911) to detect any leak in secondary containment, and a backup high-level switch (LSH-912). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: LIT-910, SIC-910A/B

F. T-910 is 10.5′ high. Level transmitter (LIT-910) set points are as follows:

a. Low-Low level Alarm LALL-910 = 1.0′

b. Low level Alarm LAL-910 = 1.5′ (PUMP OFF Level)

c. Chemical Order Level Alarm (25%) = 2.5′

d. Pump On Level = Based on process demand

e. Tank Fill Alarm (90%) = 9.0′

f. High-High level alarm LAHH-910 = 9.5′.

G. Backup High level alarm switch LSH-912 is set at 9.5′.

H. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

a. Both metering pumps P-910A/B will be powered from local 115 VAC, 1 phase receptacles and controlled by the PLC via Ethernet I/P communications based on a 4-20 mA signal from pH probe AE-101A located in MMF Feed Pumps discharge piping. There will be a selector switch at PLC panel to operate the desired pump.

b. The caustic feed system shall be in “Auto” state as follows:

i. Leak detection alarm LAH-911 is not on.

ii. PLC receives a signal that P-910 A or B is ready to run (powered).

iii. Mixer EQM-110 is running.

c. The PLC will start/stop the pump and vary pump speed to maintain a pH set point (initially 10.20) in MMF Feed Flow piping. The pump will have a local stroke length adjustment that will be initially set at startup.

J. Interlocks:

a. The Caustic feed system will be interlocked (P-910A/B shutdown) as follows:

i. Pre-treatment pumps P-100A and 100B are not running.

ii. Caustic tank T-910 Low level Alarm LAL-910.

iii. MMF feed flow is < X gpm, FSL-101 (hard-wired).

K. The Caustic Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-911 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-911 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

b. The Caustic room has a High-High level switch LSHH-911 that will generate an alarm when there is a major leak.

3.13 HYPOCHLORITE FEED SYSTEM (MI613)

A. The sodium hypochlorite (12% solution) feed system will include a double wall feed tank (T- 920) and two metering pumps (P-920A/B). This feed pump will supply hypochlorite solution to static mixer SM-200 at the MFF inlet via a secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-920), a level switch (LSH-921) to detect leak in secondary containment, and a backup high-level switch (LSH-922). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: LIT-920, SIC-920A/B

F. T-920 is 5.5' high. Level transmitter (LIT-920) set points are as follows:

a. Low-Low level Alarm LALL-920 = 1.0'

b. Low level LAL-920 = 1.25' (PUMP OFF Level)

c. Chemical Order Level Alarm (25%) = 2.5'

d. Pump On Level = Based on process demand

e. Tank Fill Alarm (90%) = 4.75′

f. High-High level alarm LAHH-920 = 4.75′.

G. Backup High level alarm switch LSH-922 is set at 9.0′.

H. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

a. Both metering pumps P-920A/B will be powered from local 115 VAC, 1 phase receptacles and controlled by the PLC via Ethernet I/P communications based on a 4-20 mA ORP signal from ORP probe AE-101B located in MMF Feed Pumps discharge piping. There will be a selector switch at PLC panel to operate the desired pump.

b. The hypochlorite feed system shall be in an "Auto" state as follows:

i. Leak detection alarm LAH-921 is not on.

ii. PLC receives a signal that P-920A/B is ready to run (powered).

iii. One of the MMF Feed Pumps P-500A/B is running.

c. The PLC will start/stop the pump and vary pump speed to maintain a set point ORP (initially 350) in MMF Feed Flow piping. The pump will have a local stroke length adjustment that will be initially set at startup.

J. Interlocks:

a. This feed system will be interlocked (P-920A/B shutdown) as follows:

i. Pre-treatment pumps P-100A and 100B are not running.

ii. Sodium hypochlorite tank T-920 Low level LAL-920

iii. MMF feed flow is < X gpm, FSL-101 (hard-wired).

K. The Hypochlorite Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-921 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-921 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

ii. The Caustic room has a High-High level switch LSHH-921 that will generate an alarm when there is a major leak.

3.14 HYDROGEN PEROXIDE FEED SYSTEM (MI615)

A. The hydrogen peroxide (27% solution) feed system will include a double wall feed tank (T-930) and two metering pumps (P-930 A/B). This feed pump will supply hydrogen peroxide solution to static mixer SM-300 at the AOP Rector System via a secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-930), a leak detector unit (LE-931) with annunciator to detect leak in secondary containment, and a high-level switch (LSH-932) and backup high-high-level switch (LSHH-932). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: FIT-934, LIT-930, PIT-933, SIC-930A/B will be monitored and controlled by the AOP System Control panel.

F. T-930 is 8.5' high. Level transmitter (LIT-930) set points are set by the AOP system vendor.

G. The AOP Reactor System PLC will control the operation and feed of hydrogen peroxide to the AOP Reactor, see Vendor Submittal for Details.

H. Interlocks:

a. The hydrogen peroxide feed system will be interlocked from Plant PLC (P-930A/B shutdown) as follows:

i. MMF feed flow is < X gpm, FSL-101 (hard-wired)

I. The Plant PLC will monitor the following hydrogen peroxide system parameters via an Ethernet link:

a. Tank T-930 leak detection (LAH-931)

b. Tank T-930 level, low-level, high-level and high-high-level (LI, LAL, LAH and LAHH-930)

c. Backup high-level and high-high-level switches (LAH-932, LAHH-932)

d. Metering pumps (P-930A/B) containment leak detection (LAH-935)

J. The Hydrogen Peroxide Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-931 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-931 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

K. The Caustic room has a High-High level switch LSHH-931 that will generate an alarm when there is a major leak.

3.15 AIR COMPRESSOR SYSTEM (MI618)

A. This system will include two air compressors (AC-610 and AC-620) each with an internal drier, filter and a dedicated controller. An air compressor cooling water tank T-650 will provide once-through cooling for the compressors using treated water from the LGAC units.

B. Both compressors' discharge pipes will be manifolded and then it goes thru an air receiver (T-640) and various pressure switches to supply air to the Oxygen Generator.

C. Each air compressor system will be controlled automatically by vendor-supplied PLC software to maintain a desired pressure range in the compressed air header.

D. Air receiver (T-640) will have a solenoid actuated auto drain valve. This intelligent drain function monitors condensate build-up with liquid level sensors and evacuates the condensate only, when necessary, thereby avoiding compressed air waste and providing for considerable energy savings.

E. Low- and high-pressure switches (PSH-644 and PSL-645) and a pressure transmitter (PIT-643) will be provided. This compressor will supply air to the Oxygen Generator.

F. Analog Signal/Control Loop: PIT-643

G. Manual Operation: Air compressor shall not be operated in manual mode.

H. Automatic Operation:

a. An air compressor will run to maintain a pre-set desired pressure set point at PSL-645 (45 psi) and shuts down at PSH-644 (110 psi).

b. Treatment Building PLC to trend PIT-643.

c. Air compressors will be alternated on a weekly basis.

I. Plant PLC will be connected with both air Compressor control panels via an Ethernet cable to start/stop, monitor data and alarms. Refer to the vendor's manual for additional operation and alarm details.

J. Air compressors (AC-610 and AC-620) are connected to cooling water supplied from Tank T-650. This tank supplies once-through cooling water for the compressors using treated water from the LGAC units. This tank will have a continuous water level transmitter (LE/LIT-650) and a backup high-level switch (LSH-651). Normally tank T-650 fills with treated water from the LGAC vessels via solenoid valve SV-652. If valve SV-652 fails to open (tank level not increasing) when it is commanded to open, valve SV-651 opens to allow potable water to fill the tank as a backup.

K. Analog Signal/Control Loops: LIT-650

L. Tank T-650 overflow pipe's bottom elevation is at 4.9' high. Level transmitter (LIT-650) set points are as follows:

a. Low-Low level Alarm LALL-650 = 0.5'

b. Low level Alarm LAL-650 = 1.0'

c. SV-652 CLOSE Level = 4.0'

d. SV-652 OPEN Level = 1.5'

e. SV-651 CLOSE Level = 4.0' (fill water backup only)

f. SV-651 OPEN Level = 1.5' (fill water back only)

g. High level alarm LAH-100 = 4.5'

h. High-High level Alarm LAHH-650 = 4.75'

3.16 BUILDING SUMP SYSTEM AND BUILDING CONTAINMENT SYSTEM (MI616/MI620)

A. To contain a leak from the largest tank (15,000 gallon) within the GWTP building, a secondary containment volume in excess of 17,000 gallons will be provided within the process area floor by raising the GWTP building's foundation wall six inches higher than the plant floor.

a. All interior rooms will be at the same elevation as foundation walls.

b. All process tanks and pumps will be placed on a six-inch-high concrete housekeeping pad.

c. No process or contaminated water will be allowed to discharge into sanitary sewer system.

B. There will be a process sump (5,700-gallon capacity) that will include two submersible pumps (P-800A and P-800B). A floor trench system in the main treatment plant area will collect equipment drain, overflow and periodic plant cleaning wash water and drain into this sump. The process area floor will be sloped toward a floor trench draining into a process sump. The chemical room sumps can be pumped into this sump.

C. Normally decant water from the backwash waste tank T-550 will be discharging into this sump on a continuous basis.

D. The sump pumps will operate as Lead/Lag and alternate every cycle. There will be one level transmitter (LIT-800) inside this sump to operate these pumps automatically. A backup high-high-level switch (LSHH-801) is inside this sump in case of transmitter failure.

E. Normally sump pumps will pump into the Eq Tank T-100. However, Sump discharge line also has a camlock fitting to discharge sump content directly into a tanker.

F. All recovery well pumps shall be shut down if sump level is High-High (refer to Section 3.2).

G. Sump depth is 10.33.’ Level alarms will be set as follows:

a. LALL-800 = 10” above sump floor – Sump low-low level alarm

b. LCL- 800 = 12” above sump floor (pump P-800A/B OFF level).

c. LCH- 800 = 48” above sump floor (lead pump ON level)

d. LCHH-800 = 60” above sump floor (lag pump ON level).

e. LAHH- 800 = 108” above sump floor (Plant shut down level).

H. Backup High-high level alarm switch LSHH-801 is set at 108”

I. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

J. Automatic Operation:

a. One or both pumps will be operated automatically based on the sump level. These pumps will operate in lead-lag operation. Provide the Operator an HMI button to allow for Lead-Lag selection of the pumps.

K. Interlocks:

a. The sump pumps shall be interlocked (not allowed to run) as follows:

i. Eq. Tank level is High-High (LAHH-100 or LAHH-101).

3.17 EYE WASH/SAFETY SHOWER SYSTEM (MI619)

A. Eight eye wash/safety shower systems will be provided, and each will contain a flow switch (FSH-951 thru 958). When any of the seven flow switches change state, an alarm will be generated. If this alarm is not acknowledged within 10 minutes, the plant will be shut down.

3.18 PROCESS TANK VENTING SYSTEM (MI617)

A. Equalization and LGAC Feed tank’s interior air is constantly drawn through a carbon canister (while fresh air is allowed to enter from outside) by a blower with a standby spare. The air will discharge through a louver to atmosphere. This system will run continuously while the plant is in operation.

B. There will be a combination pressure-vacuum relief valves (PSV-200) on the carbon canister.

C. A pressure transmitter (PIT-200) will monitor the pressure on the suction side of the carbon canister.

D. The Operator will start the carbon canister system via the HMI screen. The carbon canister system must be running before for the Treatment System to operate.

E. If the operating blower faults (YA-200A/B) or stops running (YI-200A/B) the PLC will automatically start the standby blower. The failed blower shall not start until the alarm is reset by the Operator.

F. Low or High carbon canister suction pressure will generate an alarm (PAL-200 or PAH-200), and the Treatment Plant will shut down. Setpoint to be determined during startup.

3.19 NON-POTABLE WATER SYSTEM (MI617)

A. To wash down the plant floor or tank, an equipment, a non-potable water (NPW) system will be provided. This water will be taken from the plant effluent/backwash supply tank T-500. There will be a booster pump (P-1), a bladder tank (BT-1) and a pressure transducer (PT-P1) to operate this pump. Several hose bibbs will be located inside the plant.

3.20 GAS MONITORS (MI607)

A. Two ambient oxygen monitors will be provided by the AOP reactor system vendor. One monitor (AIT-501) will be in the Ozone Generation Room, and another monitor (AIT-502) will be in the AOP Reactors Room. These monitors will be monitored by the AOP reactor system PLC panel as inputs AI-501 and AI-502, see AOP vendor submittal for details.

B. These monitors will send high gas concentration level alarms to AOP reactor system PLC as AAH-501, AAHH-501, AALL-502, AAL-502, AAH-502 and AAHH-502 (set point to be determined by AOP vendor). AOP system PLC will then communicate alarms with Plant PLC system to start opening louvers and all exhaust fans.

3.21 BUILDING AUTOMATION SYSTEM & FIRE ALARM CONTROL PANEL (MI620)

A. GWTP's HVAC systems, exhaust fans, motor operated louvers and heaters will be controlled by a building automation system (BAS) located inside this plant. Refer to the specifications.

B. There will be a fire alarm control panel (FACP) located inside this plant. This will monitor fire water flow, sprinkler systems operation and generate a fire alarm. This FACP will be connected to a remote alarm monitoring company via two dedicated phone lines. FACP will also send a fire alarm signal to BAS to shut down the fans and close all the louvers in case of a fire. FACP will also send a fire alarm signal to the Plant PLC to shut down the process equipment in case of a fire.

C. The BAS panel will be connected to plant PLC via an ethernet cable. PLC will then monitor various BAS systems' operation and send control to BAS in case of a gas release.

3.22 LOSS OF POWER MODE

A. The PLC shall utilize Ethernet communication to monitor the incoming utility power via the power meter located in Motor Control Center "MCC".

B. If a loss of utility power is detected, the Win911 alarming software shall be configured to immediately call out "Loss of Power" alarm to designated recipients.

C. While in Loss of Power Mode, all motors will shut down, all vendor supplied equipment shall shut down and the PLC shall have all discrete outputs programmed to a de-energized state. This action shall cause all valves to move to their fail position.

D. The PLC shall continue to monitor process conditions and generate additional alarms based on out-of-range conditions for 30 minutes.

3.23 PLANT RESTART

A. Provide a Plant Restart button at PLC. This should place all pumping systems in AUTO mode in a sequence as follows: start the carbon canister system, start building sump pumps followed by air compressor, then filter feed system, then EQ system, then all recovery wells and finally remaining pumping systems. Starting of these systems shall be separated by 30 seconds. Individual pumping system will start operating based on their respective tanks levels and other conditions as defined above. Sludge dewatering system is a batch mode operation.

B. If the plant is shut down due to power outage, it may be restarted automatically when power is restored (Operator selectable).

C. If the plant shuts down due to any process related alarms (as provided in attached list), plant should be restarted by the Operator physically evaluating all equipment at the site and acknowledging all alarms.

D. For the first several months, this will be the protocol to understand the frequency of occurrences and overall impact on the treatment plant. Depending on the frequency and outcome of these occurrences, it may be determined whether a Remote Alarm Acknowledgement and Remote Plant Restart is acceptable.

E. If the sump High-High alarm exists, the plant shall never be restarted remotely.

3.24 E-STOP MODE

A. E-Stops will be located within the treatment plant at control panels IOP-2 (process area), IOP-3 (chemical area) and IOP-4 (LGAC/AOP area).

B. Any E-Stop condition shall place the treatment plant into “E-Stop Mode” and generate a visual alarm (strobe light) at IOPs. The PLC shall shut down all vendor supplied equipment and have all discrete outputs programmed to a de-energized state. This action shall cause all motors to stop running, all vendor supplied panels disabled and all valves to move to their fail position.

C. The PLC shall continue to monitor process conditions and generate additional alarms based on out-of-range conditions.

D. The treatment plant shall remain in E-Stop mode until an operator physically evaluates the cause of the E-Stop and determines conditions are safe to resume operation.

3.25 HUMAN MACHINE INTERFACE REQUIREMENTS

A. Provide graphical screens (including but not limited to, process overview, individual unit process overviews, equipment overlays, controller faceplates, diagnostic and network status screens) necessary to provide a

complete operator interface to the system. Refer to Specifications for additional details.

3.26 TRENDING, HISTORICAL ARCHIVING REQUIREMENTS:

A. Provide trending and historical archiving of all analog values as well as selected discrete values. Actual values to be archived shall be assessed during the shop drawing review period. Provide a system capable of archiving any analog or discrete value that is registered at the HMI including trending functions (value versus time) for any such value for a minimum of 6 months before being erased.

3.27 REPORTS

A. Configure at minimum daily, weekly, and monthly reports outlining groundwater flows from each recovery well, CTR1 pumping system, and treated water discharge flows. Configure reports so that average instantaneous flows (gpm) per day, per week, and per month and totalized flows (gallons) per day, per week, and per month will be recorded and reported at each flow point. Exact format will be established during the shop drawing review period.

3.28 WEB INTERFACE REQUIREMENTS

A. Provide equipment, software or custom programming to limit remote access functionality for the SCADA system. The system configuration should limit inbound traffic to the Control Room SCADA and PLC equipment. Outbound traffic for remate alarm notification should not be restricted. Establish and configure appropriate security settings and confirm all with OWNER prior to enabling remote communications.

3.29 ALARMING SOFTWARE AND CONFIGURATION REQUIREMENTS

A. Configure the alarming software to capture alarms as listed in Table 2 attached after this Section. This list also provides desired responses. Coordinate with the OWNER to establish a callout escalation and configure the alarming software as required.

B. All Alarms shall be captured by the SCADA system. Additional action may be required as outlined below in the Alarm Listing.

C. All low and low-low level alarms shall be generated after preceding feed pump has operated for a minimum of 120 seconds.

3.30 LOSS OF COMMUNICATION

A. If any of the following devices stop communicating with the PLC, the plant should **not** shut down:

a. Any individual VFD,

b. Any recovery well,

c. Any remote control panel (IOp-5 or IOP-6)

TABLE 1 RECOVERY WELL PUMPS OPERATING SET POINTS

PUMPING SYSTEM	LEVEL PROBE DEPTH (FEET)	PUMP ON LEVEL (FEET)	PUMP OFF LEVEL (FEET)	PUMP SETTING POINT (FEET)	COMMENTS
RW-8	80′ BGS	X	X	120′ BGS	
RW-9	80′ BGS	X	X	120′ BGS	
RW-10A	80′ BGS	X	X	120′ BGS	

TABLE 2 – LIST OF GWTP ALARMS AND DESIRED RESPONSES

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
FAL-8	RW-8	FLOW	X	X	X		
LALL-8	RW-8	LEVEL	X	X			
LAL-8	RW-8	LEVEL	X				
LAH-8	RW-8	LEVEL	X				
LAH-VV8	VV-8	LEVEL	X				
YA-8	RW-8	POWER	X				
TA-8	VV-8 HEAT TRACE	POWER	X				
PAL-8	RW-8	PRESSURE	X				
PAH-8	RW-8	PRESSURE	X				
FAL-9	RW-9	FLOW	X	X	X		
LALL-9	RW-9	LEVEL	X	X			
LAL-9	RW-9	LEVEL	X				
LAH-9	RW-9	LEVEL	X				
LAH-VV9	VV-9	LEVEL	X				
YA-9	RW-9	POWER	X				
TA-9	VV-9 HEAT TRACE	POWER	X				
PAL-9	RW-9	PRESSURE	X				
PAH-9	RW-9	PRESSURE	X				

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
FAL-10A	RW-10A	FLOW	X	X	X		
LALL-10A	RW-10A	LEVEL	X	X			
LAL-10A	RW-10A	LEVEL	X				
LAH-10A	RW-10A	LEVEL	X				
LAH-VV10A	VV-10A	LEVEL	X				
YA-10A	RW-10A	POWER	X				
TA-10A	VV-10A HEAT TRACE	POWER	X				
PAL-10A	RW-10A	PRESSURE	X				
PAH-10A	RW-10A	PRESSURE	X				
FAL-100	PLANT INFLUENT	FLOW	X	X	X		
LAHH-100	T-100	LEVEL	X	X	X		
LAH-100	T-100	LEVEL	X				
LAL-100	T-100	LEVEL	X				
LALL-100	T-100	LEVEL	X	X	X		
LAHH-101	T-100	LEVEL	X	X	X		
YA-100A	P-100A	POWER	X	X			
YA-100B	P-100B	POWER	X	X			
FAL-101A	P-100A	FLOW	X	X	X		
FAL-101B	P-100B	FLOW	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
AAL-101	MMF FEED	pH	X	X	X	AOP RECYCLE	
AAH-101	MMF FEED	pH	X	X	X	AOP RECYCLE	
AAL-102	MMF FEED	ORP	X	X	X	AOP RECYCLE	
AAH-102	MMF FEED	ORP	X	X	X	AOP RECYCLE	
FAL-101	MMF FEED (CHEMICAL PUMPS SHUTDOWN)	FLOW	X	X	X		X
YA-110	EQM-110	POWER	X	X			
PAL-210	MMF-210/220/230	PRESSURE	X				
PAH-210	MMF-210/220/230	PRESSURE	X	X			
KA-210	MMF-210	TIME	X				
PDAH-210	MMF-210	DELTA P	X	X			
KA-220	MMF-220	TIME	X				
PDAH-220	MMF-220	DELTA P	X	X			
KA-230	MMF-230	TIME	X				
PDAH-230	MMF-230	DELTA P	X	X			
PAL-230	MMF-210/220/230	PRESSURE	X				
PAH-230	MMF-210/220/230	PRESSURE	X	X			
PDAH-240	CF-240/250	DELTA P	X	X			
YI-300B	AOP	SYSTEM WARNING	X	X			

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YI-300C	AOP	SYSTEM SHUTDOWN	X	X			
AAH-501	AOP	AMBIENT O2	X	X			
AAHH-501	AOP	AMBIENT O2	X	X			
AALL-502	AOP	AMBIENT O2	X	X			
AAL-502	AOP	AMBIENT O2	X	X			
AAH-502	AOP	AMBIENT O2	X	X			
AAHH-502	AOP	AMBIENT O2	X	X			
TALL-710	OD-4000	TEMP	X	X			
TAHH-710	OD-4000	TEMP	X	X			
LAHH-400	T-400	LEVEL	X	X	X		
LAH-400	T-400	LEVEL	X				
LAL-400	T-400	LEVEL	X				
LALL-400	T-400	LEVEL	X	X	X		
LAHH-401	T-400	LEVEL	X	X	X		
YA-400A	P-400A	POWER	X	X			
YA-400B	P-400B	POWER	X	X			
FAL-400A	P-400A	FLOW	X	X	X		
FAL-400B	P-400B	FLOW	X	X	X		
PDAH-400	LGAC-410/420/430	PRESSURE	X	X			

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAHH-500	T-500	LEVEL	X	X	X		
LAH-500	T-500	LEVEL	X				
LAL-500	T-500	LEVEL	X				
LALL-500	T-500	LEVEL	X	X	X		
LAHH-501	T-500	LEVEL	X	X	X		
YA-500A	P-500A	POWER	X	X			
YA-500B	P-500B	POWER	X	X			
FAL-500A	P-500A	FLOW	X	X	X		
FAL-500B	P-500B	FLOW	X	X	X		
LAH-MHA1	MH-A1	LEVEL	X	X			
LAH-MHB1	MH-B1	LEVEL	X	X			
LAH-OFB1	OFB1	LEVEL	X	X	X		
LAH-OFB2	OFB2	LEVEL	X	X	X		
LAH-OFB3	OFB3	LEVEL	X	X	X		
LAH-OFB4	OFB4/OFB5	LEVEL	X	X	X		
LAH-912	T-910	LEVEL	X	X	X		
LAH-910	T-910	LEVEL	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAL-910	T-910	LEVEL	X	X			
LAH-911	T-910	LEAK	X	X	X		
LAH-913	P-910A/B	LEAK	X	X	X		
LAHH-911	HYPO ROOM	LEAK	X	X	X		
YA-911	P-911	POWER	X	X			
LAH-922	T-920	LEVEL	X	X	X		
LAH-920	T-920	LEVEL	X	X	X		
LAL-920	T-920	LEVEL	X	X			
LAH-921	T-920	LEAK	X	X	X		
LAH-923	P-920A/B	LEAK	X	X	X		
LAHH-921	HYPO ROOM	LEAK	X	X	X		
YA-921	P-921	POWER	X	X			
LAHH-932	T-930	LEVEL	X	X	X		
LAH-932	T-930	LEVEL	X	X	X		
LAHH-930A	T-930	LEVEL	X	X	X		
LAH-930A	T-930	LEVEL	X	X	X		
LAL-930A	T-930	LEVEL	X	X			
LALL-930A	T-930	LEVEL	X	X			
LAH-931A	T-930	LEAK	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAH-935A	P-930A/B	LEAK	X	X	X		
LAHH-931	PEROXIDE ROOM	LEAK	X	X	X		
YA-931	P-931	POWER	X	X			
YA-800A	P-800A	POWER	X	X			
YA-800B	P-800B	POWER	X	X			
LAHH-800	SUMP	LEVEL	X	X	X		X (A)
LAH-800	SUMP	LEVEL	X	X			
LAL-800	SUMP	LEVEL	X	X			
LALL-800	SUMP	LEVEL	X	X			
LAHH-801	SUMP	LEVEL	X	X	X		X (A)
PAH-200	C-200	PRESSURE	X	X			
PAL-200	C-200	PRESSURE	X	X			
YA-200A	B-200A	POWER	X	X			
YA-200B	B-200B	POWER	X	X			
LAHH-650	T-650	LEVEL	X	X	X		
LAH-650	T-650	LEVEL	X	X			
LAL-650	T-650	LEVEL	X	X			
LALL-650	T-650	LEVEL	X	X	X		
LAH-651	T-650	LEVEL	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YI-610B	AC-610	SYSTEM WARNING	X	X	X		
YI-610C	AC-610	SYSTEM SHUTDOWN	X	X	X		
YI-620B	AC-620	SYSTEM WARNING	X	X	X		
YI-620C	AC-620	SYSTEM SHUTDOWN	X	X	X		
PAL-643	AC-610/620	PRESSURE	X	X	X		
PAH-643	AC-610/620	PRESSURE	X	X			
PAH-644	AC-610/620	PRESSURE	X	X	X		
PAL-645	AC-610/620	PRESSURE	X	X			
FAH-951 thru 958	ANY EYEWASH STATION	FACILITY	X	X	X		
YA-980	MCC	SPD	X				
TAH-981	ELECTRICAL ROOM	TEMP	X				
TAH-982	PROCESS AREA	TEMP	X				
TAH-983	COMPRESSOR ROOM	TEMP	X				
TAH-984	OZONE GENERATOR ROOM	TEMP	X				
LAHH-991	CONTAINMENT WEST	LEAK	X	X	X		X
LAHH-991	CONTAINMENT EAST	LEAK	X	X	X		X
HI-IOP2A THRU IOP4A	ANY E-STOP	FACILITY	X	X	X		X
JA-IOP1 THRU IOP6	I/O PANEL	DC POWER	X				

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YA-990	FACP	FIRE ALARM	X	X	X		X
LAHH-550	T-550	LEVEL	X	X	X		
LAH-550	T-550	LEVEL	X				
LAL-550	T-550	LEVEL	X				
LALL-550	T-550	LEVEL	X	X	X		
LAHH-551	T-550	LEVEL	X	X	X		
TA-550A	VV-550 HEAT TRACE	POWER	X				
TA-550B	VV-550 HEAT TRACE	POWER	X				

(A) - Shutdown GWTP incoming flow (ALL recovery wells) only.

TETRA TECH	Magnetic Flowmeter & Transmitter Specification Sheet	REV.	DATE
	40 60 00 2.4.4.1	B	02/12/2026

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Sg (ρ)	1.0
Minimum Flow	0 (gpm)	Temperature Range	55 - 60 (°F)
Maximum Flow	*See chart below* (gpm)	Pressure Range	N/A (psig)
Conductivity	Varies (mmhos/cm)	Solids	< 1% (%)
Clarity	Varies	pH	5 - 7

ELEMENT:

Measurement Type	Flow	Instrument Span	* By Vendor
Lining Material	PTFE	Electrode Material	Nickel Alloy 276
Tube Material	304 Stainless Steel (SST)	Accuracy	±0.15% (High Accuracy Option)
Connection Type	Flange Style - Class 150	Line Size	*See chart below*

TRANSMITTER:

Type	Smart "HART Protocol"	Output Signal	4-20 Milliamperes (mA)
Power Supply	120-VAC, 60Hz	Indicator	Local Display (M4)
Accuracy	±0.15% (High Accuracy Option)	Flow Units	GPM

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	2" pipe/flat surface	Conduit Connections	4 @ 1/2 - 14 NPT
Enclosure Rating	NEMA 4X	Mounting	Wall Mount

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

ACCESSORIES:

Cable	Combination Coil/Electrode Cable (18 AWG) See Tag Information Chart for Estimated Cable Length	Calibration Certificate	Required

MANUFACTURER BASIS OF DESIGN:

Manufacture	Rosemount		
Remote Transmitter	8712EMR1A1AXM4D1Q4RC**"xx"** **"xx"** = Coil/Electrode Cable Length	Sensor	8705THA**"xxx"**P1W0G1D1J1Q4 **"xxx"** = Line Size

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, ABB, Endress & Hauser

TAG INFORMATION:

Instrument Tag	Service	Line Size	Operating Flow	P&ID	Estimated Cable Length (Contractor to Verify)
FE/FIT-8	Recovery Well RW-8 Flow	6”	450 gpm	MI604	40 ft. (see Note 4)
FE/FIT-9	Recovery Well RW-9 Flow	6”	450 gpm	MI602	40 ft. (see Note 4)
FE/FIT-10A	Recovery Well RW-10A Flow	6”	600 gpm	MI603	40 ft. (see Note 4)
FE/FIT-100	Plant influent Flow	8”	1500 gpm	MI604	40 ft. (see Note 4)
FE/FIT-101	MMF Feed Flow	8”	1500 gpm	MI605	10 ft. (see Note 4)
FE/FIT-400	LGAC Feed Flow	8”	1500 gpm	MI609	20 ft. (see Note 4)
FE/FIT-440A	Effluent to Basin #1 Flow	10”	1500 gpm	MI612	20 ft. (see Note 4)
FE/FIT-440B	Effluent to Basins #2 & #3 Flow	10”	1500 gpm	MI612	20 ft. (see Note 4)
FE/FIT-440C	Effluent to Basins #4 & #5 Flow	10”	1500 gpm	MI612	20 ft. (see Note 4)
FE/FIT-500	BWS Pumps P-500A/B Discharge Flow	6”	950 gpm	MI611	20 ft. (see Note 4)

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description and calibrated range permanently attached to device
2. All instruments to be from the same manufacturer.
3. Note: Calibration Range by Vendor
4. Each Flowmeter must be evaluated regarding mounting location to ensure sufficient cable length is properly selected for ease of configuration and visual monitoring.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Probe Material	316 SS
Sensor Type	Ultrasonic Gap (Single Point)	Process Connection	3/4" NPT
Orientation	*See Chart Below*	Process Temperature	-40°F to 250°F

SWITCH:

Type	Relay Contacts	Response Time	2 Seconds
Current Rating	6 Amps	Indicator	N/A
Quantity & Form	DPDT	Power Supply	24VDC

HOUSING:

Material	NEMA 4X	Conduit Connection	3/4" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Drexelbrook VeriGAP	Model No.	504-1000 Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Siemens

TAG INFORMATION:

Tag Number	Service	Orientation	Insertion Length (inches)	Process Media	P&ID
LSHH-101	Equalization Tank T-100 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI605
LSHH-401	LGAC Feed Tank T-400 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI609
LSHH-501	BWS Tank T-5 00 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI611
LSHH-551	BWW Tank T-550 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI621
LSH-651	Air Compressor Cooling Water Tank T-650	Vertical	**TBD** (see Note 2)	Treated Water/ Potable Water	MI618
LSHH-801	Treatment Building Sump High-High Level	Vertical	12 (see Note 3)	Groundwater	MI616
LSHH-991	Treatment Building Leak Detection - West	Vertical	6	Groundwater	MI620
LSHH-992	Treatment Building Leak Detection - East	Vertical	6	Groundwater	MI620

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Insertion Length is final tank depth. Flange/Tank dome height needs added to the overall length.
   Exact length to be determined during Submittal Phase.
3. Insertion length to be confirmed during Submittal Phase.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Probe Material	Hastelloy "C"
Sensor Type	Ultrasonic Gap (Single Point)	Process Connection	3/4" NPT
Orientation	*See Chart Below*	Process Temperature	-40°F to 250°F

SWITCH:

Type	Relay Contacts	Response Time	2 Seconds
Current Rating	6 Amps	Indicator	N/A
Quantity & Form	DPDT	Power Supply	24VDC

HOUSING:

Material	NEMA 4X	Conduit Connection	3/4" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Drexelbrook VeriGAP	Model No.	504-1000 Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Siemens

TAG INFORMATION:

Tag Number	Service	Orientation	Insertion Length (inches)	Process Media	P&ID
LSH-922	Sodium Hypochlorite Storage Tank T-920 High Level	Vertical	**TBD** (see Note 2)	NaOCl (12%)	MI613
LSHH-921	Sodium Hypochlorite Room Leak Detection	Vertical	6	NaOCl (12%)	MI613
LSHH-931	Hydrogen Peroxide Room Leak Detection	Vertical	6	H2O2 (27%)	MI615

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Insertion Length is final tank depth. Flange/Tank dome height needs added to the overall length.
   Exact length to be determined during Submittal Phase.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Probe Material	Alloy 20 (Carpenter 20)
Sensor Type	Ultrasonic Gap (Single Point)	Process Connection	3/4" NPT
Orientation	*See Chart Below*	Process Temperature	-40°F to 250°F

SWITCH:

Type	Relay Contacts	Response Time	2 Seconds
Current Rating	6 Amps	Indicator	N/A
Quantity & Form	DPDT	Power Supply	24VDC

HOUSING:

Material	NEMA 4X	Conduit Connection	3/4" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Drexelbrook VeriGAP	Model No.	504-1000 Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Siemens

TAG INFORMATION:

Tag Number	Service	Orientation	Insertion Length (inches)	Process Media	P&ID
LSH-912	Sodium Hydroxide Storage Tank T-910 High Level	Vertical	**TBD** (see Note 2)	Caustic (25%)	MI614
LSHH-911	Sodium Hydroxide Room Leak Detection	Vertical	6	Caustic (25%)	MI614

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Insertion Length is final tank depth. Flange/Tank dome height needs added to the overall length.
   Exact length to be determined during Submittal Phase.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	1-1/2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	16 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	N/A	Adapter Flange	1-1/2" NPT to 3" ASME Flange (PVDF)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser
Model No.	FMU40-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer	Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Tank Height	Process Fluid	P&ID
LIT-650	Air Compressor Cooling Water Tank T-650	5'	Treated Water/Potable Water	MI618
LIT-920	Sodium Hypochlorite Tank T-920 Level	5.5'	Sodium Hypochlorite (12%)	MI613

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 9.6" blocking distance. Extend tank nozzles as needed to minimize blanking field within each tank.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	1-1/2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	16 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	N/A	Adapter Flange	1-1/2" NPT to 3" ASME Flange (PP)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser
Model No.	FMU40-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer	Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Tank Height	Process Fluid	P&ID
LIT-910	Sodium Hydroxide Tank T-910 Level	10.5'	Caustic (25%)	MI614

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 9.6" blocking distance. Extend tank nozzles as needed to minimize blanking field within each tank.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	26 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	Include for: LIT-550 only	Adapter Flange	2" NPT to 3" ASME Flange (PVDF)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser	Model No.	FMU41-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Tank Height	Process Fluid	P&ID
LIT-100	Eq. Tank T-100 Level	18'	Groundwater	MI605
LIT-400	LGAC Feed Tank T-400 Level	18'	Groundwater	MI609
LIT-500	Backwash Supply Tank T-500 Level	16'	Groundwater	MI611
LIT-550	Backwash Waste Tank T-550 Level	26'	Groundwater	MI621

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 13.2" blocking distance. Extend tank nozzles as needed to minimize blanking field within each tank.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	1-1/2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	16 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	N/A	Installation Bracket	316Ti for FMU40 Sensor

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser
Model No.	FMU40-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer	Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Sump Height	Process Fluid	P&ID
LIT-800	Treatment Building Sump	10'	Groundwater	MI616

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 9.6" blocking distance. Mount transmitter as needed to minimize blanking field within the sump.

TETRA TECH	Float Level Switch Specification Sheet	REV.	DATE
	40 60 00 2.4.5.5	B	02/12/26

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Float/Stem Material	316 SS
Sensor Type	Float	Mounting:	1/2" NPT(M)
Orientation	*See Below*		

SWITCH:

Type	Reed Switch	Max. Temp	392°F
Current Rating	30VA: 0.14A @ 200VAC	Wire Leads	22 AWG x 24" long
Quantity & Form	SPST	Approx. Deadband	1/8"

HOUSING:

Material	N/A	Conduit Connection	N/A

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Dwyer	Model No.	F7-HSS

ACCEPTABLE MANUFACTURERS:

Manufacturer OMEGA, WIKA

TAG INFORMATION:

Tag Number	Service	Orientation	Process Media	P&ID
LSH-VV8	Valve Vault 8 High Level	Horizontal	Groundwater	MI602
LSH-VV9	Valve Vault 9 High Level	Horizontal	Groundwater	MI602
LSH-VV10A	Valve Vault 10A High Level	Horizontal	Groundwater	MI603
LSH-MHA1	Manhole MH-A1 High Level	Horizontal	Groundwater	MI612
LSH-MHB1	Manhole MH-B1 High Level	Horizontal	Groundwater	MI612

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Pressure Range	0–900	ft W.C.
Surface Agitation Type	None	Temperature Range	55	(°F)

ELEMENT:

Measurement Type	Hydrostatic	Wetted Parts Material	316L SS
Vented/Non-Vented	Vented	Casing Material	316L SS
Rating	IP68	Cable Length	250 Ft.

TRANSMITTER:

Type	Piezo-Resistive	Output Signal	4 – 20 mA
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.25% Full Scale	Lightning Protection	Included
Cable	Tefzel (ETFE)		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

ACCESSORIES:

Termination Enclosure	Include	Bellows	Include
Cable Hanger	Include	Drying Tube Assembly	N/A

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Keller	Model No.	Levelgage Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, Rosemount

TAG INFORMATION:

Tag Number	Service	Mounting Depth (Ft. - BGS)	Cable Length (Ft.)	P&ID
LT-8	Recovery Well RW-8 Level	80	150	MI602
LT-9	Recovery Well RW-9 Level	80	150	MI602
LT-10A	Recovery Well RW-10A Level	80	150	MI603

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Pressure Range	0–900	ft W.C.
Surface Agitation Type	None	Temperature Range	55	(°F)

ELEMENT:

Measurement Type	Hydrostatic	Wetted Parts Material	316L SS
Vented/Non-Vented	Vented	Casing Material	316L SS
Rating	IP68	Cable Length	250 Ft.

TRANSMITTER:

Type	Piezo-Resistive	Output Signal	4 – 20 mA
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.25% Full Scale	Lightning Protection	Included
Cable	Tefzel (ETFE)		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

ACCESSORIES:

Termination Enclosure	Include	Bellows	Include
Cable Hanger	Include	Drying Tube Assembly	N/A

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Keller	Model No.	Levelgage Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, Rosemount

TAG INFORMATION:

Tag Number	Service	Mounting Depth (Ft.)	Cable Length (Ft.)	P&ID
LT-OFB1	Outfall Basin #1 Level	10	200	MI612
LT-OFB2	Outfall Basin #2 Level	10	200	MI612
LT-OFB3	Outfall Basin #3 Level	10	200	MI612
LT-OFB4	Outfall Basin #4 & #5 Level	10	200	MI612

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.

Plant	Naval Facilities Engineering Systems Command Norfolk, Virginia	Project	Upgrade of GM38 Area Hotspot Groundwater Treatment System - 2023
Location	Naval Weapons Industrial Reserve Plant, Bethpage, NY		

PROCESS CONDITIONS:

Process Fluid	Groundwater	Specific Gravity	0.95 – 1.16
pH	5 - 7	Temperature	50 - 70 (°F)

ELEMENT:

Case Type	Solid-front w/ blowout back	Dial Size	4 1/2 (inches)
Case Material	Black Phenolic	Window Material	Shatter-Resistant Glass
Ring Style	Threaded	Pointer	Micrometer adjustable
Measuring System	Bourdon Tube	Accuracy	+/-0.5% of span (Grade 2A)
Material	316L Stainless Steel (SS)		

SOCKET:

Location	Lower	Connection Size & Type	1/2” MNPT
Material	316L SS		

DIAPHRAGM SEAL:

Top Housing Material	316L SS	Fill Fluid	Silicone
Bot Housing Material	316L SS	Process Connection	1/2” NPT female
Diaphragm Material	316L SS	Instrument Connection	1/2” NPT female

ACCESSORIES:

Snubber	No	Siphon Type & Material	N/A

OPTIONS:

Vibration Damping: Plus! Performance Option (XLL)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	Type 1279 Pressure Gauge Type 200 Diaphragm Seal

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, WIKA

TAG INFORMATION:

Tag Number	Service	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-100A	MMF Feed Pump P-100A Discharge Pressure	6”	0 - 100	65	MI605
PI-100B	MMF Feed Pump P-100A Discharge Pressure	6”	0 - 100	65	MI605
PI-231	MMF Backwash Waste Outlet Pressure	8”	0 - 100	55	MI606
PI-240A	Cartridge Filter CF-240 Inlet Pressure	12”	0 - 100	55	MI606
PI-240B	Cartridge Filter CF-240 Outlet Pressure	12”	0 - 100	50	MI606
PI-250A	Cartridge Filter CF-250 Inlet Pressure	12”	0 - 100	55	MI606
PI-250B	Cartridge Filter CF-250 Outlet Pressure	12”	0 - 100	50	MI606
PI-400A	LGAC Feed Pump P-400A Discharge Pressure	8”	0 - 60	20	MI609
PI-400B	LGAC Feed Pump P-400B Discharge Pressure	8”	0 - 60	20	MI609
PI-440	Plant Effluent Pressure	12”	0 - 60	15	MI612

Tag Number	Service	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-500A	Backwash Supply Pump P-500A Discharge Pressure	6”	0 - 60	30	MI611
PI-500B	Backwash Supply Pump P-500B Discharge Pressure	6”	0 - 60	30	MI611
PI-800	Building Sump Pumps P-800A/B Discharge Pressure	3”	0 - 60	20	MI616
PI-1A	Non-Potable Water Pump P-1 Discharge Pressure	2”	0 - 100	50	MI617
PI-1B	Non-Potable Water BLADDER TANK BT-1 Pressure	N/A	0 - 100	50	MI617

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Plant	Naval Facilities Engineering Systems Command Norfolk, Virginia	Project	Upgrade of GM38 Area Hotspot Groundwater Treatment System - 2023
Location	Naval Weapons Industrial Reserve Plant, Bethpage, NY		

PROCESS CONDITIONS:

Process Fluid	*See Chart Below*	Specific Gravity	Varies
pH	Varies	Temperature	50 - 70 (°F)

ELEMENT:

Case Type	Solid-front w/ blowout back	Dial Size	4 1/2 (inches)
Case Material	Black Phenolic	Window Material	Shatter-Resistant Glass
Ring Style	Threaded	Pointer	Micrometer adjustable
Measuring System	Bourdon Tube	Accuracy	+/-0.5% of span (Grade 2A)
Material	316L Stainless Steel (SS)		

SOCKET:

Location	Lower	Connection Size & Type	1/2” MNPT
Material	316L SS		

DIAPHRAGM SEAL:

Top Housing Material	316L SS	Fill Fluid	Silicone
Bot Housing Material	Hastelloy C-276	Process Connection	1/2” NPT female
Diaphragm Material	Hastelloy C-276	Instrument Connection	1/2” NPT female

ACCESSORIES:

Snubber	No	Siphon Type & Material	N/A

OPTIONS:

Vibration Damping: Plus! Performance Option (XLL)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	Type 1279 Pressure Gauge Type 200 Diaphragm Seal

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, WIKA

TAG INFORMATION:

Tag Number	Service	Process Fluid	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-921	Sodium Hypochlorite Room Sump Pump	NaOCl (12%)	2”	0-30	10	MI613
PI-931	Hydrogen Peroxide Room Sump Pump	H2O2 (27%)	2”	0-30	10	MI615

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Plant	Naval Facilities Engineering Systems Command Norfolk, Virginia	Project	Upgrade of GM38 Area Hotspot Groundwater Treatment System - 2023
Location	Naval Weapons Industrial Reserve Plant, Bethpage, NY		

PROCESS CONDITIONS:

Process Fluid	*See Chart Below*	Specific Gravity	Varies
pH	Varies	Temperature	50 - 70 (°F)

ELEMENT:

Case Type	Solid-front w/ blowout back	Dial Size	4 1/2 (inches)
Case Material	Black Phenolic	Window Material	Shatter-Resistant Glass
Ring Style	Threaded	Pointer	Micrometer adjustable
Measuring System	Bourdon Tube	Accuracy	+/-0.5% of span (Grade 2A)
Material	316L Stainless Steel (SS)		

SOCKET:

Location	Lower	Connection Size & Type	1/2" MNPT
Material	316L SS		

DIAPHRAGM SEAL:

Top Housing Material	316L SS	Fill Fluid	Silicone
Bot Housing Material	Carpenter 20	Process Connection	1/2" NPT female
Diaphragm Material	Carpenter 20	Instrument Connection	1/2" NPT female

ACCESSORIES:

Snubber	No	Siphon Type & Material	N/A

OPTIONS:

Vibration Damping: Plus! Performance Option (XLL)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	Type 1279 Pressure Gauge Type 200 Diaphragm Seal

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, WIKA

TAG INFORMATION:

Tag Number	Service	Process Fluid	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-911	Sodium Hydroxide Room Sump Pump	Caustic (25%)	2"	0-30	10	MI614

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Groundwater	Sg (ρ)	0.95 – 1.16
Temperature	50 - 70 (°F)	Pressure	*See Chart Below* (psig)

ELEMENT:

Measurement Type	Gauge	Instrument Span	*By Vendor (psig)
Sensor Type	Diaphragm	Sensor Material	316L SST
Fill Fluid	Silicone	Wetted Parts	316L SST
O-Ring Material	Buna-N	Connection Size & Type	1/2" FNPT

TRANSMITTER:

Type	"Smart" (Hart Protocol)	Output Signal	4 - 20 mA DC
Power Supply	Two-wire loop-powered	Accuracy	±0.075% of span

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	SST	Conduit Connections	2 @ 1/2" FNPT (qty & size)
Mounting Bracket	2 in. Pipe	Enclosure Rating	NEMA 4X

DIAPHRAGM SEAL (IF REQUIRED):

Seal Type	RTW Threaded	Fill Fluid	Silicone 200
Top Housing Material	316L SST	Connection Size & Type	1/2" NPT
Bot Housing Material	316L SST	Diaphragm Material	316L SST
Capillary Type	N/A	Capillary Length	N/A
Mounting	Direct Mount		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Rosemount	Model No.	2088G2S22A1S1M4B4Q4

ACCEPTABLE MANUFACTURERS:

Manufacturer	Dwyer United Electric Controls

TAG INFORMATION:

Tag Number	Service	Line Size	Calibrated Range [psig]	Operating Pressure [psig]	P&ID
PIT-8	Recovery Well RW-8 Discharge Pressure	6”	0 - 100	45	MI602
PIT-9	Recovery Well RW-9 Discharge Pressure	6”	0 - 100	55	MI602
PIT-10A	Recovery Well RW-10A Discharge Pressure	6”	0 - 100	62	MI603

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.
   Pressure Transmitter ordered with diaphragm seal pre-assembled to unit.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Compressed Air	Density	~0.0752 (lb./ft^3)
Temperature	90-100 (°F)	Pressure Range	*See Chart Below* (psig)

ELEMENT:

Measurement Type	Gauge	Instrument Span	*By Vendor (psig)
Sensor Type	Diaphragm	Sensor Material	316L SST
Fill Fluid	Silicone	Wetted Parts	316L SST
O-Ring Material	Buna-N	Process Connection	1/2" FNPT

TRANSMITTER:

Type	"Smart" (Hart Protocol)	Output Signal	4 - 20 mA DC
Power Supply	Two-wire loop-powered	Accuracy	±0.075% of span

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	SST	Conduit Connections	2 - 1/2" NPT
Mounting Bracket	2 in. Pipe	Enclosure Rating	NEMA 4X

DIAPHRAGM SEAL (IF REQUIRED):

Seal Type	N/A	Fill Fluid	N/A
Top Housing Material	N/A	Connection Size & Type	N/A
Bot Housing Material	N/A	Diaphragm Material	N/A
Capillary Type	N/A	Capillary Length	N/A
Mounting	N/A		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Rosemount	Model No.	2088G2S22A1M4B4Q4

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, United Electric Controls

TAG INFORMATION:

Tag Number	Service	Line Size	Calibrated Range [psig]	Operating Pressure [psig]	P&ID
PIT-643	Compressed Air Header Pressure	2"	0 - 150	90	MI618

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Air	Density	~0.0752 (lb./ft^3)
Temperature	50 - 70 (°F)	Pressure Range	*See Chart Below* (psig)

ELEMENT:

Measurement Type	Gauge	Instrument Span	*By Vendor (psig)
Sensor Type	Diaphragm	Sensor Material	316L SST
Fill Fluid	Silicone	Wetted Parts	316L SST
O-Ring Material	Glass-filled PTFE	Process Connection	1/2" FNPT

TRANSMITTER:

Type	"Smart" (Hart Protocol)	Output Signal	4 - 20 mA DC
Power Supply	Two-wire loop-powered	Accuracy	±0.075% of span

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	SST	Conduit Connections	2 - 1/2" NPT
Mounting Bracket	2 in. Pipe	Enclosure Rating	NEMA 4X

DIAPHRAGM SEAL (IF REQUIRED):

Seal Type	N/A	Fill Fluid	N/A
Top Housing Material	N/A	Connection Size & Type	N/A
Bot Housing Material	N/A	Diaphragm Material	N/A

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer Rosemount Model No. 3051CG1A22A1A S5B4Y2L4Q4

ACCEPTABLE MANUFACTURERS:

Manufacturer Dwyer, United Electric Controls

ACCESSORIES:

Rosemount 305 Integral Manifold (3-valve configuration)

TAG INFORMATION:

Tag Number	Service	Line Size	Calibrated Range	Operating Pressure	P&ID
PIT-200	Carbon Canister Inlet Pressure	8"	-25 to 25 inH2O	2" H2O Vac	MI617

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

TETRA TECH	Pressure Switch Specification Sheet	REV.	DATE
	40 95 00 2.4.6.2	A	02/19/24

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Compressed Air	Sg (ρ)	~0.0752 (lb./ft^3)
Temperature	90 - 100 (°F)		

ELEMENT:

Measurement Type	Pressure	Instrument Span	0 – 200 PSI
Sensor Type	Piston Actuator	Connection Size & Type	1/2" NPT
Insertion	Inline	Orientation	Horizontal
Diaphragm Material	Buna-N		

SWITCH:

Type	Relay Output	Response Time	1 (seconds)
Contact Rating	15 Amps @ 120VAC	Quantity/Form	SPDT

HOUSING:

Material	Epoxy Coated Aluminum	Rating	NEMA 4X Watertight
Mounting Hardware	N/A	Conduit Connections	3/4" FNPT

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	B-Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Dwyer
United Electric Controls

TAG INFORMATION:

Tag Number	Service	Pressure Switch Model No.	Setpoint	Line Size	P&ID
PSH-644	Compressed Air Header High Pressure	B4-24-B-XNHX06-200# (See Note 2)	110 PSI	2”	MI618
PSL-645	Compressed Air Header Low Pressure	B4-24-B-XNHX06-200# (See Note 3)	45 PSI	2”	MI618

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Set PSH-644 for operation on increasing pressure.
3. Set PSL-645 for operation on decreasing pressure.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Sg (ρ)	~1.0
Temperature Range	55 - 75 (°F)	Pressure	0 – 65 (psig)

SENSOR #1:

Measurement Type	pH / Temperature	Measured Range Temp	32 - 230 (°F)
Measuring Electrode	Memosens CPS91E	Sensor Cable	Memosens CYK10
Measured Range pH	0 - 14		

SENSOR #2:

Measurement Type	ORP	Measured Range ORP	-1500 to 1500 (mV)
Measuring Electrode	Memosens CPS92E	Sensor Cable	Memosens CYK10

ANALYZER:

Type	Liquiline CM442	Output Signal	4-20 Milliamperes (mA)
Power Supply	120 Volts AC (VAC)	Output Signal Accuracy	< 50 µA
Measurement 1	pH	Indicator	Monochromatic LCD
Measurement 2	Temperature	Operation Manual	English
Measurement 3	ORP		

HOUSING:

Material	Polycarbonate	Conduit Connections	1/2" NPT
Mounting Hardware	SST	Enclosure Rating	NEMA 4X
Mounting Bracket	2” Pipe Kit / Mounting Plate		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

SENSOR ACCESSORIES:

Retractable Electrode Holder Cleanfit CPA871 (Inline)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser	Analyzer Model No.	CM442 w/(4) 4-20mA Output
Sensor #1 Model No.	CPS91E	Sensor #2 Model No.	CPS92E

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Hach

TAG INFORMATION:

Tag Number	Service	Pipe Size	Inline or Tank Mount	Analyzer	P&ID
AE-101A	MMF FEED pH / Temperature Electrode	2”	Inline	AIT-101	MI605
AE-101B	MMF FEED ORP Electrode	2”	Inline	AIT-101	MI605

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description and calibrated range permanently attached to device.
2. All instruments to be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Temperature	Instrument Span	-40 to 140°F
Sensor Type	PT1000 RTD	Sensor Material	304 SS

TRANSMITTER:

Power Supply	24VDC	Output Signal	4 to 20 mA DC
Accuracy	±0.5° @ 25°C	Indicator Scale	Not Required

HOUSING:

Material	Polycarbonate	Finish	N/A
Mounting Hardware	None	Conduit Connections	1/2" NPT
Enclosure Rating	NEMA 4X		

THERMOWELL:

Type	N/A	Insertion (U) Dimension	N/A (inches)
Material	N/A	Lagging (T) Dimension	N/A (inches)
Connection Size & Type	N/A		

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

N/A

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Dwyer	Model No.	BTT-O251

ACCEPTABLE MANUFACTURERS:

Manufacturer Omega, United Electric Controls

TAG INFORMATION:

Tag Number	Service	Operating Range	P&ID
TT-981	Electrical Room Temperature	0 – 120°F	MI620
TT-982	Process Area	0 – 120°F	MI620
TT-983	Compressor Room	0 – 120°F	MI620
TT-984	Ozone Generator Room	0 – 120°F	MI620

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

SECTION 40 60 00

PROCESS CONTROL
05/20

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(2014; Errata 2016) Electric Meters - Code for Electricity Metering
ANSI INCITS 154	(1988; R 2004) Office Machines and Supplies - Alphanumeric Machines - Keyboard Arrangement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142	(2007; Errata 2014) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61131-3	(2013) Programmable Controllers - Part 3: Programming Languages

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA 101.01	(2015) Human Machine Interfaces for Process Automation Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2015) Application Guideline for Terminal

	Blocks
NEMA ICS 5	(2017) Industrial Control and Systems: Control Circuit and Pilot Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 79	(2015) Electrical Standard for Industrial Machinery

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 250	(1991) Calibration Services Users Guide

UNDERWRITERS LABORATORIES (UL)

UL 508A	(2018; Reprint Jul 2022) UL Standard for Safety Industrial Control Panels
UL 1059	(2019; Reprint Jul 2022) UL Standard for Safety Terminal Blocks

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. or for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Contractor Design Drawings; G

Draft As-Built Drawings; G

SD-03 Product Data

Control Drawings

Sensors and Meters

Performance Verification Test (PVT)

Factory Test Procedure

SD-06 Test Reports

Factory Test Report

Testing, Adjusting and Commissioning

Performance Verification Test(PVT)

Endurance Test

Turbine Flowmeter

SD-07 Certificates

Control and Sensor Wiring

Ground Rods

Wiring

Installation

SD-10 Operation and Maintenance Data

Training Manual; G

Control System; G

SD-11 Closeout Submittals

Final As-Built Drawings; G

1.3 SITE ENVIRONMENTAL CONDITIONS

The expected site environmental conditions are a minimum of -5 degrees F and a maximum of 100 degrees F.

1.4 SEQUENCING

TABLE I: PROJECT SEQUENCING specifies the sequencing of submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the 'TYPE' column).

1.5.1 Sequencing for Submittals

The sequencing specified for submittals is the deadline by which the submittal must be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon re-submittal there will be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.

1.5.2 Sequencing for Activities

The sequencing specified for activities indicates the earliest the activity may begin.

1.5.3 Abbreviations

In TABLE I the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The process control system must be used to monitor and control the operation of process equipment as specified and in accordance with the sequence of operation and control schematics shown on the drawings. The process control system must provide for operator interaction, overall process control system supervision, and process equipment control and monitoring. The system must adhere to Section 25 05 11 CYBERSECUIRITY OF FACILITY-RELATED CONTROL SYSTEMS. Provide hardware configured and sized to support expansion as specified and shown on the drawings.

The process control system must be complete including sensors, field preamplifiers, signal conditioners, offest and span adjustments, amplifiers, transducers, transmitters, control devices, engineering units conversions and algorithms for the applications; and must maintain the specified end-to-end process control loop accuracy from the sensor to display and final control element. Connecting conductors must be suitable for installed controls. Enclosures must be rated for NEMA 4X, unless noted otherwise on the contract drawings.

2.1.1 Operation

The process control system provided under this specification must operate using a combination of sequential function charts, function block diagrams, structured text, instruction, and ladder logic type as defined in IEC 61131-3 and supervisory control to provide the required sequences of operation. Input data to the controller must be obtained by using instruments and controls interfaced to mechanical, electrical, utility systems and other systems as shown and specified. All required setpoints, settings, alarm limits, and sequences of operation must be as identified in the database/ settings tables and sequences of operation indicated.

2.1.2 Points

Provide inputs to and outputs from the process control system in accordance with the Input/Output (I/O) Summary Table indicated. Each connected analog output (AO), analog input (AI), binary output (BO), binary input (BI), pulse accumulator (PA) input and other input or output device connected to the control system must represent a "point" where referred to in this specification.

2.1.3 Building Telecommunications Cabling (BTC)

Provide data transmission systems for communication between PLCs and between PLCs and the central station and server as specified in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP) and as indicated.

2.1.4 System Reliabilty

The system must be designed for maximum reliability, safety and integrity.

2.2 MATERIALS AND EQUIPMENT

2.2.1 Product Certifications

Computing devices, as defined in FCC Part 15, supplied as part of the process control system must be certified to comply with the requirements

of Class B computing devices.

2.2.2 Standard Products

Materials and equipment must be standard unmodified products of a manufacturer regularly engaged in the manufacturing of such products. Units of the same type of equipment must be products of a single manufacturer. Items of the same type and purpose must be identical and supplied by the same manufacturer, unless replaced by a new version approved by the Government.

2.2.3 Nameplates

Each major component of equipment must have the manufacturer's name and address, and the model and serial number in a conspicuous place. Laminated plastic nameplates must be provided for equipment devices and panels furnished. Each nameplate must identify the device, such as pump "P-1" or valve "VLV-402". Labels must be coordinated with the schedules and the process and instrumentation drawings. Laminated plastic must be 1/8 inch thick, white with black center core. Nameplates must be a minimum of 1 by 3 inches with minimum 1/4 inch high engraved block lettering. Nameplates for devices smaller than 1 by 3 inches must be attached by a nonferrous metal chain. All other nameplates must be attached to the device.

2.3 GENERAL REQUIREMENTS

Equipment located outdoors, not provided with climate controlled enclosure, must be capable of operating in the ambient temperature range. Electrical equipment will conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Equipment and wiring must be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt, corrosive agents, and hazardous area classification.

2.4 SENSORS

2.4.1 Transmitter

Unless indicated otherwise, each sensor must be provided with a transmitter, selected to match the sensor. Except where specifically indicated otherwise on the drawings, the transmitter must be provided with a four digit or analog visual display of the measured parameter and with a 4 to 20 mAdc output signal proportional to the level of the measured parameter. Accuracy must be plus or minus 0.5 percent of full scale reading with output error not exceeding plus or minus 0.5 percent of the calibrated measurement . Transmitter must be located where indicated, mounted integrally with the sensor, pipe mounted, wall mounted or installed in the control panel. The distance between the sensor and transmitter must not exceed the manufacturer's recommendation. Field preamplifiers and signal conditioners must be included when necessary to maintain the accuracy from sensor to the programmable logic controller or recorder.

2.4.2 Off-Gas or Vapor Service

Sensors and meters in off-gas or vapor service must be rated for continuous duty service at fluid approach velocities from 500 to 5000 fpm with correspondingly higher constriction velocities over a fluid temperature range from minus 0 degrees F to 120 degrees F at pressures from

minus 7.2 psi gage up to 100 psi gage.

2.4.3 Liquid Service

Sensors and meters in liquid service must be rated for continuous duty service at fluid approach velocities from 0.327 ft/s to 10 ft/s with correspondingly higher constriction velocities over a fluid temperature range from 32 degrees F to 120 degrees F at pressures up to 100 psi gage.

2.4.4 Flow Rate Sensors and Meters

Liquid flow indication must be provided in gpm. Vapor flow indication must be provided in cubic feet per minute. Pressure taps must incorporate appropriate snubbers. Unless indicated otherwise, the flow transmitter must produce a signal that is proportional to the volumetric flow rate, compensated for fluid temperature, and must have an accuracy of plus or minus 1 percent of the actual flow. Flow transmitter must be located within 15 feet of the flow element. The flow transmitter must include a digital readout of the volumetric flow rate to 3 significant figures. The controller must provide a 4-20 mAdc output signal to the programmable logic controller, proportional to the measured parameter. Flow rate must be controlled to within plus or minus 5 percent of the design flow.

2.4.4.1 Flow Switch

Flow switch must have a repetitive accuracy of plus or minus 10 percent of actual flow setting. Switch actuation must be adjustable over the operating flow range. Flow switch for use in contaminated groundwater system must be rated for use and constructed of suitable materials for installation in the environment encountered. The flow switch must have non flexible paddle with Form C snap action contacts, rated in accordance with NEMA ICS 1.

2.4.4.2 Magnetic Flowmeter

Magnetic flowmeter must be non-intrusive, DC pulse type and must measure fluid flow through the use of a self generated magnetic field. The meter must have automatic zeroing circuitry. The magnetic flow element must be encapsulated in type 300 stainless steel . Flowmeter must be capable of measuring up to a maximum flow velocity of 10 fps. The metering tube must be constructed of 316 stainless steel . The meter must be rated for a process temperature range of 32 to 212 F and 0 to 149F ambient. The maximum pressure drop across the meter and appurtenances must be 5 psi at the maximum flow rate.

2.4.5 Level Instrumentation

Pressure taps must incorporate appropriate snubbers. Relays and housing must be intrinsically safe or explosion proof as required by the NFPA hazard rating for compatibility with the contents of the tank or sump. The controller must provide a 4-20 mAdc output signal to the programmable logic controller, proportional to the measured parameter.

2.4.5.1 Displacement Type Level Switch

Liquid level switch must be displacement type, having a minimum of two tandem floats with each float independently activating a set of Form C contacts at two different level settings. Each switch must have an

adjustable differential band. The mounting connections must be threaded, flanged or surface mounted to suit the application. All surfaces in contact with the tank contents must be austenitic stainless steel. The switch enclosure must be explosion proof for use in a hazardous environment, complete with a sealed water tight junction box, terminal block, and mounting plate. Each set of contacts must be snap action, dry contact type with one normally open and one normally closed, contact rated in accordance with NEMA ICS 1. The switch must be actuated by a magnetically equipped stainless steel displacer. Repetitive accuracy must be plus or minus 1/4 inch of actual displacer setting.

2.4.5.2 Non-Contact Ultrasonic Level Sensor

The sensor must be microprocessor based and must provide continuous, non-contact level measurement of liquids and solids utilizing microwave pulsed time of flight measurement method. Sensor must have pushbutton calibration and LCD display. The sensor must operate in a frequency band approved for industrial use. The sensor must be capable of measuring in a range of 0 to 30 feet with an accuracy of plus or minus .25 percent of full scale and repeatability ±0.125" . The sensor must be capable of distinguishing between real echoes, reflections and background noise. The sensor must automatically compensate for temperature changes. The sensor must be capable of operating in a temperature range from minus 15 degrees F to 120 degrees F. Assembly must be flange mounted of sufficient size to eliminate echoing and suitable for the installed environment indicated. Mounting assembly must be suitable for service without requiring entry or drainage of the vessel where level is being measured.

2.4.5.3 Leak Detection

Double walled containment system leak detectors must use electrodes mounted in the interstices of double walled containment systems with a minimum time delay of 0.5 seconds. Leak detectors for open systems must be mounted at slab or floor level with either a minimum time delay of 0.5 seconds or a minimum built-in-vertical adjustment of 1/8 inch to prevent activation due to high humidity. Detector must have a contact rating of 1.0 amps resistive or 200 mA inductive at 28 VDC.

2.4.6 Pressure Instrumentation

Pressure taps must incorporate appropriate snubbers.

2.4.6.1 Pressure Sensor and Transducer

The sensing element must be either diaphragm type. The pressure transducer must withstand up to 150 percent of rated pressure, with an accuracy of plus or minus 1.0 percent of full scale selected to put the design range of the measured pressure in the middle third of the transducer's range. Pressure must be measured in psi gage with a range, plus or minus 10 percent of design range and must be furnished with display to the nearest 0.145 psi. The transmitter output error must not exceed 0.1 percent of calibrated span.

2.4.6.2 Pressure Switch

Sensors must be diaphragm and must be constructed of 316 stainless steel . Pressure switch must have a repetitive accuracy of plus or minus 1.0 percent of the operating range and must withstand up to 400 percent of

rated pressure.

Switch actuation set point must be adjustable over the operating pressure range the switch. The switch must have Form C snap-action contacts rated in accordance with NEMA ICS 1.

2.4.6.3 Differential Pressure

The sensor/transmitter assembly accuracy must be plus or minus 1 percent of full scale. The over pressure rating must be a minimum of 150 percent of the operating pressure. Transmitter must be suitable for installation with the low pressure connection removed.

2.4.7 Temperature Instrumentation

Temperature sensors may be provided without transmitters. Where transmitters are used, the range must be the smallest available from the manufacturer and suitable for the application such that the range encompasses the expected range of temperatures to be measured. The end to end accuracy includes the combined effect of sensitivity, hysteresis, linearity and repeatability between the measured variable and the end user interface (graphic presentation) including transmitters if used.

2.4.8 Process Analytical Instrumentation

Probes must be easily removable without interrupting service. Sampling pumps must be included where necessary or applicable to the sensing device. For sensors integral to the electronic controller the sample may be drawn directly into the sensor or may be drawn through a sample tube. For sensors remotely located the sample may be drawn through a sample tube. Outdoor sample tubes must be heat traced. Sensor and controller construction must be suitable for operation in the monitored medium. Systems requiring automated zero and calibration gas or reagents must be provided with five days supply of calibration gas or reagent. The controller must be provided with a minimum of three [alarm lights. The first alarm light must indicate when the lower (warning) detection level has been exceeded. The second alarm light hall indicate when the upper (alarm) detection level has been exceeded. The third alarm light must indicate a controller malfunction, including loss of power or loss of sensor input] [sets of dry contacts rated in accordance with NEMA ICS 1. The first set of contacts must close when the lower (warning) detection level has been exceeded. The second set of contacts must close when the upper (alarm) detection level has been exceeded. The third set of contacts must close when a controller malfunction has occurred, including loss of power or loss of sensor input]. The alarm levels must be individually adjustable. The controller must be provided with an audible warning horn that sounds when the upper detection level has been exceeded, and a warning horn silence button. The controller must provide a 4-20 mAdc output signal to the programmable logic controller, proportional to the measured parameter. The controller must be provided with an internal battery to maintain operation for a minimum of 12 hours if power is lost.

2.4.8.1 Oxygen Reduction Potential (ORP)

The sensor must be flow-through type. Sensor must have a redox potential range of plus or minus 1500 mV and must have an accuracy of plus or minus [1] percent of sensor span. The sensor must automatically compensate for

temperature over the temperature range. The sensor body must be suitable for installation in the environment.

2.4.8.2 pH Monitoring

The sensor must be flow-through type. Sensor must have a range of 0. pH units to 14. pH units and must have an accuracy of plus or minus 0.1. pH unit. The sensor must automatically compensate for temperature over the temperature range. The sensor body must be PVC, CPVC or epoxy.

2.4.9 Emergency Stop

Emergency stop pushbutton must have red mushroom actuator and yellow background. Actuator must be self-latching and manually reset. Provide contacts that are NEMA ICS A600 and directly opened. Pushbutton must meet NFPA 79 SECTION 10.7.

2.5 PROGRAMMABLE LOGIC CONTROLLER (PLC)

2.5.1 PLC General Requirements

PLCs must be micro-processor based, capable of receiving binary and analog inputs and, through programming, must be able to control binary and analog output functions, perform data handling operations and communicate with external devices. PLCs must function properly at temperatures between 32 and 122 degrees F at 5 to 95 percent relative humidity non-condensing and must tolerate storage temperatures between minus 40 and plus 140 degrees F at 5 to 95 percent relative humidity non-condensing.

2.5.2 Modular PLC

PLCs must be based on a modular, field expandable design allowing the system to be tailored to the process control application. The system must be expandable through the use of additional hardware and/or user software. As a minimum, the PLC must include a mounting backplane, power supply module, central processing unit (CPU) module, communications module, and input/output (I/O) module. The modules must be grouped together in a mounting rack or cabinet. The mounting rack backplane must provide the communications mechanism to fully integrate the individual modules located within the rack. Modules other than I/O modules must plug directly into the backplane. The use of wire connectors between modules will not be allowed except for expansion of the system to include multiple backplanes. The rack size must be as needed to hold the equipment necessary while performing the required control functions. The system configuration must allow for the removal and/or installation of modules under power.

2.5.2.1 Central Processing Unit (CPU) Module

The CPU module must be a self contained, microprocessor based unit that provides time of day, scanning, application program execution, storage of application programs, storage of numerical values related to the application process and logic, I/O bus traffic control, peripheral and external device communications and self diagnostics. The scan time must be 250 milliseconds or better including spare I/O channels.

2.5.2.2 Communications Module

The communications module must allow peer-to-peer communication with other

PLCs and must allow the PLC to communicate with the central station, or workstation. The communication module must utilize the manufacturer's standard communication architecture and protocol, ethernet architecture and protocol or a combination of these. The communication module must allow programming of the PLC to be done locally through the use of a laptop computer or from the central station or remote workstation.

2.5.2.3 Power Supply Module

One or more power supply modules must be provided as necessary to power other modules installed in the same cabinet. Power supply modules must plug directly into the backplane. Auxiliary power supplies may be used to supply power to remote cabinets or modules.

a. Power supply modules must use AC power with a nominal voltage of 120 VAC plus or minus 5 percent. The power supply module must monitor the incoming line voltage level and must provide over current and over voltage protection. If the voltage level is detected as being out of range the power supply module must continue to provide power for an adequate amount of time to allow for a safe and orderly shutdown. Power supply modules must be capable of withstanding a power loss for a minimum of 20 milliseconds while still remaining in operation and providing adequate power to all connected modules.

b. Each power supply module must be provided with an on-off switch integral to the module. If the manufacturer's standard power supply module is not provided with an on-off switch, a miniature toggle type switch must be installed near the PLC and must be clearly labeled as to its function..

c. Provide power supply modules with an indicating light which must be lit when the module is operating properly.

2.5.2.4 Input/Output (I/O) Modules

Modules must be self contained, microprocessor based units that provide an interface to field devices. Each module must contain visual indication to display the on-off status of individual inputs or outputs. Each I/O must be protected against reversal of polarity of the signal. Analog inputs and analog outputs must have 'open, short and out of range circuit' detection. It must be configurable per channel.

2.5.3 Program Storage/Memory Requirements

The CPU must utilize the manufacturer's standard non-volatile memory for the operating system. The controller must have electronically battery backup volatile memory. Must be possible to change battery with power on for storage of user programs. The user programs must be loaded through the controller keypad, central station or through the use of a laptop computer. The CPU memory capacity must be based on the system's control requirements. The memory capacity must be sized such that, when the system is completely programmed and functional, no more than 50 percent of the memory allocated for these purposes is used.

2.5.4 Input/Output Characteristics

Each controller must allow for analog input, analog output, binary input and binary output. The number and type of inputs and outputs for the system must be as shown on the drawings and must comply with the sequence

of control. The system capacity must include a minimum of 20 percent spare input and output points (no less than two points) for each point type provided. During normal operation, a malfunction in any input/output channel must affect the operation of that channel only and must not affect the operation of the CPU or any other channel. All input circuits must have a minimum optical isolation of 1500 VRMS and must be filtered to guard against high voltage transients from the externally connected devices. All output circuits must have a minimum optical isolation of 1500 VRMS and must be filtered to guard against high voltage transients from the externally connected devices.

2.5.4.1 Analong Inputs

Analog input circuits must be available in 4-20 mA.

2.5.4.2 Binary Inputs

Binary input circuits must be available in 10-30 VDC or 79-132 VAC.

2.5.4.3 Analog Outputs

Analog output circuits must be available in 4-20 mA.

2.5.4.4 Binary Outputs

Binary output circuits must be available in 10-30 VDC or 79-132 VAC.

2.5.5 Wiring Connections

Wiring connections must be heavy duty, self lifting, pressure type screw terminals to provide easy wire insertion and secure connections. The terminals must accept two #14 AWG wires. A hinged protective cover must be provided over the wiring connections. The cover must have write-on areas for identification of the external circuits.

2.5.6 Diagnostics

Each PLC must have diagnostic routines implemented in firmware. The CPU must continuously perform self-diagnostic routines that will provide information on the configuration and status of the CPU, memory, communications and input/output. The diagnostic routines must be regularly performed during normal system operation. A portion of the scan time of the controller must be dedicated to performing these housekeeping functions. In addition, a more extensive diagnostic routine must be performed at power up and during normal system shutdown. The CPU must log input/output and system faults in fault tables which must be accessible for display. When a fault affects input/output or communications modules the CPU must shut down only the hardware affected and continue operation by utilizing the healthy system components. All faults must be annunciated at the PLC and the central station. Diagnostic software must be useable in conjunction with the portable tester. The following diagnostics must be performed:

a. Analog Inputs: Sensor out of range, open or shorted loop, analog-to-digital converter check

b. Analog Outputs: Open or shorted loop

c. Configuration: Check compatibility and availability of selected I/O hardware and software

d. Memory: Checksum, parity check End-to End CPU memory

2.5.7 Accuracy

Provide controllers with an accuracy of plus or minus 0.25 percent of input span.

2.6 PLC SOFTWARE

Furnish all PLC software described in this specification as part of the complete control system.

2.6.1 Operating System

Each PLC must be provided with the manufacturer's standard operating system software package. The PLC must maintain a point database in its memory that includes all parameters, constraints and the latest value or status of all points connected to the PLC. Execution of the PLC application programs must use the data in memory resident files. The operating system must support a full compliment of process control functions. It must be possible to define these functions using a mix of ladder logic diagrams, function blocks, sequential function charts and text programming. Programming methods and interactions must be based on IEC 61131-3. A combination of the programming methods must be possible within a single controller. The operating system must allow loading of control logic locally or remotely from a designated workstation. It must also support data entry and diagnostics using an operator interface panel attached directly to the PLC. Each PLC must be capable of operating in stand alone mode.

2.6.1.1 Startup

The PLC must have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.

2.6.1.2 Failure Mode

Upon failure for any reason, each PLC must force all PLC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device. Primary/Secondary systems must transfer I/O scan and control to the PLC not currently failed.

2.6.2 Functions

The controller operating system must be able to scan inputs, control outputs, and read and write to its internal memory in order to perform the required control as indicated in the sequence of control on the drawings. The controller must periodically perform self diagnostics to verify that it is functioning properly.

2.6.2.1 Analog Monitoring

Measure and transmit all analog values including calculated analog points.

2.6.2.2 Logic (Virtual)

Logic (virtual) points must be software points entered in the point database which are not directly associated with a physical I/O function. Logic (virtual) points must be analog or binary points created by calculation from any combination of binary and analog points, or other data having all the properties of real points, including alarms, without the associated hardware. Logic (virtual) points must be defined or calculated and entered into the database. The calculated analog point must have point identification in the same format as any other analog point.

2.6.2.3 State Variables

If an analog point represents more than two (up to 8) specific states, each state must be nameable. For example, a level sensor must be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

2.6.3 Alarm Processing

Each PLC must have alarm processing software for AI, DI, and PA alarms for all real and virtual points connected to that PLC.

2.6.3.1 Binary Alarms

Binary alarms are those abnormal conditions indicated by BIs as specified and shown. The system must automatically suppress analog alarm reporting associated with a binary point when that point is turned off.

2.6.3.2 Analog Alarms

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings must be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits must be assigned to each analog point in the system. In control point adjustment (CPA) applications, key the limit to a finite deviation traveling with the setpoint. The system must automatically suppress analog alarm reporting associated with an analog point when that analog point is turned off.

2.6.4 Constraints

2.6.4.1 Equipment Constraints Definitions

Each control point in the database must have PLC resident constraints defined and entered by the Contractor, including as applicable: maximum starts (cycles) per hour; minimum off time; minimum on time; high limit (value in engineering units); and low limit (value in engineering units).

2.6.4.2 Constraints Checks

All control devices connected to the system must have the PLC constraints checked and passed before each command is issued. Each command point must have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value must be assigned to each AI. Each individual point must be capable of being selectively disabled by the operator from the central station.

2.6.5 Control Sequences and Control Loops

Specific functions to be implemented are defined in individual system control sequences and database tables shown on the drawings, and must include, as applicable, the following functions: PI control must provide proportional control and proportional plus integral control; two position control must provide control for a two state device by comparing a set point against a process variable and an established dead band; floating point control must exercise control when an error signal exceeds a selected dead band, and must maintain control until the error is within the dead band limits; signal selection must allow the selection of the highest or lowest analog value from a group of analog values as the basis of control and must include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs; signal averaging must allow the mathematical calculation of the average analog value from a group of analog values as the basis of control and must include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control; reset function must develop an AO based on up to two AIs and one operator specified reset schedule.

2.7 CONTROL PANELS

2.7.1 Components

2.7.1.1 Enclosures

The enclosure for each control panel must conform to the requirements of NEMA 250 for the types specified. Finish color must be the manufacturer's standard, unless otherwise indicated. Enclosures for installation in mechanical equipment rooms must be Type 12; those for installation in clean, dry indoor occupied space may be Type 1; other locations must be as otherwise specified or shown. Enclosures for equipment installed outdoors must be Type 4X or as shown. Enclosures for installation in a corrosive environment must be Type 4X and must be constructed of stainless steel . Painted steel must not be allowed for use in a corrosive environment. Enclosure must be provided with a single, continuously hinged exterior door with print pocket, 3-point latching mechanism and key lock and a single, continuously hinged interior door.

2.7.1.2 Controllers

Provide controllers in accordance with paragraph Programmable Logic Controller (PLC).

2.7.1.3 Standard Indicator Light

Indicator lights showing on, off, stand-by, automatic, manual depending on the application must comply with NEMA ICS 1, NEMA ICS 2 and UL 508A. Lights must be heavy duty, round and must mount in a 0.875 inch mounting hole. Indicator lights must be LED type and must operate at 120 VAC or 24 VDC. Long life bulbs must be used. Indicator light must be provided with a legend plate labeled as shown on the drawings. Lens color must be as indicated on the drawings. Lights must be push to test (lamp) type.

2.7.1.4 Selector Switches

Selector switches must comply with NEMA ICS 1, NEMA ICS 2 and UL 508A.

Selector switches must be heavy duty, round and must mount in a 0.875 inch mounting hole. The number of positions must be as indicated on the drawings. Switches must be as indicted of the drawings. Switches must be rated for 600 volts, 10 amperes continuous. Selector switches must be provided with a legend plate labeled as shown on the drawings. Where indicated or required, dual auxiliary contacts must be provided for the automatic position to provide position sensing at the central station or workstation. Auxiliary contacts must be rated for 120 VAC, 1A as a minimum.

2.7.1.5 Push Buttons

Push buttons must comply with NEMA ICS 1, NEMA ICS 2 and UL 508A. Push buttons must be heavy duty, round and must mount in a 22.5 mm 0.875 inch mounting hole. The number and type of contacts must be as indicated on the drawings or required by the Sequence of Control. Push buttons must be rated for 600 volts, 10 amperes continuous. Push buttons must be provided with a legend plate labeled as shown on the drawings.

2.7.1.6 Relays

Relays must comply with NEMA ICS 5 and derated for altitude above 1,500 m. Relays must be as required by the Sequence of Control. Relay coil must be as required by the drawings and must be provided with matching mounting socket. Power consumption must not be greater than 3 watts.

2.7.1.7 Terminal Blocks

Terminal blocks must comply with NEMA ICS 4 and UL 1059. A terminal identification strip must form part of the terminal block and each terminal must be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

2.7.1.8 Alarm Horns

Alarm horns must be provided where indicated on the drawings. Horns must be vibrating type and must comply with UL 508A. Horns must provide 100 dB at 10 feet. Exterior mounted horns must be weather proof by design or must be mounted in a weather proof enclosure that does not reduce the effectiveness of the horn.

2.7.2 Panel Assembly

Control panels must be factory assembled and shipped to the jobsite as a single unit. Panels must be fabricated as indicated and devices must be mounted as shown or required. Each panel must be fabricated as a bottom or side-entry connection point for process control system electrical power, process control system wiring, and communications system wiring to other control panels.

2.7.3 Electrical Requirements

Each panel must be powered by a dedicated circuit, as shown on the contract drawings.

2.7.4 Grounding

Control panel enclosures must be equipped with a solid copper ground bus or equivalent. The ground bus must be securely anchored to the enclosure

so as to effectively ground the entire structure. Clamp-type terminals sized large enough to carry the maximum expected current must be provided on the ground bus for grounding cables. Where a definite circuit ground is required, a single wire not less than #10 AWG must run independently to the panel ground bus and must be fastened to the ground bus with a bolted terminal lug. Cases of instruments, relays and other devices must be effectively grounded through the enclosures steel structure unless otherwise indicated. Insulated wiring having a continuous rated current of not less than the circuit fuse rating must be used for grounding. Grounding terminals of power receptacles must be solidly grounded to the panel enclosure.

2.7.5 Convenience Outlet

A 120 volt ac, 5 amp, ground fault interruption (GFI) type duplex convenience outlet(s) must be provided as indicated on drawings.

2.7.6 Panel Interior Light

Where indicated, control panels must be provided with an LED light, size as indicated on drawings. The light must be operated by an on-off switch mounted on the interior door of the enclosure.

2.8 COMPUTER HARDWARE

For computer hardware furnished under this specification provide standard products of a single manufacturer which advertises service in all 48 contiguous states, and provide only model currently in production.

2.8.1 Server Hardware

Computer Server Hardware (server) must be a desktop or server computer meeting the following minimum requirements:

2.8.1.1 Processor

Minimum Quad-core processor designed for server applications. Processor speed must be at least 50 percent of the speed of the fastest Intel server processor commercially available.

2.8.1.2 Random Access Memory (RAM)

300 percent of the recommended requirements of the software to be installed on the serverand no less than 32GB.

2.8.1.3 Communications Ports

Four USB 3 3.0 3.1 ports.

2.8.1.4 Hard Drives

2.8.1.4.1 Internal Hard Drives

Solid State Hard drives with SATA-3 Controller providing at least 1TB usable disk space. Hard drives must use RAID (Redundant Array of Inexpensive Disks) at levels 1 or 5 (RAID-1 or RAID-5).

2.8.1.5 Video Output

32-bit color at a minimum resolution of 1920 by 1080 at a minimum refresh rate of 70 Hz and a DVI or display port output.

2.8.1.6 Network Interface

Minimum Two integrated 1000Base-T Ethernet with RJ45 connector.

2.8.1.7 Monitor

Widescreen flat panel LCD monitor sized as indicated but no less than 24 inch nominal with a minimum resolution of 1920 by 1080 pixels and a minimum refresh rate of 70Hz.

2.8.1.8 Keyboard

101 key wired or wireless USB keyboard having a minimum 64 character standard ASCII character set based on ANSI INCITS 154.

2.8.1.9 Mouse

2-button wired or wireless USB optical scroll mouse with a minimum resolution of 400 dots per inch.

2.8.1.10 Power Supplies

Dual, fully redundant power supplies.

2.8.2 Workstation Hardware (Desktop and Laptop)

Provide a standard desktop computer or a laptop meeting the following minimum requirements for the Computer Workstation Hardware (workstation).

2.8.2.1 Processor

2.8.2.1.1 Desktop

Minimum Quad-core processor designed for desktop applications.

2.8.2.1.2 Laptop

Minimum Quad-core processor designed for laptop applications.

2.8.2.2 Random Access Memory (RAM)

200 percent of the recommended requirements of the software to be installed on the server and no less than 16GB.

2.8.2.3 Communications Ports

2.8.2.3.1 Desktop

Minimum two USB ports, RJ-45 Ethernet port.

2.8.2.3.2 Laptop

Two USB ports, RJ-45 Ethernet port.

2.8.2.4 Hard Drive and Controller

2.8.2.4.1 Desktop

Minimum 1 TB or larger with a SATA-3 controller.

2.8.2.4.2 Laptop

1TB or larger solid state drive.

2.8.2.5 Video Output

2.8.2.5.1 Desktop

32-bit color with dual monitor support minimum resolutions of 1920 by 1080 at minimum refresh rates of 70 Hz and dual DVI or display port outputs.

2.8.2.5.2 Laptop

32-bit color with a minimum resolution of 1920 by 1080 at minimum refresh rates of 70 Hz and DVI or HDMI output.

2.8.2.6 Network Interface

2.8.2.6.1 Desktop

Integrated 1000Base-T Ethernet with RJ45 connector.

2.8.2.6.2 Laptop

Integrated 1000Base-T Ethernet with RJ45 connector.

2.8.2.7 Monitor

2.8.2.7.1 Desktop

Dual widescreen flat panel LCD monitors sized as indicated but no less than 24 inch nominal with minimum resolutions of 1920 by 1080 pixels and a minimum refresh rate of 70Hz.

2.8.2.7.2 Laptop

LCD Screen sized as indicated but no less than 13 inch nominal with a minimum supported resolution of no less than 1920 by 10800 pixels.

2.8.2.8 Keyboard

2.8.2.8.1 Desktop

101 key wired or wireless USB keyboard having a minimum 64 character standard ASCII character set based on ANSI INCITS 154

2.8.2.8.2 Laptop

Standard laptop keyboard.

2.8.2.9 Mouse

2.8.2.9.1 Desktop

2-button wired or wireless USB optical scroll mouse with a minimum resolution of 400 dots per inch.

2.8.2.9.2 Laptop

Integrated touch-pad plus a 2-button wired or wireless USB optical scroll mouse with a minimum resolution of 400 dots per inch.

2.8.2.10 Printers

Provide local or network printers as indicated. Provide local printers which have a USB interface. Provide network printers which have a 100Base-T or faster interface with an RJ45 connection.

2.8.2.10.1 Laser Printer

Provide laser printers as indicated meeting the following minimum requirements:

Resolution 600 by 600 dots per inch
Printing Time 10 pages per minute
Data Buffer Size 16 Megabytes
Media Type Paper and transparency film
Media Size ANSI A(216 by 279 mm 8.5 by 11 inches) or 11 by 17 inches [Color] and other sizes as indicated
Paper Cassette 250 sheet capacity

2.8.3 Uninterruptible Power Supply (UPS)

A self contained UPS suitable for installation and operation at the Server and Workstation must be provided. The unit[s] must be sized to provide a minimum of 5 minutes of operation of the central station [and operator's workstation] computer. The UPS must incorporate surge suppression, noise filtering (normal and common mode) short circuit protection and voltage regulation (brownout and overvoltage protection). UPS must be complete with all necessary power supplies, transformers, batteries, and accessories and must include visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of low battery power. The UPS must comply with the Federal Communications Commission Standard 15J part A for radio noise emissions.

2.9 TOUCHSCREEN HMI

Human Machine Interface (HMI) display screens must be supplied to provide an interface to the PLC. The touch screens must be compatible with the specific PLC being furnished. Locate touch screens in the cabinets as shown in the Contract Drawings. The touch screens must provide maintenance information and indication of the systems. The touch screens must be 15" minimum panel mount with a minimum resolution of 1024x768. Provide operator interface as shown on the Contract Drawings or approved equal.

2.9.1 TOUCHSCREEN HMI Display Layout

Develop HMI control and supervision display layouts complying with the minimum requirements of the Control Narrative in the Contract Drawings.

Submit for approval prior to implementation.

2.10 MONITORING AND CONTROL SOFTWARE

Provide a single software package which implements the SCADA, Alarming, Trending, Graphical System Display, and System Display Editor functionality. Other specified M&C functionality may be implemented in the same software package or in additional software packages. The monitoring and control software must provide the communication, programming and control capabilities necessary to support all specified points and functions, plus a minimum expansion of 20 percent of the current number of points, complete with their point database. The monitoring and control station must be online at all times and must perform all required functions as specified. Where multiple modules are used the modules must be capable of sharing data and operating together seamlessly. Software must be a client-server software package with a graphical user interface (GUI) using either thick or thin (web-based) clients. The system must support multiple user operation with multiple tasks for each user and must support operation and management of all peripheral devices.

2.10.1 M&C Software Update Licensing

In addition to all other licensing requirements, provide M&C Software licensing which includes licensing of the following software updates for a period of no less than 3 years:

a. Security and bug-fix patches issued by the M&C Software manufacturer.

b. Security patches to address any vulnerability identified in the National Vulnerability Database at http://nvd.nist.gov with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

2.10.2 Graphical Operations

2.10.2.1 Graphical User Interface

The central station must be provided with a mouse driven, graphical user interface.

2.10.2.2 Display Information

The central station must display information necessary to support all requirements specified, including: operator commands; alarm notification; reports; system graphics as specified and as shown, incorporating dynamic data; and curve plotting.

2.10.2.3 System Graphics Implementation

System graphics displays must be hierarchical displays which integrate dynamic data into the display. System graphics must reflect actual system configuration. Each system schematic must be included as a separate display. Different colors, textures, and use of inverted video must be used for various components and dynamic data. The displays must include standard and/or custom symbols. A library of callable display symbols containing symbols for all necessary equipment and control devices must be furnished. Symbols must conform to ISA 101.01 where applicable. Data associated with a display must be updated within 5 seconds of the

binary status change or the analog change in excess of the analog change differential. Any dynamic data which is not current, due to PLC communications failure, PLC failure, or point out of service, must be highlighted or flagged.

2.10.2.4 Display Editor

The display editor must enable the user to create, modify, save and delete displays and symbols. Within the display there must by dynamic fields with the function of linking the dynamic fields with the database and must be executed automatically as the last step of the database generation and modification procedure.

2.10.2.5 Graphical Programming

The system must include a graphical programming function which must be used to create all control sequences utilized in the control panels. This function must reside in the central station to create, modify, and test software for control panel resident programs. Program elements must be able to be combined into a custom template which can then be used as a standard function. Program checkout and debug facilities must include display of dynamic and/or simulated system variables and points on the programming screens. The user must be able to fix or force values of variables to enable program checkout during debugging.

2.10.2.6 System Menus and Displays

The user must be able to call up the following displays by dedicated function key, pull down menu or by icon and must be able to page forward and backward on linked multiple page displays. The system menu and index displays must also contain icons which can be used to call up subsequent displays.

a. System Menu (list of all graphics and menus).

b. Index (list of all PLCs).

c. Alarm Summary (list of active, acknowledged and unacknowledged alarms).

d. Historic Trends (site specific trend charts and for analog and discrete data).

e. Network Health (graphically display communication status to PLC(s), Control Panels, etc)

2.10.2.7 Hard-Copy Screen Request

The central station must be able to obtain a hard copy of the monitor display being viewed. This must be an exact "snapshot" of the data and device symbols shown on the selected monitor.

2.10.3 Command Software

The software must provide for defining and selecting points, parameters, graphics, report generation, and all other functions associated with operation. The operator commands must be usable from central station computer and workstation keyboards with individual operator passwords as specified.

2.10.4 Alarms

Provide M&C Software meeting the following minimum requirements for alarms:

a. The M&C software must be capable of generating alarms by comparing the value of any point from any connected system to user-configurable limits and must notify an operator of the occurrence of an alarm condition. The process control system alarm history must be stored and must be recallable by the operator using the report generator.A minimum of the most recent 25 system alarms must be directly available at the central station computer. Operator acknowledgment of one alarm must not be considered as acknowledgment of any other alarm nor must it inhibit reporting of subsequent alarms. Alarm data to be displayed and stored must include: identification of the alarm; date and time to the nearest second of occurrence; device or sensor type; limit exceeded (if analog); engineering units; current value or status; alarm class; and alarm messages.

b. The M&C software must support at least two alarm priority levels: critical and informational. Critical alarms must remain in alarm until acknowledged by an operator and the alarm condition no longer exists; informational alarms must remain in alarm until the alarm condition no longer exists or until the alarm is acknowledged.

c. The creation, modification, and handling (routing) of alarms must be fully accessible and fully adjustable from the graphical user interface.

d. Alarm Data. Alarm data to be displayed and stored must include:

1) Identification of alarm including building, system (or sub-system), and device name.

2) Date and time to the nearest second of occurrence.

3) Alarm type:

4) Unreliable: Indicates that the source device has failed due to the sensing device or alarm parameter being out-of-range or bad data.

5) High Alarm.

6) Low Alarm.

7) Current value or status of the alarm point, including engineering units

8) Alarm limits, including engineering units.

9) Alarm priority.

10) Alarm Message: A unique message with a field of at least 60 characters.

11) Acknowledgement status of the alarm including the time, date and user of acknowledgement.

2.10.4.1 Binary Alarms

Binary alarms must be subject to immediate reporting, within the alarm

response time, at the central station.

2.10.4.2 Analog Alarms

These alarms must be subject to immediate reporting, within the alarm response time, at the central station. The control panel analog readings must be compared to predefined high and low limits, and alarmed to the central station each time a value enters or returns from a limit condition. For those applications where setpoint adjustments are made, the alarm limit must be keyed to a finite deviation traveling with the setpoint.

2.10.4.3 Alarm Messages

A unique message with a field of 60 characters must be provided for each alarm.

2.10.5 Pop-up Note Function

A pop-up note function must be included with the workstation, providing the operator a capability of noting any data which may be associated with alarms or with any other event. A note created by an operator must be automatically called up when any other workstation calls up the associated point, alarm, or alarm summary. The pop-up note function must also support free form entry of data which can be used by any workstation operators as general reminders or instructions.

2.10.6 Real Time Clock Synchronization

The system must synchronize each central station computer, real time clock, within one second and at least once per day automatically, without operator intervention and without requiring system shutdown. The central station computer must automatically initiate a call once per day to the NIST clock to obtain the correct time and date and update the real time clock.

2.10.7 System Reaction

Under system normal heavy load, no more than 10 seconds must lapse from the time a binary status alarm or analog alarm occurs at a PLC until the change is displayed at the central station [and operator's workstation]. The total system response time from initiation of a control action command to display of the resulting status change must not exceed 20 seconds under system normal heavy load conditions, assuming a zero response time for operation of the PLC's control device. The alarm printer must continue to print out all occurrences, including time of occurrence, to the nearest second. All system normal heavy load conditions must be introduced to the system via AIs and DIs.

2.10.8 Report Generator

Software must be provided to generate and format standard and custom reports for displaying, printing, and storing on disk. Reports must use database values and parameters, values calculated using the real time static database or historical data base; with the reports subsequently stored on hard disk or Network Attached Storage (NAS). Dynamic operation of the system must not be interrupted to generate a report. The report must contain the time and date when the report was printed. The software must allow for automatic and manual generation of reports. For automatic reports an operator must be able to specify the time the initial report is

to be generated, the time interval between reports, end of period, and the output format for the report. Manual report generation must allow for the operator to request at any time the output of any report.

2.10.8.1 Periodic Automatic Report

The system must allow for specifying, modifying, or inhibiting the report to be generated, the time the initial report is to be generated, the time interval between reports, end of period, and the output peripheral.

2.10.8.2 Request Report Mode

The system must allow for the operator to request, at any time, an immediate printout of any report.

2.10.9 Data Interchange

The M&C Software and Reporting Software shall have the ability to format and store on a local hard drive or Network Attached Storage (NAS) the data, trends, profiles, reports and logs as specified in a defined, standard format such as ASCII text or DIF for export and further processing by other software and/or computer systems.

2.10.10 Control Panel and DTS Circuit Alarms

The system must supervise each control panel, I/O function and DTS circuit for alarm reporting, including: control panel not responding; control panel responding (return to normal); control panel intrusion alarm; control panel offline; control panel online (return to normal); control panel failure (self-diagnostics); point not responding to command; and point change of state without command.

2.10.11 Central Station Database

The central station database must be stored on disk and in memory.

2.10.11.1 Database Definition Process

Software must be provided to define and modify each point in the database using operator commands. The definition must include all physical parameters and constraints associated with each point. Each database item must be callable for display or printing, including EEPROM, ROM and RAM resident data. Each point must be defined and entered into central station database.

2.10.11.2 Dynamic Database

The dynamic database includes those variables which change with time or conditions including all DIs, AIs, PAs, and virtual (logic) points.

2.10.11.3 Static Database

The static database includes those fixed parameters and constraints from all PLCs which define the characteristics of the system and I/O functions such as alarm limits, start/stop times, point names, PLC channel addresses, and sensor spans.

2.10.11.4 Workstation Access to Dynamic Data

Any workstation with proper access password and connected to the central station via the process control network must have access to the central station's dynamic data. Display of data must commence within 5 seconds.

2.10.12 Historical Data Storage and Retrieval

A historical data storage and retrieval function must be provided at the central station to collect and store dynamic data. This function must be in addition to other data storage requirements. The storage function must also have the capability to collect and store multiple sets of analog and discrete data at pre-specified sampling rates. This function must have the capability to retain historical data on hard disk for an unlimited duration. The operator must also be able to selectively recall all data stored on hard disk. Retrieval and printing of the contents of any selected historical data file must be available using the data retrieval and report generation program. The output of the report generation program must be capable of being viewed on the screen, printed in a report, or stored.

2.10.13 Trending

Provide M&C software capable of creating, modifying, uploading and archiving Point properties and performing real-time display of point properties.

a. The M&C Software must include a graphical display for trend configuration, creation and deletion accessible through the graphical user interface. Each trend must be user-configurable for:

   (1) Point to trend.

   (2) Sampling interval: adjustable between 1 second and 1 hour.

   (3) Start and Stop Time of Trend: Start and stop times determined by one or more of the following methods:

      (a) Start time and stop time

      (b) Start time and duration

      (c) Start time and number of samples

b. The M&C software must be capable of displaying and printing a graphical representation of each trend, and of multiple trended points on the same graph. The software must be capable of saving trend logs to a file. If the file format is not plain ASCII text in a Comma-Separated-Value (CSV) format, provide a means to export or convert the file to plain ASCII text in a CSV format.

2.10.14 Analog Monitoring

The system must measure, transmit, and display analog values, including calculated analog points. Differential measurements must be displayed as positive or negative values with respect to their reference points shown. Displays and reports must express analog values in proper engineering units with sign. Provide 128 different sets of engineering unit conversions. Each engineering conversion unit must include range, span,

and conversion equation.

2.10.15 LAN Software

A network operating system must be supplied as part of the LAN software. The network operating system must support network device access to the central station. The network must provide network access to shared peripherals. The LAN software must provide for transparent communication with any node on the system. The LAN software must support the following:

2.10.15.1 Access Control

Access control to the central station computer and workstations. Operators must be able to perform all specified functions, given the proper passwords, including database definition/modification, graphic creation/modification, and trending.

2.10.15.2 Other Functions and Configurations

2.10.16 Virus Protection Software

Provide Virus Protection Software consisting of the project site's standard virus protection software complete with a virus definition update subscription.

2.10.17 Disk Imaging (Backup) Software

Provide Disk imaging (backup) software capable of performing a bare-metal restore (imaging and restoring to a new blank hard drive such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software).

2.11 DATA COMMUNICATION REQUIREMENTS

Process control system data communications must support the specified functions and process control system configuration shown on the drawings.

2.11.1 Central Station/PLC

The central station must be able to initiate an upload or download of PLC data programs.

2.11.2 Communication

Communication with other computer systems must be accomplished using an Ethernet communications port. The central station or workstation must be able to initiate upload or download of data files.

2.12 FACTORY TEST

The process control system must be tested at the factory prior to shipment. Written notification of planned testing must be given to the Government at least 21 days prior to testing, and in no case must notice be given until after the Contractor has received written Government approval of the test procedures.

2.12.1 Factory Test Setup

Assemble and integrate the factory test setup as specified to prove that

performance of the system satisfies all requirements of this project, including system communications requirements in accordance with the approved test procedures. The factory test must take place during regular daytime working hours on weekdays. Equipment used must be the same equipment that is to be delivered to the site. The factory test setup must include the following:

Factory Test	
central station equipment	one each of the components
workstation	one of each type
control panel	not less than two control panels: at least one of each type used in the system plus at least one per DTS type
test set	one of each type
communications circuits	one of each type and speed to be utilized in the proposed system including bridges, modems, encoder/decoders, transceivers and repeaters
surge protection equipment	for power, communications, I/O functions and networks
I/O functions	sufficient to demonstrate the I/O capability and system normal operation
software	software required for proper operation of the proposed system including application programs and sequences of operation

2.12.2 Factory Test Procedure

Test procedures must define the tests required to ensure that the system meets technical, operational, and performance requirements. The test procedures must define location of tests, milestones for the tests, and identify simulation programs, equipment, personnel, facilities, and supplies required. Provide for testing all process control system capabilities and functions specified and shown. Cover actual equipment and sequences to be used for the specified project and include detailed instructions for test setup, execution, and evaluation of test results. The test reports must document results of the tests. Surge testing need not be conducted acceptable documented proof can be provided that such testing has been satisfactorily demonstrated to the Government with identical surge protection applied. The procedures must include the following:

	Test Procedure
equipment	block diagram
hardware and software	descriptions
commands	operator commands
I/O functions	test database points with failure modes
passwords	required for each operator access level
each type of digital and analog point in the test database	description
test equipment	list
surge protection	circuit diagrams
inputs required (I/O point values and status) and corresponding expected results of each set of input values	for each application program
default values	for the application program inputs not implemented or provided for in the contract documents for the application programs to be tested

2.12.3 Factory Test Report

Submit original copies of data produced during the factory test, including results of each demonstration procedure within 7 days after completion of each test. Arrange the report so that commands, responses, and data acquired are correlated to allow logical interpretation of the data.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

3.1.1 Installation

Install system components and appurtenances in accordance with the manufacturer's instructions and provide necessary interconnections, services, and adjustments required for a complete and operable system. Adjust or replace devices not conforming to the required accuracies. Replace factory sealed devices, rather than adjusting. Installation, adjustment, and operation of the equipment specified must be supervised by a manufacturer's representative experienced in the installing, adjusting, and testing of the equipment.

a. Install instrumentation and communication equipment and cable grounding as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

b. Install wiring in exposed areas, including low voltage wiring, in rigid conduit as specified in Section 26 20 00 INTERIOR DISTRIBUTION

SYSTEM. Wiring in air plenum areas installed without conduit must be plenum-rated in accordance with NFPA 70.

c. Submit detail drawings containing complete piping, wiring, schematic, flow diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Piping and Instrumentation (P&ID) drawings (prepared using industry recognized device symbols, clearly defined and describing piping designations to define the service and materials of individual pipe segments and instrument tags employing Instrument Society of America suggested identifiers). Include in the Drawings, as appropriate: product specific catalog cuts; a drawing index; a list of symbols; a series of drawings for each process control system using abbreviations, symbols, nomenclature and identifiers as shown; valve schedules; compressed instrument air station schematics and ASME air storage tank certificates for each type and make of compressed instrument air station.

3.1.1.1 Isolation, Penetrations and Clearance from Equipment

Dielectric isolation must be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exteriors must be made watertight. Holes in concrete, brick, steel and wood walls must be drilled or core drilled with proper equipment; conduits installed through openings must be sealed with materials which are compatible with existing materials. Openings must be sealed with materials which meet the requirements of NFPA 70 and Section 07 84 00 FIRESTOPPING. Installation must provide clearance for control-system maintenance. Process control system installation must not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.1.2 Device Mounting

Devices must be installed in accordance with manufacturers' recommendations and as shown. Control devices to be installed in piping must be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Any deviations must be documented and submitted to the Government for approval prior to mounting. Damaged insulation must be replaced or repaired after devices are installed to match existing work. Damaged galvanized surfaces must be repaired by touching up with zinc paint.

3.1.1.3 Grooved Mechanical Joints

Grooves must be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools must be the products of the same manufacturer. Pipe and groove dimensions must comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field must be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe must be measured and recorded.

3.2 INSTALLATION OF EQUIPMENT

Install equipment as specified, as shown and as required in the

manufacturer's instructions for a complete and fully operational control system.

3.2.1 Control Panels

Control panels must be located as indicated on the drawings. Devices located in the control panels must be as shown on the drawings or as needed to provide the indicated control sequences.

3.2.2 Flow Measuring Device

Fluid flow instruments must be installed in accordance with manufacturer's recommendations, unless otherwise indicated in the specification. The minimum straight unobstructed piping for flowmeter installation must comply with manufacturer recommendations. Meters for gases and vapors must be installed in vertical piping, and meters for liquids must be installed in horizontal piping, unless otherwise recommended by the manufacturer or indicated in the specifications.

3.2.2.1 Magnetic Flowmeter

Meter must be installed in vertical piping so that the flow tube remains full of the process fluid under all operating conditions. The minimum straight unobstructed piping for flowmeter installation must comply with manufacturer recommendations. The flowmeter and piping system must be grounded to earth ground.

3.2.3 Level Instruments

3.2.3.1 Ultrasonic Level Sensor

Sensor must be installed vertically in the top of the tank and in accordance with the manufacturer's instructions. Switches must be accessible for maintenance and calibration. In applications where switches cannot be directly mounted to a tank by the threaded or flanged connection, a mounting bracket must be provided for connection to the inside tank wall. Sensor must be positioned to maximize the return echo signal and minimize vessel obstructions in the sensors line of sight. The minimum recommended distance from the tank fill opening and from the side of the tank must be maintained.

3.2.4 Pressure Instruments

Pressure sensors and pressure transducers must be verified by calibration. All pressure taps must incorporate appropriate snubbers. Pressure sensors and pressure switches must have valves for isolation, venting, and taps for calibration. Pressure switches and pressure transducers installed on liquid or steam lines must have drains. Pressure transducers, differential pressure sensors and differential pressure switches must have nulling valves. Pressure switches must be adjusted to the proper setpoint and must be verified by calibration. Switch contact ratings and duty must be selected for the application.

3.2.5 Temperature Instrument Installation

3.2.5.1 RTD

RTDs used for space temperature sensing must include a housing suitable for wall mounting. RTD assemblies must be readily accessible and

installed to allow easy replacement.

3.2.6 Process Analytical Instrumentation

3.2.6.1 PH and ORP Sensor

Pipe mounted flow sensor must be located in a threaded tee or fitting to allow removal from the pipe. Submersible sensor must be completely immersed in the fluid being monitored using an ensemble that will allow for removal of the sensor from the fluid for replacement. The sensor must be located in an area of continuous flow. The transmitter must be located remote from the sensor. The transmitter must be mounted to allow the digital readout to be easily viewed.

3.2.7 Electric Power Devices

3.2.7.1 Transducers

Transducers must be wired in accordance with the manufacturer's instructions.

3.2.8 Output Devices

Output devices (transducers, relays, contactors, or other devices) which are not an integral part of the control panel, must be mounted in an enclosure mounted adjacent to the control panel, unless otherwise shown. Where H-O-A and/or override switches on the drawings or required by the control sequence, the switches must be installed so that the process control system controls the function through the automatic position and other controls work through the hand position.

3.2.9 Enclosures

All enclosure penetrations must be from the bottom or side of the enclosure, and must be sealed to preclude entry of water using a silicone rubber sealant.

3.2.10 Transformers

Transformers for control voltages below 120 VAC must be fed from the nearest power panel or motor control center, using circuits provided for the purpose. Provide a disconnect switch on the primary side and a fuse on the secondary side. Transformers must be enclosed in a steel cabinet with conduit connections.

3.3 WIRE, CABLE AND CONNECTING HARDWARE

3.3.1 LAN Cables and Connecting Hardware

LAN cables and connecting hardware must be installed in accordance with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM and Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

3.3.2 Metering and Sensor Wiring

Metering and sensor wiring must be installed in accordance with the requirements of ANSI C12.1, NFPA 70, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.3.2.1 Power Line Surge Protection

Control panels must be protected from power line surges. Protection must meet the requirements of IEEE C62.41.1 and IEEE C62.41.2. Fuses must not be used for surge protection.

3.3.2.2 Sensor and Control Wiring Surge Protection

Digital and analog inputs must be protected against surges induced on control and sensor wiring. Protect binary and analog outputs against surges induced on control and sensor wiring installed outdoors and as shown. Fuses must not be used for surge protection. Test the inputs and outputs in both the normal and common mode using the following two waveforms: The first waveform must be 10 microseconds by 1000 microseconds with a peak voltage of 1500 volts and a peak current of 60 amperes. The second waveform must be 8 microseconds by 20 microseconds with a peak voltage of 1000 volts and a peak current of 500 amperes. Submit certified test results for surge protection.

3.4 SOFTWARE INSTALLATION

Load software required for an operational process control system, including databases (for points specified and shown), operational parameters, and system, command, and application programs. Adjust, tune, debug, and commission all software and parameters for controlled systems to assure proper operation in accordance with the sequences of operation and database tables.

3.5 CONTROL DRAWINGS

3.5.1 Control

Control drawings, reproducible, with corresponding CADD files, must be provided for equipment furnished and for interfaces to equipment at each respective equipment location. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system manually must be prepared in typed form, reproducible, with corresponding word processor files and posted beside the diagrams. Diagrams and instructions must be submitted prior to posting. The framed instructions must be posted before acceptance testing of the system.

3.5.2 Contractor Design Drawings

Contractor Design Drawings as a single complete package:
4 hard copies and 1 copies in electronic form. As a minimum they must include wiring, logic, and layout. Submit hardcopy drawings on 17 by 11 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule. Contractor Design Drawings must be approved prior to any fabrication.

3.5.2.1 Draft As-Built

Draft As-Built Drawings as a single complete package: 4 hard copies and 1 copies in electronic form. Submit hardcopy drawings on 17 by 11 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that

are tabular, including but not limited to the Point Schedule and Equipment Schedule.

3.5.2.2 Final As-Built

Final As-Built Drawings as a single complete package: 4 hard copies and 1 copies in electronic form. Submit hardcopy drawings on 17 by 11 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

3.5.3 Points Schedule

Provide a Points Schedule in tabular form for each system, with the indicated columns and with each row representing a hardware point, network point or configuration point in the system.

a. When a Points Schedule was included in the Contract Drawing package, use the same fields as the Contract Drawing with updated information in addition to the indicated fields.

3.5.3.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.5.3.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.5.3.3 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.5.3.4 Range

The range of values, including units, associated with the point, including setpoint adjustment range, a sensor measurement range, or the status of a safety.

3.5.3.5 Input or Output (I/O) Type

The type of input or output signal associated with the point. Use the following abbreviations for entires in this column:

a. AI: The value comes from a hardware (physical) Analog Input

b. AO: The value is output as a hardware (physical) Analog Output

c. DI: The value comes from a hardware (physical) Discrete Input

d. DO: The value is output as a hardware (physical) Discrete Output

e. PULSE: The value comes from a hardware (physical) Pulse Accumulator Input

f. NET-IN: The value is provided from the network (generally from another
device). Use this entry only when the value is received from another device as part of scheduling or as part of a sequence of operation, not when the value is received on the network for supervisory functions such as trending, alarming, override or display at a user interface.

g. NET-OUT: The value is provided to another controller over the network.
Use this entry only when the value is transmitted to another device as part of scheduling or as part of a sequence of operation, not when the value is transmitted on the network for supervisory functions such as trending, alarming, override or display at a user interface.

3.6 FIELD TESTING AND ADJUSTING EQUIPMENT

Provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness the PVT, and written permission must be obtained from the Government before proceeding with the testing. Original copies of data produced, including results of each test procedure, during PVT must be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test. The test procedures must cover actual equipment and functions specified for the project.

3.6.1 Testing, Adjusting and Commissioning

After successful completion of the factory test as specified, the Contractor will be authorized to proceed with the installation of the system equipment, hardware, and software. Once the installation has been completed, tested, adjusted, and commissioned each control loop and system in accordance with NIST SP 250 and must verify proper operation of each item in the sequences of operation, including hardware and software. Calibrate field equipment, including control devices, adjust control parameters and logic (virtual) points including control loop setpoints, gain constants, constraints, and verify data communications before the system is placed online. Test installed ground rods as specified in IEEE 142 and submit certification stating that the test was performed in accordance with IEEE 142. Calibrate each instrumentation device connected to the process control system control network by making a comparison between the reading at the device and the display at the workstation, using a standard at least twice as accurate as the device to be calibrated. Check each control point within the process control system control network by making a comparison between the control command at the central station and field-controlled device. Deliver trend logs/graphs of all points showing to the Government that stable control has been achieved. Points on common systems must be trended simultaneously. One log must be provided showing concurrent samples taken once a minute for a total of 4 hours. One log must be provided showing concurrent samples taken once every 30 minutes, for a total of 24 hours. Verify operation of systems in the specified failure modes upon Process control system network failure or loss of power, and verify that systems return to process control system control automatically upon a resumption of process control system network operation or return of power. Deliver a report describing results of functional tests, diagnostics, calibrations and commissioning procedures including written certification to the Government that the installed complete system has been calibrated, tested, adjusted and commissioned and is ready to begin the PVT. The report must also include a copy of the approved PVT procedure.

3.6.2 Performance Verification Test (PVT)

Submit test procedures for the PVT. The test procedure must describe all tests to be performed and other pertinent information such as specialized test equipment required and the length of the PVT. The test procedures must explain, in detail, step-by-step actions and the expected results, to demonstrate compliance with all the requirements of the drawings and this specification. The test procedure must be site specific and based on the inputs and outputs, required calculated points and the sequence of control. Refer to the actions and expected results to demonstrate that the process control system performs in accordance with the sequence of control. Include a list of the equipment to be used during the testing plus manufacturer's name, model number, equipment function, the date of the latest calibration and the results of the latest calibration.

Demonstrate that the completed Process control system complies with the contract requirements. All physical and functional requirements of the project including communication requirements must be demonstrated and shown. Demonstrate that each system operates as required in the sequence of operation. The PVT as specified must not be started until after receipt of written permission by the Government, based on the written report including certification of successful completion of testing, adjusting and commissioning as specified, and upon successful completion of training as specified. Upon successful completion of the PVT, furnish test reports and other documentation.

3.6.3 Endurance Test

Use the endurance test to demonstrate the overall system reliability of the completed system. The endurance test must be conducted in phases. The endurance test must not be started until the Government notifies the Contractor in writing that the PVT is satisfactorily completed, training as specified has been completed, outstanding deficiencies have been satisfactorily corrected, and that the Contractor has permission to start the endurance test. Provide an operator to man the system during Phase I endurance testing, in addition to any Government personnel that may be made available. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, commence an assessment period as described for Phase II. Upon successful completion of the endurance test, deliver test reports and other documentation, as specified, to the Government prior to acceptance of the system.

3.6.3.1 Phase I (Testing)

The test must be conducted 24 hours per day, for 7 consecutive calendar days, including holidays, and the system must operate as specified. Make no repairs during this phase of testing unless authorized by the Government in writing.

3.6.3.2 Phase II (Assessment)

After the conclusion of Phase I, identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report must explain in detail the nature of each failure, corrective action taken, results of tests performed, and must recommend the point at which testing should be resumed. After delivering the written report, convene a test review meeting at the job site to present the results and

recommendations to the Government. The meeting must not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, demonstrate that failures have been corrected by performing appropriate portions of the performance verification test. The Government reserves the right to cancel the test review meeting if no failures or deficiencies occur during the Phase I testing. If the Government chooses to do so, the Contractor will be notified in writing. Based on the Contractor's report and the test review meeting, the Government will determine if retesting is necessary and the restart point. The Government reserves the right to require that the Phase I test be totally or partially rerun. Do not commence any required retesting until after receipt of written notification by the Government. After the conclusion of any retesting which the Government may require, the Phase II assessment must be repeated as if Phase I had just been completed.

3.6.3.3 Exclusions

The Contractor will not be held responsible for failures resulting from the following: Outage of the main power supply in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the process control system performed as specified. Failure of a Government furnished communications link, provided that the PLC automatically and correctly operates in the stand-alone mode as specified, and that the failure was not due to Contractor furnished equipment, installation, or software. Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.

3.7 FIELD TRAINING

Field training oriented to the specific system must be provided for designated personnel. Furnish a copy of the training manual for each trainee plus two additional copies. Manuals must include an agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson. Furnish audiovisual equipment and other training supplies and materials. Copies of the audiovisuals must be delivered with the printed training manuals. The Government reserves the right to videotape training sessions for later use. A training day is defined as 8 hours of classroom instruction, excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. Submit the training manual and schedule to receive approval from the Government at least 30 days before the training.

3.7.1 Preliminary Operator Training

Prior to the start of field testing, preliminary operator training must be taught at the project site for 8 consecutive training hours. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations with guidance and describe the general hardware architecture and functionality of the system. This course must include: general system architecture; functional operation of the system, including workstations; operator commands; application programs, control sequences, and control loops; database entry and modification; reports generation; alarm reporting; diagnostics; and historical files.

3.7.2 Additional Operator Training

Following the field testing, additional classroom training must be taught for 1 day. Individual instruction must consist of "hands-on" training under the constant monitoring of the instructor. Classroom training must include instruction on the specific hardware configuration of the installed process control system and specific instructions for operating the installed system. Upon completion of the course, the students should be fully proficient in system operation and have no unanswered questions regarding operation of the installed process control system. Each student should be able to start the system, operate the system, recover the system after a failure and describe the specific hardware architecture and operation of the system and be fully proficient in all system operations. Report the skill level of each student at the end of this course.

3.7.3 Maintenance Training

Following the endurance test a minimum period of one training days must be provided by a factory representative or a qualified Contractor trainer for five designated personnel on maintenance of the equipment. The training must include: physical layout of each piece of hardware, calibration procedures, preventive maintenance procedures, schedules, troubleshooting, diagnostic procedures and repair instructions.

3.7.4 Specialized Training

Following the maintenance training, a minimum period of 4 hours training must be provided by a factory representative or a qualified contractor trainer to address each instrument type.

3.7.4.1 Flow Meter Training

Each type of flow meter, to include calibration, maintenance and testing of flow elements and transducers.

3.7.4.2 Specialized Sensor Training

Provide training on each type of specialized sensor such as pH,and ORP to include calibration, maintenance and testing of sensing elements and transducers for five people.

3.8 OPERATION AND MAINTENANCE DATA REQUIREMENTS

Outline the step-by-step procedures required for system startup, operation and shutdown. Include in the instructions layout, wiring and control diagrams of the system as installed, the manufacturer's name, model number, service manual, parts list and a brief description of all equipment and their basic operating features. List routine maintenance procedures, possible breakdowns and repairs and troubleshooting guides.

-- End of Section --

SECTION 40 60 00

PROCESS CONTROL DESCRIPTION

PART 1. GENERAL

1.1 DESCRIPTION

This Section covers the operating functions of all equipment and controls of the instruments for the Groundwater Treatment Plant (GWTP).

The GWTP consists of various unit processes as listed below and as depicted on Contract Drawings MI601 thru MI621. Control descriptions for these processes are described herein (Para 3.2 thru 3.21).

A. Extraction/recovery Systems (MI602 THRU MI604)

B. Equalization Tank / Filter Feed System (MI605)

C. Multi-media Filtration (MMF) System (MI606)

D. Bag Filter System (MI606)

E. Ozone Generation System (MI607)

F. Advanced Oxidation Process (AOP) System (MI608)

G. Ozone Destruction System (MI608)

H. Liquid Phase Granular Activated Carbon (LGAC) Feed System (MI609)

I. Liquid Phase Granular Activated Carbon (LGAC)System (MI610)

J. Effluent System (MI612)

K. MMF/LGAC Backwash System (MI611)

L. Backwash Waste / Discharge System (MI621

M. Hypochlorite Feed System (MI613)

N. Caustic Feed System (MI614)

O. Hydrogen Peroxide System (MI615)

P. Building Sump (MI616)

Q. Process Tanks Venting System (MI617)

R. Non potable water system (MI617)

S. Air Compressor System (MI618)

T. Eyewash and Safety Showers System (MI619)

U. Utility Monitoring & Control System (UMCS) and Fire Alarm Panel (FAP) (MI620)

This Section also specifies following requirements:

A. Loss of Power Mode Operation

B. Restart Mode

C. E-Stop Operation

D. Human Machine Interface

E. Trending, Historical Archiving

F. Reporting

G. Web Interface

H. Alarming Software and Configuration

I. Loss of Communication

Operator controls and indications described herein shall be at the Supervisory Control and Data Acquisition (SCADA) System interface to the Programmable Logic Controller (PLC).

All PLC functions described herein refer to the process PLC located in the Operator Control Room.

CONTRACTOR shall be responsible for ensuring that all control loops operate properly and safely, regardless of equipment supplier, vendor, or subcontractor. CONTRACTOR shall coordinate repair or replacement of any faulty process equipment, control equipment, wiring, or other system components.

The Drawings and Specifications are intended to provide minimum process control requirements only. CONTRACTOR is responsible for determining the configuration, design, layout, and details of all control loops.

1.2 DEFINITIONS

A. Soft Controls: Software, or Soft, controls will be programmed controls available to the operator through four Human Machine Interface (HMI) terminals located within the Treatment Facility or two SCADA workstations located in the Operator Control Room.

B. Hard Controls: Hard controls refer to devices such as pushbuttons, hand switches, and potentiometers.

1.3 ABBREVIATIONS:

A. RW- Recovery Well

B. HMI – Human Machine Interface

C. LCS – Local Control Station

D. MCC – Motor Control Center

E. H-O-A – Hand-Off-Auto Selector Switch

F. PC – Personal Computer

G. PI – Proportional / Integral

H. PLC – Programmable Logic Controller

I. VFD - Variable Frequency Drive

J. SCADA – Supervisory Control and Data Acquisition

K. N.O. – Normally Open Contact

L. N.C. – Normally Closed Contact

1.4 SUBMITTALS

A. Reference Specification 40 60 00, Section 1.2 Submittals

B. An interlock list (table) for all non-vendor supplied equipment and instrumentation. The interlock list shall clearly define all interlocks, alarms, and outcomes with regard to process equipment.

PART 2. NOT USED

PART 3. EXECUTION

3.1 GENERAL OPERATING DISCRIPTION

A. Supervisory Control and Data Acquisition (SCADA) System:

a. The purpose of the process control system is to monitor and control a groundwater treatment process consisting of groundwater extraction, treatment, and discharge to outfall basins.

b. The SCADA System shall provide a graphical interface for monitoring, control, and alarming of the system. The SCADA System shall allow for

adjustment of set points and timers as applicable for alarms and control loops, trending of values, and historical archiving of parameter data.

c. Access to the SCADA System will be available to the operator either from all HMIs located within the Treatment Building, SCADA workstations located in the Operator Control Room, or portable HMI at Recovery Wells RW9 and RW-10A.

B. Motors: Unless otherwise noted herein, the following shall be true for all process motor driven devices:

a. Process motors shall be provided with a Hand-Off-Auto (H-O-A) selector switch mounted on the door of its respective Motor Control Center (MCC) compartment. There will be Start/Stop pushbuttons at the motors.

i. In HAND, the motor will operate manually in this mode using Start-Stop pushbuttons.

ii. Any motor utilizing a VFD will be configured to operate at a low speed (Hz) in HAND mode.

b. In OFF, motor operation shall be disabled, and the motor starter shall be de- energized.

c. In AUTO, the motor starter shall be under the control of the PLC. Both Manual and Auto mode will be provided at the HMI

i. In Manual Mode at HMI, equipment will be operated with interlocks or interlocks can be bypassed if required (with a list of active/bypassed interlocks that is operator selectable for each piece of equipment).

ii. In Auto mode at HMI, equipment will run in fully automatic mode with all interlocks in place (bypassing interlocks is not permissible).

d. All process motor starters shall have auxiliary contacts for “run” indication via Ethernet to the PLC. If a motor is called to start and the return input from the auxiliary contact is not made within 5 seconds, a mismatch alarm shall annunciate at the HMI. These Alarms are indicated as YA-xxx in the Alarm List.

e. All process motor driven devices under PLC control shall have a disconnect switch adjacent to the device. This shall interrupt power to the motor and lockout the device. An auxiliary contact shall provide a discrete input signal to the PLC indicating the disconnect switch position.

f. Unless otherwise noted, all process motors shall be furnished with a local control station that includes Start-Stop (S/S) pushbuttons. The Start-Stop pushbuttons shall be wired back to the motor control circuit and can only operate when a given motor's H-O-A switch is the "HAND" position.

C. Setpoints and Settings: All set points, settings and timers shown on the HMI shall be adjustable between +/100% of the initial setting listed. Limits to setting entries shall be refined in the field during startup and configured.

D. For each motor, graphically represent the physical position of its associated H-O-A selector switch. In addition, provide HMI Start/Stop and Auto/Manual buttons for all process pumps/motors. When an H-O-A selector switch is in the "Auto" position, the operator shall have the ability to select Auto/Manual on the HMI. HMI "Manual" allows the operator to Start/Stop the motor from the HMI. In addition, HMI "Manual" operation shall give an operator the ability to bypass certain interlocks if necessary. "Interlock Bypass" mode shall be achieved by giving an operator the ability to mouse click on a pump/motor, which will display its "Interlock List". The operator shall then have the ability to select which Interlocks to Bypass. Anytime a pump/motor has any Interlocks bypassed in the HMI "Manual" state, the HMI shall provide a visual indication of this state. HMI "Auto" allows automatic PLC control of the motor and shall not allow the bypass of any Interlocks.

E. For each valve, provide HMI Open/Close and Auto/Manual buttons. HMI Auto/Manual operation shall be identical to the description for the motors in Part D above.

F. Duplex pumping system: Various systems have two pumps. Generally, one pump is capable of handling the designed flow and the second pump is standby. If one pump fails to operate, a pump fail alarm shall be generated (YA-xxx) and the Operator will be notified to bring the second pump online manually. If necessary, the standby pump can be started manually from the HMI if the H-O-A selector switch is in "Auto" and the HMI selector is set to "Manual".

G. Variable Frequency Drive (VFD): Unless otherwise stated, all VFDs shall operate in proportional- integral (PI) algorithm to modulate the speed of the operating motors to meet and maintain the system setpoint. Operator shall have the capability at one of the two SCADA workstations or any of the HMI's located on the plant floor to monitor and adjust these parameters. All VFDs shall utilize Ethernet for communication with the treatment building PLC and shall be configured to enter a "Faulted" state in the event of Ethernet communication failure. Regardless of operating mode, all VFD's shall be programmed with a "one-shot" in the PLC program to initially start at 15Hz.

H. Mismatch alarms: All command outputs from SCADA, analog or discrete, shall have an associated "Mismatch Alarm." The mismatch alarm shall compare the

desired output (e.g., VFD speed, valve position, run command) to the measured variable (VFD speed, valve position, run status) and, if after an adjustable period of time the measured value is not within 5% of the desired value, annunciate an alarm. Valve Alarms are indicated as ZA-xxx in the Alarm List.

I. If a system shuts down due to a critical alarm and there is no operator present (e.g. - weekend or after normal working hours), the system shall not be restarted until someone is physically present at the site.

J. Out of Range Alarms: For all analog 4-20mA values, provide "Out of Range Alarms" if the signal value drops below 4ma or above 20mA for more than 5 seconds.

K. Trending: All analog values and controller setpoints shall be trended locally on the SCADA/Historian software. All pumps on/Off and valve Open/Close status shall also be trended.

L. Totalizations: Flows with an "FQI" designation (gallons) and motor runtimes (hours) shall be totalized and displayed on the screen. Provide runtime totalizations for all pumps and blowers. Provide "run time" values for each carbon vessel by monitoring valve positions to identify "run" status. Totalization values shall not be resettable.

3.2 GROUNDWATER EXTRACTION / RECOVERY SYSTEM (MI602 THRU MI604)

A. Three extraction wells RW-8, RW-9, and RW-10A, will be installed for the groundwater collection system, as follows:

a. Recovery Well RW-8 located approximately 8 feet to west of the Groundwater Treatment Plant (GWTP). RW-8 is approximately 120-feet below ground surface and is capable of pumping 450 to 650 gallons per minute (gpm).

b. Recovery Well RW-9 located approximately 2,500 feet east of the Groundwater Treatment Plant (GWTP) along Alken Avenue. RW-9 is approximately 120-feet below ground surface and is capable of pumping 450 to 650 gallons per minute (gpm).

c. Recovery Well RW-10A located approximately 4,000 feet east of the Groundwater Treatment Plant (GWTP) just south of N. Pine Street. RW-10A is approximately 120-feet below ground surface and is capable of pumping 600 to 700 gallons per minute (gpm).

B. All recovery wells have a submersible pump and a pressure transducer to indicate well level (LT-8, LT-9 & LT-10A), a pump discharge pressure transmitter (PIT-8, PIT-9 & {PIT-10A), and a valve vault high level switch (LSH-VV8, LSH-VV9 & LSH-VV10A). At RW -9 and RW-10A, a magnetic flow meter (FE/FIT-9 & FE/FIT-10A) monitors the pump flow rate and there is a manual sample point located in valve vault. RW-8 will have a magnetic flowmeter located inside the GWTP.

C. All recovery well pumps are operated in AUTO mode based on Operator adjustment of its VFD speed (frequency) through the HMI. Operator will initially start the well pump at 30 Hz, increasing the speed until flow is maintained.

D. All piping inside well vault and manholes will be insulated and heat traced. Heat trace is monitored at PLC as failsafe discrete inputs.

E. High level alarms at all valve vaults are monitored at PLC as N.C. discrete inputs. Setpoint = 6” above finished floor.

F. Recovery wells RW-9 and RW-10A Recovery well RW-8 discharge line enter the GWTP thru south side and then manifold into one pipe with RW-8 (east side) before discharging into Equalization Tank T-100. Prior to discharging into Equalization Tank T-100, there is an influent flow meter FIT-100 to measure flow rate and totalized flow (FQ-100) of all wells as the combined “plant inflow”.

G. The treatment plant is designed to treat a maximum flow of 1500 gpm.

H. Analog Control Loops: See Table 1 (as attached) regarding Extraction Wells operating set points.

I. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

   b. Local Operation: Reference Section 3.1 (B) for motor control.

J. Automatic Operation:

   a. Recovery wells shall be allowed to operate when all of the following conditions are satisfied:

      i. EQ Tank level (LIT-100) is less than 16.0’ (EWs-Auto Level), and

      ii. Building sump level is not at high-high water level (LAHH-800 or LAHH-801).

   b. Each well pump will be operated at a constant well level in between respective LCH and LCL. Both flow and well level set points are pre-established based on the groundwater model data.

   c. Each well pump will start at pump on set point level (LCH-XX) and turnoff (LCL-XX) at pump-off set points.

   d. If a flow of less than 50 gpm is detected at a flow meter (RW-8, RW-9 or RW-10A) for more than 10 seconds, respective pump will be

shut down, and a PUMP FAIL (FAL-XX) alarm will be generated. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

e. If a pump discharge pipe has a heat trace power off at vault for >120 seconds, an alarm (TA-XX) will be generated. However, the pump will continue to operate in HMI "Auto" mode thus avoiding any pipe freezing issue. The alarm can be reset by the Operator once the condition is cleared.

K. Interlocks:

a. All recovery well pumps shall be interlocked (shutdown) and allowed to restart if any of the following non-critical conditions occur:

i. Equalization Tank T-100 High-Level (LAH-100) is ON for >30 seconds. The RW pumps will restart when EQ tank level drops below RWs-Auto OFF level for more than 5 minutes.

ii. The building sump High-High Level (LAH-800) is ON for >60 seconds. All of these pumps will restart when sump level drops to sump Low level for >30 seconds.

b. All recovery well pumps shall be interlocked (shutdown) and not allowed to restart if any of the following critical conditions occur. An operator must be present at the facility anytime a critical plant shutdown condition occurs in order to properly inspect and restart the equipment. <u>Under no circumstances shall any plant shutdown condition be reset remotely.</u>

i. Equalization Tank T-100 High-High Level (LAHH-100 or LAHH-101) is ON for >30 seconds.

ii. The building sump High-High Level (LAHH-800 OR LAHH-801) is ON for >30 seconds.

iii. If treatment building secondary containment High Level (LAH-991 or LAH-992) is ON.

iv. If high water level in any valve vault (LAH-VV8, LAH-VV9 or LAH-VV10A) is on for more than 10 seconds.

v. High level in any outfall basin (LAHH-OFB1, LAHH-OFB2, LAHH-OFB3 and LAHH-OFB4) for more than 60 seconds.

3.3 EQUALIZATION TANK / FILTER FEED SYSTEM (MI605)

A. All recovery wells will discharge groundwater in Equalization Tank T-100. This tank will also receive water from recycle of water from MMF feed pumps P-100A/B, MMF / Cartridge Filters outlet, AOP system outlet and plant

effluent during recycle (startup/testing phase) or plant upset conditions. This tank will have a continuous water level transmitter (LE/LIT-100) and a backup high-high-level switch (LSHH-101).

B. Tank T-100 has a side-mounted mixer (EQM-110) Mixer EQM-110 will have a single speed motor and will run continuously unless Tank T-100 level drops below X'.

C. Two MMF feed pumps (P-100A and P-100B) will be provided with VFDs. These pumps will transfer water from T-100 to MMF vessels. The common pump discharge line will have a slipstream to recycle line for pH and ORP probes (AE-101A & AE-101B) to measure pH, ORP and temperature, a flow meter (FIT-101) to measure MMF feed flow rate, a manual flow control valve (one per pump), and a recycle line back to T-100. Both flow control valves and recycle valve may need to be adjusted at start-up to establish a desired pre-treatment flow rate depending on the collection system flow.

D. One pump is capable of pumping up to 1500 gpm flow. This is based on a maximum estimated plant inflow of 1500 gpm flow. Thus, these pumps will operate as Primary and Standby.

E. Tank T-100 will receive caustic solution (refer to the respective chemical feed systems) based on MMF feed flow pH and oxidation-reduction potential (ORP) readings, respectively. This tank's pH will be maintained at 8.0 and ORP at approximately 300 (settings to be determined [TBD] at start-up). PLC will monitor and control pH and ORP (set points, control, and gain; Operator selectable).

F. MMF Feed Flow pH analyzer (AE-101A) will have low and high pH alarms as AAL-101A and AAH-101A, respectively. These will initially be set at ± 0.2 units of the pH setpoint.

G. MMF Feed Flow ORP analyzer (AE-101A) will have low and high ORP alarms as AAL-101B and AAH-101B, respectively. These will initially be set at ± 50 units of the ORP setpoint.

H. Analog Signal/Control Loops: LIT-100, FIT-101, SIC-100A/B, AIT-101A/B

I. Tank T-100 overflow pipe's bottom elevation is at 11.75' high. Level transmitter (LIT-100) set points are as follows:

   a. Low-Low level Alarm LALL-100 = 1.0'

   b. PUMPS P-100A/B OFF Level LCL-100 = 1.5'

   c. Eq Pump control initial set point = 10.0'

   d. Pumps P-100A/B On Level = 10.5'

   e. RWs-Auto OFF level = >9.0'

f. High level alarm LAH-100 = 15.5′.

g. High-High level alarm LAHH-100 = 16.5′.

J. Backup High-High level alarm LAH-101 is set at 16.5′.

K. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

b. Local Operation: Reference Section 3.1 (B) for motor control.

L. Automatic Operation

a. MMF Feed pumps shall be allowed to operate when all equipment has its respective H-O-A selector switch in the "Auto" position, and all of the following conditions are satisfied:

i. Tank T-100 level is not Low-Low, and

ii. Tank T-400 is not High, and

iii. Caustic (P-910A/B) and hypochlorite (P-920A/B) feed system H-O-A selector switches are in the "Auto" position, and

iv. LGAC feed pumps (P-400A/B) H-O-A selector switches are in the "Auto" position.

b. Normally primary pump (P-100A) starts at PUMP ON level, and VFD varies the speed to maintain T-100 level to an initial set point of "10" feet. This pump's speed can be lowered until the flow at FIT-101 reaches 600 gpm (or 40% of maximum VFD speed). If tank level starts dropping, pump will shut down at its OFF level.

c. The pumps will be manually alternated once per month by the operator. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

d. If a flow of <100 gpm is detected at flow meter FIT-101 for more than 10 seconds, the operating pump will be shut down, respective PUMP FAIL alarm (FAL-101A or 101B) will be generated, and the Operator will be alerted via the HMI to manually switch over and start the standby pump. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

M. Interlocks:

a. Equalization Tank system (P-100A/B, all chemical feed systems, and mixer) shall be interlocked (shut down) as follows:

i. Tank T-100 level is at Low-Low level Alarm LALL-100.

ii. Cartridge Filters CF-240/250 is at High Differential Pressure PDAH-240.

iii. Tank T-400 is at High-High level Alarm LAHH-400 or LAHH-401.

iv. The Equalization Tank/ Filter Feed system will not be allowed to restart until interlock conditions are cleared and alarms are reset by the Operator. Operator must be at the plant to clear the interlock conditions and re-start the plant. The system shall never be restarted remotely.

3.4 MULTI-MEDIA FILTRATION (MMF) SYSTEM (MI606)

A. Three MMFs (MMF-210, MMF-220 and MMF-230) on a skid will be provided. Two MMFs stay in operation while third is in standby mode.

B. A local PLC based control panel operates all the MMFs electric butterfly valves and allows an automatic backwash sequence based on either a high differential pressure, timer, or manual “backwash initiate” input. This panel also generates alarms and interlocks. This panel is monitored by plant PLC and sends signals for enable/disable for backwash cycle via Ethernet link to plant control system.

C. All three MMFs will have automated air operated ON/OFF valves on water inlet (YV-210A, YV-220A and YV-230A), water outlet (YV-210B, YV-220B and YV-230B), backwash inlet (YV-210, YV-220 and YV-230) and backwash water outlet (YV-210C, YV-220C and YV-230C).

D. Each vessel will have a local differential pressure indicator (PDI-210, PDI-220 and PDI-230). These instruments will send high pressure alarms (PDAH-210, PDAH-220 and PDAH-230), initially set at 20 psig, to the local panel. If the pressure drops across a MMF exceeds that set point, that filter goes in backwash mode and standby MMF goes in operation mode. In addition, a pressure transmitter will be installed on MMFs inlet and outlet lines (PIT-210 and PIT-230). All of these instruments send signals to a local control panel. In addition, plant PLC will compute a differential pressure reading (PIT-210 minus PIT-230) and trend and correlate with the operating MMF’s differential pressure.

E. Each MMF can also be operated in in a timer or manual mode, operator selected at the local panel.

F. All automated BFVs will have opened and closed limit switches sending status signals to the local panel. As described above, when MMF control panel sends a command to open or close a valve and the corresponding limit switch input

is not received within 5 seconds, a mismatch alarm will be generated from the PLC. These are indicated as ZA-xxx in the Alarm List.

G. Plant PLC monitors all signals and enables/disable this local control panel. In this mode, a MMF must remain in operation for at least 8 hours.

H. Analog Signals: PIT-210 and PIT-230

I. Manual Operation: MMF can be operated in manual mode for a short period for test purposes only.

J. Automatic Operation:

a. MMF can be operated when the MMF system is in “Auto” state as described below.

i. Any two MMF vessels water inlet valves (YV-210A & YV-210B, YV-220A & YV-220B, YV-230A & YV-230B) are positioned to process water and the other set is closed AND all backwash inlet/outlet automated valves on all MMFs are closed, OR

ii. At least two of the MMFs are available to process water (no high differential pressure alarm or being backwashed).

K. The MMFs are operated as follows:

a. Two MMFs are online while third one is on standby.

b. When the pressure drop across a filter exceeds a preset value (10 to 15) pounds per square inch gauge (psig), it will require backwashing.

c. Backwashing shall be initiated automatically based on one of three 3 modes (operator selectable): timer, pre-determined pressure drops, or total gallons of water treated.

d. One filter can proceed through its backwash cycle while the other two filters are in service. Refer to MMF/LGAC Backwash System for backwash operation details.

i. Thus, when MMF-210 goes in backwash mode, YV-210A and YV-210B are closed; YV-210 and YV-210C are open, thus bringing the standby MMF online automatically.

ii. Similarly, when MMF-220 goes in backwash mode, YV-220A and YV-220B are closed; YV-220 and YV-220C are open, bringing the standby MMF online automatically.

iii. Similarly, when MMF-230 goes in backwash mode, YV-230A and YV-230B are closed; YV-230 and YV-230C are open, bringing the standby MMF online automatically.

e. If a high-pressure alarm (PDAH-210, PDAH-220 or PDAH-230) is detected for >60 seconds, (either in timer mode or total water treated mode), the operating MMF shall be placed in backwash mode and the standby MMF shall be placed in service.

f. If one of the filters has a differential pressure high alarm while the second filter is being backwashed, shutdown P-100A/B. P-100A/B can be restarted when one of the filters is back in service.

g. Reinitiate backwash if backwash fails first time.

h. Trend MMF's pressure drop value as MMF-210-dP, MMF-220-dP and MMF-230-dP (PIT-210 minus PIT-230). Plant operator can then compare them with PDI-210, PDI-220 or PDI-230 readings (local display).

i. Provide selector switches at HMI for the operator to operate or backwash MMF.

L. Interlocks:

a. Refer to MMF system's submittal for related interlocks.

3.5 BAG FILTER SYSTEM (MI606)

A. There will be a duplex cartridge filter system. Only one bag filter stays in operation while second is in standby mode. The Operator will manually switch to the standby filter on a high pressure drop at DPIT-240 (initially set at 20 psi, to be finalized during startup).

3.6 ADVANCED OXIDATION PROCESS (AOP) SYSTEM (MI607 AND MI608)

A. There will be a Vendor supplied AOP reactor(s) sized for 500 – 1000 gpm flow, complete with ozone generation system, ozone injectors, hydrogen peroxide injector, static mixers, gas/liquid separator with ozone destructor automated forward / recycle valves, interconnecting piping, valves, and instrumentation.

B. The ozone generation system consists of an oxygen generator unit, ozone generation unit, water chiller, controls and instrumentation as required by the selected AOP System Vendor.

C. A local PLC based control panel operates the AOP system. This panel also generates alarms and interlocks. This panel is monitored by plant PLC and sends signals for enable/disable for AOP System via Ethernet I/P communications to plant control system. All monitored and alarm signals will be generated during discussions with the selected AOP Vendor.

D. Automated recycle (MOV-350A) and forward (MOV-350B) valves are provided with the AOP system so that no untreated water can be discharged to LGAC units.

a. Normally recycle valve MOV-350A stays closed while forward valve MOV-350B stays open (interlocked so that normally only one of them stays open). It is normal for both valves to be open for a short period of time during valve actuation to avoid dead heading pump P-100A or P-100B.

b. Whenever pump P-100A or 100B starts, the recycle valve (MOV-350A) opens and forward valve (MOV-350B) closes for approximately X minutes (selectable at AOP Control Panel). This is to allow AOP lamps to warm up, flow to establish through the AOP system, and hydrogen peroxide to react with water.

c. Recycle valve MOV-350A is interlocked with Eq. Tank T-100 level – if High-High tank level alarm (LAHH-100 or LAHH-101) exists do not allow recycle valve to open and shut down the Treatment Plant.

E. Automatic Operation:

a. The AOP can be operated when the AOP system is in “Auto” state as per the vendor supplied signal.

b. The AOPs will be controlled by a Vendor-supplied control panel. The treatment plant PLC will have hard-wired communication to both AOP PLCs for monitoring and control. The treatment plant PLC will control remote start/stop, system running, system shutdown, and system warning of the AOPs. In addition, the treatment plant PLC is connected to the AOP units via Ethernet in order to monitor various data and alarms generated within each AOP. Refer to AOP Specification Section 46 30 13 for additional details.

c. Monitor and trend each lamp run time, current, voltage and total wattage.

d. The above information is provided as a general guideline and shall be verified by the selected Vendor.

F. Interlocks:

a. The AOP system is designed for various interlocks within the Vendor-provided PLC software (refer to vendor’s manual). In addition, the AOP system shall be interlocked (shut down) as follows:

b. MMF feed flow is < X gpm, FSL-101 (hard-wired).

c. Hydrogen peroxide feed pump P-930A/B is not running or has a Low Flow alarm (FAL-934)

d. Hydrogen peroxide concentration is low.

e. Refer to AOP Feed system for related interlocks.

3.7 LIQUID PHASE GRANULAR ACTIVATED (LGAC) FEED SYSTEM (MI609)

A. The AOP reactor(s) will discharge treated water into LGAC Feed Tank T-400. This tank will have a continuous water level transmitter (LE/LIT-400) and a backup high-high-level switch (LSHH-401).

B. Two LGAC feed pumps (P-400A and P-400B) will be provided with VFDs. These pumps will transfer water from T-400 to the LGAC vessels. The common pump discharge line will have a flow meter (FIT-400) to measure LGAC feed flow rate, a manual flow control valve (one per pump). Both flow control valves may need to be adjusted at start-up to establish a desired flow rate depending on the feed tank influent flow.

C. One pump is capable of pumping up to 1800 gpm flow. Thus, these pumps will operate as Primary and Standby.

D. Analog Signal/Control Loops: LIT-400, FIT-400, SIC-400A/B

E. Tank T-400 overflow pipe’s bottom elevation is at 18’ high. Level transmitter (LIT-400) set points are as follows:

   a. Low-Low level Alarm LALL-400 = 1.0’

   b. PUMPS P-400A/B OFF Level LCL-400 = 1.5’

   c. LGAC Feed Pump control initial set point = 10.0’

   d. Pumps P-400A/B On Level = 10.5’

   e. High level alarm LAH-400 = 15.5’.

   f. High-High level alarm LAHH-400 = 16.5’.

F. Backup High-High level alarm LAH-401 is set at 16.5’.

G. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

   b. Local Operation: Reference Section 3.1 (B) for motor control.

H. Automatic Operation

   a. LGAC Feed pumps shall be allowed to operate when all equipment has its respective H- O-A selector switch in the “Auto” position and all of the following conditions are satisfied:

      i. Tank T-400 level is not Low-Low, and

      ii. Tank T-500 is not High, and

iii. Outfall Basins 1 thru 5 are not High-High.

b. Normally primary pump (P-400A) starts at PUMP ON level, and VFD varies the speed to maintain T-400 level to an initial set point of "10" feet. This pump's speed can be lowered until the flow at FIT-400 reaches 600 gpm (or 40% of maximum VFD speed). If tank level starts dropping, pump will shut down at its OFF level.

c. The pumps will be manually alternated once per month by the operator. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

d. If a flow of <100 gpm is detected at flow meter FIT-400 for more than 10 seconds, the operating pump will be shut down, respective PUMP FAIL alarm (FAL-400A or 400B) will be generated, and the Operator will be alerted via the HMI to manually switch over and start the standby pump. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

I. Interlocks:

a. LGAC Feed system (P-400A/B) shall be interlocked (shut down) as follows:

i. Tank T-400 level is at Low-Low level Alarm LALL-400.

ii. Tank T-400 is at High-High level Alarm LAHH-400 or LAHH-401.

iii. The LGAC Feed system will not be allowed to restart until interlock conditions are cleared and alarms are reset by the Operator. Operator must be at the plant to clear the interlock conditions and re-start the plant. The system shall never be restarted remotely.

3.8 LIQUID PHASE GRANULAR ACTIVATED (LGAC) CARBON SYSTEM (MI610)

G. Three LGAC filters will be provided.

H. LGAC-410, LGAC-420 and LGAC-430 have several manual operated valves so these can be operated as lead-lag mode based on differential pressure switch (PDSH-400).

I. When a differential pressure across a LGAC exceeds 15 psi, then it is the time to backwash that LGAC for 15 minutes (manual mode). During backwash mode, only one LGAC will stay in operation.

Refer to MMF/LGAC Backwash System for LGAC backwash operation.

3.9 PLANT EFFLUENT SYSTEM (MI610, MI611 & MI612)

A. Treated water from the LGAC system enters T-500. This tank will also serve as the Backwash Supply Tank, refer to MMF/LGAC Backwash System. This tank will have a continuous water level transmitter (LE/LIT-500) and a backup high-high level switch (LSHH-501).

B. A ON/OFF valve MOV-400 on the plant effluent and an ON/OFF valve MOV-400A on plant recycle line will be provided. This recycle line is provided to adjust the treatment system during startup and upset conditions.

C. Treated water from the LGAC system enters effluent piping where manual valves BFV-440A, 440B and BFV-440C are used to divert water to Outfall Basin 1, Basins 2 & 3, and Basins 4 & 5.

D. The water flow rate to each basin is measured through FIT-440A, FIT-440B, and FIT-440C.

E. Exiting the plant, the water will initially be discharged to five Outfall basins, configured as follows:

   a. Outfall Basin #1

   b. MH A-01 (Basins #2 & #3), equipped with High-High level alarms to control potential flooding of the drainage system.

   c. MH B-01 (Basins #4 & #5), equipped with High-High level alarms to control potential flooding of the drainage system.

F. Transmitters LT-OFB1, LT-OFB2, LT-OFB3, and LT-OFB4 monitor the water level in the five basins. Excessive water level in the basin trigger shutdown of the recovery well pumps RW-8, RW-9, and RW-10A.

G. If pH <6.0 or >9.0 is detected at AE-101A/AIT-101 (MMF feed flow) for >120 seconds, an alarm shall be generated (AAL/AAH-101). If this alarm stays on >5 minutes, plant recycle valve MOV-400A will open and effluent valve MOV-400 will close. Once this pH returns to 6.0-9.0 range for >5 minutes, recycle valve MOV-400A will close and effluent valve MOV-400 will open.

3.10 MMF/LGAC BACKWASH SYSTEM (MI611)

A. T-500 is also used to supply backwash water for backwashing the MMF and LGAC vessels. This tank’s maximum operating volume is about 9,950 gallons (below overflow pipe). A maximum of 5,000 gallons of water is needed to backwash one of the LGAC or MMF described under MMF/LGAC Backwash System. Thus, a minimum of 7’of water depth in this tank is needed for the backwash event.

B. To backwash either MMFs or LGACs, two pumps P-500A/B will be provided. Normally one pump will run while the other is a standby spare. These pumps

will receive water from T-500 and pump water through the MMFs or LGACs and discharge into the Backwash Waste Tank T-550.

C. Both MMFs and LGACs will require a backwash step procedure (flow and duration) to be provided by the respective equipment vendor. Flow rate will be set via the operating pump's (P-500A/B) VFD.

D. Only one MMF vessel can be backwashed at a time, and the backwash will depend on water levels in tanks T-500 and T-550. MMF and LGAC systems shall have an interlock prohibiting the simultaneous backwash of a vessel in both systems. This is due to the MMF backwash cycle being an Automatic function while the GAC backwash is manually initiated.

E. Analog Signal/Control Loops: LIT-500, FI-500, SC-500, LIT-550.

F. Tank T-500 overflow pipe's bottom elevation is at 13.5' high. Level transmitter (LIT-500) set points are as follows:

   a. Low-Low level Alarm LALL-500 = 1.0'

   b. Low level Alarm LAL-500 = 1.5'

   c. Pump P-500/A/B OFF Level = 7.0'

   d. Pump On Level = 9.5'

   e. High level alarm LAH-500 = 10.50'.

   f. High-High level alarm LAHH-500 = 11.50'.

G. Backup High-high level alarm switch LSHH-501 is set at 11.5'.

H. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

      i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

   a. Backwash Supply Pumps (P-500A/B) shall be operated when the MMF/LGAC Backwash system is in "Auto" state as described below.

      i. Backwash Waste Tank T-550 level LIT-550 is <2', and

      ii. T-500 level is >7.0' thus allowing sufficient backwash supply water for backwashing any one of the MMF or LGAC vessels.

   b. Only one of the backwash pumps operates at a time.

c. The backwash pump is operated when the MMF or LGAC requires backwash, as discussed previously. Backwash flow and duration will be as per the MMF and LGAC vendor submittals.

d. Provide MMF BW Ready and LGAC BW Ready status at PLC.

e. The Operator will alternate the pumps manually once per month. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

J. Interlocks:

a. Backwash pump shall be interlocked (not allowed to operate) as below:

i. Dirty Backwash Water Tank High-high level Alarm LAHH-550 or LAHH-551.

ii. T-500 level is <6.5’.

K. The LGAC backwash system is expected to be required only periodically (e.g., every three to six months) and will be conducted manually. During the backwash of an LGAC unit, the plant may continue to run, but at a reduced flowrate (e.g., 700 GPM to 1,400 GPM).

L. Pump P-500A or -500B is then used to provide low pressure water to backwash the LGACs. For the pump selected for operation, the corresponding suction and discharge valves should be opened. For example, for P-500A operation, open BFV-500A-1 and BFV-500A-2 and BFV-XXX (LGAC backwash supply valve).

M. During backwash of the selected LGAC, the process flow valves for that unit are first closed to isolate the LGAC from the process water and then the backwash valves are open. For example, for LGAC-410, BFV-400A and -400B are first closed, this isolates the unit from the process flow. Then BFV-400C and BFV-400D are opened. After backwash, the valve positions are reversed, isolating the backwash system first.

N. The backwash cycle normally lasts approximately 15 minutes but can be extended by allowing the Backwash Waste Tank to drain.

O. The Backwash Waste Tank T-550 receives backwash water from the MMF and LGAC units. The tank can handle 4-times the volume of the Backwash Supply Tank and thereby minimize potential overflow of the Backwash Waste Tank.

3.11 BACKWASH WASTE / DISCHARGE SYSTEM(MI621)

A. Backwash Waste Tank T-550 will receive backwash water from the MMFs and LGACs. This tank will have a continuous water level transmitter (LE/LIT-550) and a backup high-high level switch (LSHH-551).

B. Decanted water from T-550 will return to the treatment building sump via automated ball valve MOV-550A, while backwash wastewater is discharge to the local sewer system through automated ball valve MOV-550B. A Parshall flume flow meter FIT-550 monitors the wastewater flow to the sewer system.

C. Tank T-550 overflow pipe's bottom elevation is at 23.75' high. Level transmitter (LIT-550) set points are as follows:

a. Low-Low level Alarm LALL-550 = 0.75'

b. MOV-550A CLOSE Level = XX'

c. MOV-550A OPEN Level = XX'

d. MOV-550B CLOSE Level = XX'

e. MOV-550B OPEN Level = XX'

f. High level Alarm LAH-550 = 22'.

g. High-High level Alarm LAHH-550 = 25'.

D. Backup High-high level alarm switch LSHH-551 is set at 25.5'.

E. Interlocks:

a. MOV-550A shall be interlocked (not allowed to operate) as below:

i. Treatment Building Sump High-High level alarm LAHH-800 or LAHH-801

3.12 CAUSTIC FEED SYSTEM (MI614)

A. The caustic (25% sodium hydroxide) feed system will include a double wall feed tank (T-910) and two metering pumps (P-910 A/B). This pump will supply caustic to tank T-100 via secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-910), a level switch (LSH-911) to detect any leak in secondary containment, and a backup high-level switch (LSH-912). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: LIT-910, SIC-910A/B

F. T-910 is 10.5′ high. Level transmitter (LIT-910) set points are as follows:

a. Low-Low level Alarm LALL-910 = 1.0′

b. Low level Alarm LAL-910 = 1.5′ (PUMP OFF Level)

c. Chemical Order Level Alarm (25%) = 2.5′

d. Pump On Level = Based on process demand

e. Tank Fill Alarm (90%) = 9.0′

f. High-High level alarm LAHH-910 = 9.5′.

G. Backup High level alarm switch LSH-912 is set at 9.5′.

H. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

a. Both metering pumps P-910A/B will be powered from local 115 VAC, 1 phase receptacles and controlled by the PLC via Ethernet I/P communications based on a 4-20 mA signal from pH probe AE-101A located in MMF Feed Pumps discharge piping. There will be a selector switch at PLC panel to operate the desired pump.

b. The caustic feed system shall be in “Auto” state as follows:

i. Leak detection alarm LAH-911 is not on.

ii. PLC receives a signal that P-910 A or B is ready to run (powered).

iii. Mixer EQM-110 is running.

c. The PLC will start/stop the pump and vary pump speed to maintain a pH set point (initially 10.20) in MMF Feed Flow piping. The pump will have a local stroke length adjustment that will be initially set at startup.

J. Interlocks:

a. The Caustic feed system will be interlocked (P-910A/B shutdown) as follows:

i. Pre-treatment pumps P-100A and 100B are not running.

ii. Caustic tank T-910 Low level Alarm LAL-910.

iii. MMF feed flow is < X gpm, FSL-101 (hard-wired).

K. The Caustic Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-911 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-911 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

b. The Caustic room has a High-High level switch LSHH-911 that will generate an alarm when there is a major leak.

3.13 HYPOCHLORITE FEED SYSTEM (MI613)

A. The sodium hypochlorite (12% solution) feed system will include a double wall feed tank (T- 920) and two metering pumps (P-920A/B). This feed pump will supply hypochlorite solution to static mixer SM-200 at the MFF inlet via a secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-920), a level switch (LSH-921) to detect leak in secondary containment, and a backup high-level switch (LSH-922). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: LIT-920, SIC-920A/B

F. T-920 is 5.5' high. Level transmitter (LIT-920) set points are as follows:

a. Low-Low level Alarm LALL-920 = 1.0'

b. Low level LAL-920 = 1.25' (PUMP OFF Level)

c. Chemical Order Level Alarm (25%) = 2.5'

d. Pump On Level = Based on process demand

e. Tank Fill Alarm (90%) = 4.75′

f. High-High level alarm LAHH-920 = 4.75′.

G. Backup High level alarm switch LSH-922 is set at 9.0′.

H. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

a. Both metering pumps P-920A/B will be powered from local 115 VAC, 1 phase receptacles and controlled by the PLC via Ethernet I/P communications based on a 4-20 mA ORP signal from ORP probe AE-101B located in MMF Feed Pumps discharge piping. There will be a selector switch at PLC panel to operate the desired pump.

b. The hypochlorite feed system shall be in an "Auto" state as follows:

i. Leak detection alarm LAH-921 is not on.

ii. PLC receives a signal that P-920A/B is ready to run (powered).

iii. One of the MMF Feed Pumps P-500A/B is running.

c. The PLC will start/stop the pump and vary pump speed to maintain a set point ORP (initially 350) in MMF Feed Flow piping. The pump will have a local stroke length adjustment that will be initially set at startup.

J. Interlocks:

a. This feed system will be interlocked (P-920A/B shutdown) as follows:

i. Pre-treatment pumps P-100A and 100B are not running.

ii. Sodium hypochlorite tank T-920 Low level LAL-920

iii. MMF feed flow is < X gpm, FSL-101 (hard-wired).

K. The Hypochlorite Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-921 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-921 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

ii. The Caustic room has a High-High level switch LSHH-921 that will generate an alarm when there is a major leak.

3.14 HYDROGEN PEROXIDE FEED SYSTEM (MI615)

A. The hydrogen peroxide (27% solution) feed system will include a double wall feed tank (T-930) and two metering pumps (P-930 A/B). This feed pump will supply hydrogen peroxide solution to static mixer SM-300 at the AOP Rector System via a secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-930), a leak detector unit (LE-931) with annunciator to detect leak in secondary containment, and a high-level switch (LSH-932) and backup high-high-level switch (LSHH-932). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: FIT-934, LIT-930, PIT-933, SIC-930A/B will be monitored and controlled by the AOP System Control panel.

F. T-930 is 8.5' high. Level transmitter (LIT-930) set points are set by the AOP system vendor.

G. The AOP Reactor System PLC will control the operation and feed of hydrogen peroxide to the AOP Reactor, see Vendor Submittal for Details.

H. Interlocks:

a. The hydrogen peroxide feed system will be interlocked from Plant PLC (P-930A/B shutdown) as follows:

i. MMF feed flow is < X gpm, FSL-101 (hard-wired)

I. The Plant PLC will monitor the following hydrogen peroxide system parameters via an Ethernet link:

a. Tank T-930 leak detection (LAH-931)

b. Tank T-930 level, low-level, high-level and high-high-level (LI, LAL, LAH and LAHH-930)

c. Backup high-level and high-high-level switches (LAH-932, LAHH-932)

d. Metering pumps (P-930A/B) containment leak detection (LAH-935)

J. The Hydrogen Peroxide Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-931 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-931 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

K. The Caustic room has a High-High level switch LSHH-931 that will generate an alarm when there is a major leak.

3.15 AIR COMPRESSOR SYSTEM (MI618)

A. This system will include two air compressors (AC-610 and AC-620) each with an internal drier, filter and a dedicated controller. An air compressor cooling water tank T-650 will provide once-through cooling for the compressors using treated water from the LGAC units.

B. Both compressors' discharge pipes will be manifolded and then it goes thru an air receiver (T-640) and various pressure switches to supply air to the Oxygen Generator.

C. Each air compressor system will be controlled automatically by vendor-supplied PLC software to maintain a desired pressure range in the compressed air header.

D. Air receiver (T-640) will have a solenoid actuated auto drain valve. This intelligent drain function monitors condensate build-up with liquid level sensors and evacuates the condensate only, when necessary, thereby avoiding compressed air waste and providing for considerable energy savings.

E. Low- and high-pressure switches (PSH-644 and PSL-645) and a pressure transmitter (PIT-643) will be provided. This compressor will supply air to the Oxygen Generator.

F. Analog Signal/Control Loop: PIT-643

G. Manual Operation: Air compressor shall not be operated in manual mode.

H. Automatic Operation:

a. An air compressor will run to maintain a pre-set desired pressure set point at PSL-645 (45 psi) and shuts down at PSH-644 (110 psi).

b. Treatment Building PLC to trend PIT-643.

c. Air compressors will be alternated on a weekly basis.

I. Plant PLC will be connected with both air Compressor control panels via an Ethernet cable to start/stop, monitor data and alarms. Refer to the vendor's manual for additional operation and alarm details.

J. Air compressors (AC-610 and AC-620) are connected to cooling water supplied from Tank T-650. This tank supplies once-through cooling water for the compressors using treated water from the LGAC units. This tank will have a continuous water level transmitter (LE/LIT-650) and a backup high-level switch (LSH-651). Normally tank T-650 fills with treated water from the LGAC vessels via solenoid valve SV-652. If valve SV-652 fails to open (tank level not increasing) when it is commanded to open, valve SV-651 opens to allow potable water to fill the tank as a backup.

K. Analog Signal/Control Loops: LIT-650

L. Tank T-650 overflow pipe's bottom elevation is at 4.9' high. Level transmitter (LIT-650) set points are as follows:

a. Low-Low level Alarm LALL-650 = 0.5'

b. Low level Alarm LAL-650 = 1.0'

c. SV-652 CLOSE Level = 4.0'

d. SV-652 OPEN Level = 1.5'

e. SV-651 CLOSE Level = 4.0' (fill water backup only)

f. SV-651 OPEN Level = 1.5' (fill water back only)

g. High level alarm LAH-100 = 4.5'

h. High-High level Alarm LAHH-650 = 4.75'

3.16 BUILDING SUMP SYSTEM AND BUILDING CONTAINMENT SYSTEM (MI616/MI620)

A. To contain a leak from the largest tank (15,000 gallon) within the GWTP building, a secondary containment volume in excess of 17,000 gallons will be provided within the process area floor by raising the GWTP building's foundation wall six inches higher than the plant floor.

a. All interior rooms will be at the same elevation as foundation walls.

b. All process tanks and pumps will be placed on a six-inch-high concrete housekeeping pad.

c. No process or contaminated water will be allowed to discharge into sanitary sewer system.

B. There will be a process sump (5,700-gallon capacity) that will include two submersible pumps (P-800A and P-800B). A floor trench system in the main treatment plant area will collect equipment drain, overflow and periodic plant cleaning wash water and drain into this sump. The process area floor will be sloped toward a floor trench draining into a process sump. The chemical room sumps can be pumped into this sump.

C. Normally decant water from the backwash waste tank T-550 will be discharging into this sump on a continuous basis.

D. The sump pumps will operate as Lead/Lag and alternate every cycle. There will be one level transmitter (LIT-800) inside this sump to operate these pumps automatically. A backup high-high-level switch (LSHH-801) is inside this sump in case of transmitter failure.

E. Normally sump pumps will pump into the Eq Tank T-100. However, Sump discharge line also has a camlock fitting to discharge sump content directly into a tanker.

F. All recovery well pumps shall be shut down if sump level is High-High (refer to Section 3.2).

G. Sump depth is 10.33.’ Level alarms will be set as follows:

a. LALL-800 = 10” above sump floor – Sump low-low level alarm

b. LCL- 800 = 12” above sump floor (pump P-800A/B OFF level).

c. LCH- 800 = 48” above sump floor (lead pump ON level)

d. LCHH-800 = 60” above sump floor (lag pump ON level).

e. LAHH- 800 = 108” above sump floor (Plant shut down level).

H. Backup High-high level alarm switch LSHH-801 is set at 108”

I. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

J. Automatic Operation:

a. One or both pumps will be operated automatically based on the sump level. These pumps will operate in lead-lag operation. Provide the Operator an HMI button to allow for Lead-Lag selection of the pumps.

K. Interlocks:

a. The sump pumps shall be interlocked (not allowed to run) as follows:

i. Eq. Tank level is High-High (LAHH-100 or LAHH-101).

3.17 EYE WASH/SAFETY SHOWER SYSTEM (MI619)

A. Eight eye wash/safety shower systems will be provided, and each will contain a flow switch (FSH-951 thru 958). When any of the seven flow switches change state, an alarm will be generated. If this alarm is not acknowledged within 10 minutes, the plant will be shut down.

3.18 PROCESS TANK VENTING SYSTEM (MI617)

A. Equalization and LGAC Feed tank’s interior air is constantly drawn through a carbon canister (while fresh air is allowed to enter from outside) by a blower with a standby spare. The air will discharge through a louver to atmosphere. This system will run continuously while the plant is in operation.

B. There will be a combination pressure-vacuum relief valves (PSV-200) on the carbon canister.

C. A pressure transmitter (PIT-200) will monitor the pressure on the suction side of the carbon canister.

D. The Operator will start the carbon canister system via the HMI screen. The carbon canister system must be running before for the Treatment System to operate.

E. If the operating blower faults (YA-200A/B) or stops running (YI-200A/B) the PLC will automatically start the standby blower. The failed blower shall not start until the alarm is reset by the Operator.

F. Low or High carbon canister suction pressure will generate an alarm (PAL-200 or PAH-200), and the Treatment Plant will shut down. Setpoint to be determined during startup.

3.19 NON-POTABLE WATER SYSTEM (MI617)

A. To wash down the plant floor or tank, an equipment, a non-potable water (NPW) system will be provided. This water will be taken from the plant effluent/backwash supply tank T-500. There will be a booster pump (P-1), a bladder tank (BT-1) and a pressure transducer (PT-P1) to operate this pump. Several hose bibbs will be located inside the plant.

3.20 GAS MONITORS (MI607)

A. Two ambient oxygen monitors will be provided by the AOP reactor system vendor. One monitor (AIT-501) will be in the Ozone Generation Room, and another monitor (AIT-502) will be in the AOP Reactors Room. These monitors will be monitored by the AOP reactor system PLC panel as inputs AI-501 and AI-502, see AOP vendor submittal for details.

B. These monitors will send high gas concentration level alarms to AOP reactor system PLC as AAH-501, AAHH-501, AALL-502, AAL-502, AAH-502 and AAHH-502 (set point to be determined by AOP vendor). AOP system PLC will then communicate alarms with Plant PLC system to start opening louvers and all exhaust fans.

3.21 BUILDING AUTOMATION SYSTEM & FIRE ALARM CONTROL PANEL (MI620)

A. GWTP’s HVAC systems, exhaust fans, motor operated louvers and heaters will be controlled by a building automation system (BAS) located inside this plant. Refer to the specifications.

B. There will be a fire alarm control panel (FACP) located inside this plant. This will monitor fire water flow, sprinkler systems operation and generate a fire alarm. This FACP will be connected to a remote alarm monitoring company via two dedicated phone lines. FACP will also send a fire alarm signal to BAS to shut down the fans and close all the louvers in case of a fire. FACP will also send a fire alarm signal to the Plant PLC to shut down the process equipment in case of a fire.

C. The BAS panel will be connected to plant PLC via an ethernet cable. PLC will then monitor various BAS systems’ operation and send control to BAS in case of a gas release.

3.22 LOSS OF POWER MODE

A. The PLC shall utilize Ethernet communication to monitor the incoming utility power via the power meter located in Motor Control Center “MCC”.

B. If a loss of utility power is detected, the Win911 alarming software shall be configured to immediately call out “Loss of Power” alarm to designated recipients.

C. While in Loss of Power Mode, all motors will shut down, all vendor supplied equipment shall shut down and the PLC shall have all discrete outputs programmed to a de-energized state. This action shall cause all valves to move to their fail position.

D. The PLC shall continue to monitor process conditions and generate additional alarms based on out-of-range conditions for 30 minutes.

3.23 PLANT RESTART

A. Provide a Plant Restart button at PLC. This should place all pumping systems in AUTO mode in a sequence as follows: start the carbon canister system, start building sump pumps followed by air compressor, then filter feed system, then EQ system, then all recovery wells and finally remaining pumping systems. Starting of these systems shall be separated by 30 seconds. Individual pumping system will start operating based on their respective tanks levels and other conditions as defined above. Sludge dewatering system is a batch mode operation.

B. If the plant is shut down due to power outage, it may be restarted automatically when power is restored (Operator selectable).

C. If the plant shuts down due to any process related alarms (as provided in attached list), plant should be restarted by the Operator physically evaluating all equipment at the site and acknowledging all alarms.

D. For the first several months, this will be the protocol to understand the frequency of occurrences and overall impact on the treatment plant. Depending on the frequency and outcome of these occurrences, it may be determined whether a Remote Alarm Acknowledgement and Remote Plant Restart is acceptable.

E. If the sump High-High alarm exists, the plant shall never be restarted remotely.

3.24 E-STOP MODE

A. E-Stops will be located within the treatment plant at control panels IOP-2 (process area), IOP-3 (chemical area) and IOP-4 (LGAC/AOP area).

B. Any E-Stop condition shall place the treatment plant into “E-Stop Mode” and generate a visual alarm (strobe light) at IOPs. The PLC shall shut down all vendor supplied equipment and have all discrete outputs programmed to a de-energized state. This action shall cause all motors to stop running, all vendor supplied panels disabled and all valves to move to their fail position.

C. The PLC shall continue to monitor process conditions and generate additional alarms based on out-of-range conditions.

D. The treatment plant shall remain in E-Stop mode until an operator physically evaluates the cause of the E-Stop and determines conditions are safe to resume operation.

3.25 HUMAN MACHINE INTERFACE REQUIREMENTS

A. Provide graphical screens (including but not limited to, process overview, individual unit process overviews, equipment overlays, controller faceplates, diagnostic and network status screens) necessary to provide a

complete operator interface to the system. Refer to Specifications for additional details.

3.26 TRENDING, HISTORICAL ARCHIVING REQUIREMENTS:

A. Provide trending and historical archiving of all analog values as well as selected discrete values. Actual values to be archived shall be assessed during the shop drawing review period. Provide a system capable of archiving any analog or discrete value that is registered at the HMI including trending functions (value versus time) for any such value for a minimum of 6 months before being erased.

3.27 REPORTS

A. Configure at minimum daily, weekly, and monthly reports outlining groundwater flows from each recovery well, CTR1 pumping system, and treated water discharge flows. Configure reports so that average instantaneous flows (gpm) per day, per week, and per month and totalized flows (gallons) per day, per week, and per month will be recorded and reported at each flow point. Exact format will be established during the shop drawing review period.

3.28 WEB INTERFACE REQUIREMENTS

A. Provide equipment, software or custom programming to limit remote access functionality for the SCADA system. The system configuration should limit inbound traffic to the Control Room SCADA and PLC equipment. Outbound traffic for remate alarm notification should not be restricted. Establish and configure appropriate security settings and confirm all with OWNER prior to enabling remote communications.

3.29 ALARMING SOFTWARE AND CONFIGURATION REQUIREMENTS

A. Configure the alarming software to capture alarms as listed in Table 2 attached after this Section. This list also provides desired responses. Coordinate with the OWNER to establish a callout escalation and configure the alarming software as required.

B. All Alarms shall be captured by the SCADA system. Additional action may be required as outlined below in the Alarm Listing.

C. All low and low-low level alarms shall be generated after preceding feed pump has operated for a minimum of 120 seconds.

3.30 LOSS OF COMMUNICATION

A. If any of the following devices stop communicating with the PLC, the plant should **not** shut down:

a. Any individual VFD,

b. Any recovery well,

c. Any remote control panel (IOp-5 or IOP-6)

TABLE 1 RECOVERY WELL PUMPS OPERATING SET POINTS

PUMPING SYSTEM	LEVEL PROBE DEPTH (FEET)	PUMP ON LEVEL (FEET)	PUMP OFF LEVEL (FEET)	PUMP SETTING POINT (FEET)	COMMENTS
RW-8	80′ BGS	X	X	120′ BGS	
RW-9	80′ BGS	X	X	120′ BGS	
RW-10A	80′ BGS	X	X	120′ BGS	

TABLE 2 - LIST OF GWTP ALARMS AND DESIRED RESPONSES

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
FAL-8	RW-8	FLOW	X	X	X		
LALL-8	RW-8	LEVEL	X	X			
LAL-8	RW-8	LEVEL	X				
LAH-8	RW-8	LEVEL	X				
LAH-VV8	VV-8	LEVEL	X				
YA-8	RW-8	POWER	X				
TA-8	VV-8 HEAT TRACE	POWER	X				
PAL-8	RW-8	PRESSURE	X				
PAH-8	RW-8	PRESSURE	X				
FAL-9	RW-9	FLOW	X	X	X		
LALL-9	RW-9	LEVEL	X	X			
LAL-9	RW-9	LEVEL	X				
LAH-9	RW-9	LEVEL	X				
LAH-VV9	VV-9	LEVEL	X				
YA-9	RW-9	POWER	X				
TA-9	VV-9 HEAT TRACE	POWER	X				
PAL-9	RW-9	PRESSURE	X				
PAH-9	RW-9	PRESSURE	X				

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
FAL-10A	RW-10A	FLOW	X	X	X		
LALL-10A	RW-10A	LEVEL	X	X			
LAL-10A	RW-10A	LEVEL	X				
LAH-10A	RW-10A	LEVEL	X				
LAH-VV10A	VV-10A	LEVEL	X				
YA-10A	RW-10A	POWER	X				
TA-10A	VV-10A HEAT TRACE	POWER	X				
PAL-10A	RW-10A	PRESSURE	X				
PAH-10A	RW-10A	PRESSURE	X				
FAL-100	PLANT INFLUENT	FLOW	X	X	X		
LAHH-100	T-100	LEVEL	X	X	X		
LAH-100	T-100	LEVEL	X				
LAL-100	T-100	LEVEL	X				
LALL-100	T-100	LEVEL	X	X	X		
LAHH-101	T-100	LEVEL	X	X	X		
YA-100A	P-100A	POWER	X	X			
YA-100B	P-100B	POWER	X	X			
FAL-101A	P-100A	FLOW	X	X	X		
FAL-101B	P-100B	FLOW	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
AAL-101	MMF FEED	pH	X	X	X	AOP RECYCLE	
AAH-101	MMF FEED	pH	X	X	X	AOP RECYCLE	
AAL-102	MMF FEED	ORP	X	X	X	AOP RECYCLE	
AAH-102	MMF FEED	ORP	X	X	X	AOP RECYCLE	
FAL-101	MMF FEED (CHEMICAL PUMPS SHUTDOWN)	FLOW	X	X	X		X
YA-110	EQM-110	POWER	X	X			
PAL-210	MMF-210/220/230	PRESSURE	X				
PAH-210	MMF-210/220/230	PRESSURE	X	X			
KA-210	MMF-210	TIME	X				
PDAH-210	MMF-210	DELTA P	X	X			
KA-220	MMF-220	TIME	X				
PDAH-220	MMF-220	DELTA P	X	X			
KA-230	MMF-230	TIME	X				
PDAH-230	MMF-230	DELTA P	X	X			
PAL-230	MMF-210/220/230	PRESSURE	X				
PAH-230	MMF-210/220/230	PRESSURE	X	X			
PDAH-240	CF-240/250	DELTA P	X	X			
YI-300B	AOP	SYSTEM WARNING	X	X			

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YI-300C	AOP	SYSTEM SHUTDOWN	X	X			
AAH-501	AOP	AMBIENT O2	X	X			
AAHH-501	AOP	AMBIENT O2	X	X			
AALL-502	AOP	AMBIENT O2	X	X			
AAL-502	AOP	AMBIENT O2	X	X			
AAH-502	AOP	AMBIENT O2	X	X			
AAHH-502	AOP	AMBIENT O2	X	X			
TALL-710	OD-4000	TEMP	X	X			
TAHH-710	OD-4000	TEMP	X	X			
LAHH-400	T-400	LEVEL	X	X	X		
LAH-400	T-400	LEVEL	X				
LAL-400	T-400	LEVEL	X				
LALL-400	T-400	LEVEL	X	X	X		
LAHH-401	T-400	LEVEL	X	X	X		
YA-400A	P-400A	POWER	X	X			
YA-400B	P-400B	POWER	X	X			
FAL-400A	P-400A	FLOW	X	X	X		
FAL-400B	P-400B	FLOW	X	X	X		
PDAH-400	LGAC-410/420/430	PRESSURE	X	X			

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAHH-500	T-500	LEVEL	X	X	X		
LAH-500	T-500	LEVEL	X				
LAL-500	T-500	LEVEL	X				
LALL-500	T-500	LEVEL	X	X	X		
LAHH-501	T-500	LEVEL	X	X	X		
YA-500A	P-500A	POWER	X	X			
YA-500B	P-500B	POWER	X	X			
FAL-500A	P-500A	FLOW	X	X	X		
FAL-500B	P-500B	FLOW	X	X	X		
LAH-MHA1	MH-A1	LEVEL	X	X			
LAH-MHB1	MH-B1	LEVEL	X	X			
LAH-OFB1	OFB1	LEVEL	X	X	X		
LAH-OFB2	OFB2	LEVEL	X	X	X		
LAH-OFB3	OFB3	LEVEL	X	X	X		
LAH-OFB4	OFB4/OFB5	LEVEL	X	X	X		
LAH-912	T-910	LEVEL	X	X	X		
LAH-910	T-910	LEVEL	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAL-910	T-910	LEVEL	X	X			
LAH-911	T-910	LEAK	X	X	X		
LAH-913	P-910A/B	LEAK	X	X	X		
LAHH-911	HYPO ROOM	LEAK	X	X	X		
YA-911	P-911	POWER	X	X			
LAH-922	T-920	LEVEL	X	X	X		
LAH-920	T-920	LEVEL	X	X	X		
LAL-920	T-920	LEVEL	X	X			
LAH-921	T-920	LEAK	X	X	X		
LAH-923	P-920A/B	LEAK	X	X	X		
LAHH-921	HYPO ROOM	LEAK	X	X	X		
YA-921	P-921	POWER	X	X			
LAHH-932	T-930	LEVEL	X	X	X		
LAH-932	T-930	LEVEL	X	X	X		
LAHH-930A	T-930	LEVEL	X	X	X		
LAH-930A	T-930	LEVEL	X	X	X		
LAL-930A	T-930	LEVEL	X	X			
LALL-930A	T-930	LEVEL	X	X			
LAH-931A	T-930	LEAK	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAH-935A	P-930A/B	LEAK	X	X	X		
LAHH-931	PEROXIDE ROOM	LEAK	X	X	X		
YA-931	P-931	POWER	X	X			
YA-800A	P-800A	POWER	X	X			
YA-800B	P-800B	POWER	X	X			
LAHH-800	SUMP	LEVEL	X	X	X		X (A)
LAH-800	SUMP	LEVEL	X	X			
LAL-800	SUMP	LEVEL	X	X			
LALL-800	SUMP	LEVEL	X	X			
LAHH-801	SUMP	LEVEL	X	X	X		X (A)
PAH-200	C-200	PRESSURE	X	X			
PAL-200	C-200	PRESSURE	X	X			
YA-200A	B-200A	POWER	X	X			
YA-200B	B-200B	POWER	X	X			
LAHH-650	T-650	LEVEL	X	X	X		
LAH-650	T-650	LEVEL	X	X			
LAL-650	T-650	LEVEL	X	X			
LALL-650	T-650	LEVEL	X	X	X		
LAH-651	T-650	LEVEL	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YI-610B	AC-610	SYSTEM WARNING	X	X	X		
YI-610C	AC-610	SYSTEM SHUTDOWN	X	X	X		
YI-620B	AC-620	SYSTEM WARNING	X	X	X		
YI-620C	AC-620	SYSTEM SHUTDOWN	X	X	X		
PAL-643	AC-610/620	PRESSURE	X	X	X		
PAH-643	AC-610/620	PRESSURE	X	X			
PAH-644	AC-610/620	PRESSURE	X	X	X		
PAL-645	AC-610/620	PRESSURE	X	X			
FAH-951 thru 958	ANY EYEWASH STATION	FACILITY	X	X	X		
YA-980	MCC	SPD	X				
TAH-981	ELECTRICAL ROOM	TEMP	X				
TAH-982	PROCESS AREA	TEMP	X				
TAH-983	COMPRESSOR ROOM	TEMP	X				
TAH-984	OZONE GENERATOR ROOM	TEMP	X				
LAHH-991	CONTAINMENT WEST	LEAK	X	X	X		X
LAHH-991	CONTAINMENT EAST	LEAK	X	X	X		X
HI-IOP2A THRU IOP4A	ANY E-STOP	FACILITY	X	X	X		X
JA-IOP1 THRU IOP6	I/O PANEL	DC POWER	X				

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YA-990	FACP	FIRE ALARM	X	X	X		X
LAHH-550	T-550	LEVEL	X	X	X		
LAH-550	T-550	LEVEL	X				
LAL-550	T-550	LEVEL	X				
LALL-550	T-550	LEVEL	X	X	X		
LAHH-551	T-550	LEVEL	X	X	X		
TA-550A	VV-550 HEAT TRACE	POWER	X				
TA-550B	VV-550 HEAT TRACE	POWER	X				

(A) - Shutdown GWTP incoming flow (ALL recovery wells) only.

TETRA TECH	Magnetic Flowmeter & Transmitter Specification Sheet	REV.	DATE
	40 60 00 2.4.4.1	B	02/12/2026

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Sg (ρ)	1.0
Minimum Flow	0 (gpm)	Temperature Range	55 - 60 (°F)
Maximum Flow	*See chart below* (gpm)	Pressure Range	N/A (psig)
Conductivity	Varies (mmhos/cm)	Solids	< 1% (%)
Clarity	Varies	pH	5 - 7

ELEMENT:

Measurement Type	Flow	Instrument Span	* By Vendor
Lining Material	PTFE	Electrode Material	Nickel Alloy 276
Tube Material	304 Stainless Steel (SST)	Accuracy	±0.15% (High Accuracy Option)
Connection Type	Flange Style - Class 150	Line Size	*See chart below*

TRANSMITTER:

Type	Smart "HART Protocol"	Output Signal	4-20 Milliamperes (mA)
Power Supply	120-VAC, 60Hz	Indicator	Local Display (M4)
Accuracy	±0.15% (High Accuracy Option)	Flow Units	GPM

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	2" pipe/flat surface	Conduit Connections	4 @ 1/2 - 14 NPT
Enclosure Rating	NEMA 4X	Mounting	Wall Mount

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

ACCESSORIES:

Cable	Combination Coil/Electrode Cable (18 AWG) See Tag Information Chart for Estimated Cable Length	Calibration Certificate	Required

MANUFACTURER BASIS OF DESIGN:

Manufacture	Rosemount		
Remote Transmitter	8712EMR1A1AXM4D1Q4RC"**xx**" "**xx**" = Coil/Electrode Cable Length	Sensor	8705THA"**xxx**"P1W0G1D1J1Q4 "**xxx**" = Line Size

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, ABB, Endress & Hauser

TAG INFORMATION:

Instrument Tag	Service	Line Size	Operating Flow	P&ID	Estimated Cable Length (Contractor to Verify)
FE/FIT-8	Recovery Well RW-8 Flow	6”	450 gpm	MI604	40 ft. (see Note 4)
FE/FIT-9	Recovery Well RW-9 Flow	6”	450 gpm	MI602	40 ft. (see Note 4)
FE/FIT-10A	Recovery Well RW-10A Flow	6”	600 gpm	MI603	40 ft. (see Note 4)
FE/FIT-100	Plant influent Flow	8”	1500 gpm	MI604	40 ft. (see Note 4)
FE/FIT-101	MMF Feed Flow	8”	1500 gpm	MI605	10 ft. (see Note 4)
FE/FIT-400	LGAC Feed Flow	8”	1500 gpm	MI609	20 ft. (see Note 4)
FE/FIT-440A	Effluent to Basin #1 Flow	10”	1500 gpm	MI612	20 ft. (see Note 4)
FE/FIT-440B	Effluent to Basins #2 & #3 Flow	10”	1500 gpm	MI612	20 ft. (see Note 4)
FE/FIT-440C	Effluent to Basins #4 & #5 Flow	10”	1500 gpm	MI612	20 ft. (see Note 4)
FE/FIT-500	BWS Pumps P-500A/B Discharge Flow	6”	950 gpm	MI611	20 ft. (see Note 4)

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description and calibrated range permanently attached to device
2. All instruments to be from the same manufacturer.
3. Note: Calibration Range by Vendor
4. Each Flowmeter must be evaluated regarding mounting location to ensure sufficient cable length is properly selected for ease of configuration and visual monitoring.

TETRA TECH	Flow Switch Specification Sheet	REV.	DATE
	40 60 00 2.4.4.2	A	03/25/24

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Sg (ρ)	1
Temperature	55 - 60 (°F)	Operating Pressure	*See chart below* (psig)

ELEMENT:

Measurement Type	Flow	Wetted Parts	Red brass, 316 SS, phosphor bronze, EPDM
Sensor Type	Drag Disks/Strips	Connection Size & Type	1" NPT

SWITCH:

Type	Microswitch	Electrical Connections	Terminal Block
Contact Rating	15A @ 125 VAC	Quantity/Form	DPDT
Setpoint Adjustment	Yes (continuous)	Switch Setpoint Decreasing	2.5 (fps)

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

ACCESSORIES:

Indicator	None	Other	

MANUFACTURER SPECIFICATIONS:

Manufacturer	Omega	Model No.	FSW-43A

ACCEPTABLE MANUFACTURERS:

Manufacturer Dwyer (FLOTECT), Gems

TAG INFORMATION:

Tag Number	Service	Line Size	Flow Range (fps)	Operating Pressure (psig)	P&ID
FSL-101	MMF Feed Low Flow Switch	12"	1-6	60	MI605

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description and calibrated range permanently attached to device
2. All instruments to be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Probe Material	316 SS
Sensor Type	Ultrasonic Gap (Single Point)	Process Connection	3/4" NPT
Orientation	*See Chart Below*	Process Temperature	-40°F to 250°F

SWITCH:

Type	Relay Contacts	Response Time	2 Seconds
Current Rating	6 Amps	Indicator	N/A
Quantity & Form	DPDT	Power Supply	24VDC

HOUSING:

Material	NEMA 4X	Conduit Connection	3/4" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Drexelbrook VeriGAP	Model No.	504-1000 Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Siemens

TAG INFORMATION:

Tag Number	Service	Orientation	Insertion Length (inches)	Process Media	P&ID
LSHH-101	Equalization Tank T-100 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI605
LSHH-401	LGAC Feed Tank T-400 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI609
LSHH-501	BWS Tank T-5 00 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI611
LSHH-551	BWW Tank T-550 High-High Level	Vertical	**TBD** (see Note 2)	Groundwater	MI621
LSH-651	Air Compressor Cooling Water Tank T-650	Vertical	**TBD** (see Note 2)	Treated Water/ Potable Water	MI618
LSHH-801	Treatment Building Sump High-High Level	Vertical	12 (see Note 3)	Groundwater	MI616
LSHH-991	Treatment Building Leak Detection - West	Vertical	6	Groundwater	MI620
LSHH-992	Treatment Building Leak Detection - East	Vertical	6	Groundwater	MI620

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Insertion Length is final tank depth. Flange/Tank dome height needs added to the overall length.
   Exact length to be determined during Submittal Phase.
3. Insertion length to be confirmed during Submittal Phase.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Probe Material	Hastelloy "C"
Sensor Type	Ultrasonic Gap (Single Point)	Process Connection	3/4" NPT
Orientation	*See Chart Below*	Process Temperature	-40°F to 250°F

SWITCH:

Type	Relay Contacts	Response Time	2 Seconds
Current Rating	6 Amps	Indicator	N/A
Quantity & Form	DPDT	Power Supply	24VDC

HOUSING:

Material	NEMA 4X	Conduit Connection	3/4" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Drexelbrook VeriGAP	Model No.	504-1000 Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Siemens

TAG INFORMATION:

Tag Number	Service	Orientation	Insertion Length (inches)	Process Media	P&ID
LSH-922	Sodium Hypochlorite Storage Tank T-920 High Level	Vertical	**TBD** (see Note 2)	NaOCl (12%)	MI613
LSHH-921	Sodium Hypochlorite Room Leak Detection	Vertical	6	NaOCl (12%)	MI613
LSHH-931	Hydrogen Peroxide Room Leak Detection	Vertical	6	H2O2 (27%)	MI615

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Insertion Length is final tank depth. Flange/Tank dome height needs added to the overall length.
   Exact length to be determined during Submittal Phase.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Probe Material	Alloy 20 (Carpenter 20)
Sensor Type	Ultrasonic Gap (Single Point)	Process Connection	3/4" NPT
Orientation	*See Chart Below*	Process Temperature	-40°F to 250°F

SWITCH:

Type	Relay Contacts	Response Time	2 Seconds
Current Rating	6 Amps	Indicator	N/A
Quantity & Form	DPDT	Power Supply	24VDC

HOUSING:

Material	NEMA 4X	Conduit Connection	3/4" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Drexelbrook VeriGAP	Model No.	504-1000 Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Siemens

TAG INFORMATION:

Tag Number	Service	Orientation	Insertion Length (inches)	Process Media	P&ID
LSH-912	Sodium Hydroxide Storage Tank T-910 High Level	Vertical	**TBD** (see Note 2)	Caustic (25%)	MI614
LSHH-911	Sodium Hydroxide Room Leak Detection	Vertical	6	Caustic (25%)	MI614

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Insertion Length is final tank depth. Flange/Tank dome height needs added to the overall length.
   Exact length to be determined during Submittal Phase.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	1-1/2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	16 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	N/A	Adapter Flange	1-1/2" NPT to 3" ASME Flange (PVDF)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser
Model No.	FMU40-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer	Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Tank Height	Process Fluid	P&ID
LIT-650	Air Compressor Cooling Water Tank T-650	5'	Treated Water/Potable Water	MI618
LIT-920	Sodium Hypochlorite Tank T-920 Level	5.5'	Sodium Hypochlorite (12%)	MI613

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 9.6" blocking distance. Extend tank nozzles as needed to minimize blanking field within each tank.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	1-1/2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	16 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	N/A	Adapter Flange	1-1/2" NPT to 3" ASME Flange (PP)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser
Model No.	FMU40-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer	Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Tank Height	Process Fluid	P&ID
LIT-910	Sodium Hydroxide Tank T-910 Level	10.5'	Caustic (25%)	MI614

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 9.6" blocking distance. Extend tank nozzles as needed to minimize blanking field within each tank.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	26 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	Include for: LIT-550 only	Adapter Flange	2" NPT to 3" ASME Flange (PVDF)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser	Model No.	FMU41-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Tank Height	Process Fluid	P&ID
LIT-100	Eq. Tank T-100 Level	18'	Groundwater	MI605
LIT-400	LGAC Feed Tank T-400 Level	18'	Groundwater	MI609
LIT-500	Backwash Supply Tank T-500 Level	16'	Groundwater	MI611
LIT-550	Backwash Waste Tank T-550 Level	26'	Groundwater	MI621

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 13.2" blocking distance. Extend tank nozzles as needed to minimize blanking field within each tank.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	*See Chart Below*	Pressure Range	Atm (psig)
Surface Agitation Type	None	Temperature Range	60 (°F)

ELEMENT

Measurement Type	Ultrasonic	Wetted Parts Material	PVDF
Beam Angle	11°	Distance From Sidewall	1/6 of Tank Diameter
Process Connection	1-1/2" NPT	Suspension Bracket	N/A

TRANSMITTER:

Type	Integral	Output Signal	4 – 20 mA, HART
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.2% of measured dist.	Max. Range	16 ft.

HOUSING:

Material	Aluminum	Finish	Powder-coated
Mounting Hardware	*See Accessories*	Conduit Connections	2 – 1/2" NPT

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

Weather Protection Cover	N/A	Installation Bracket	316Ti for FMU40 Sensor

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser
Model No.	FMU40-ANB2A41

ACCEPTABLE MANUFACTURERS:

Manufacturer	Siemens, Flowline

TAG INFORMATION:

Tag Number	Service	Sump Height	Process Fluid	P&ID
LIT-800	Treatment Building Sump	10'	Groundwater	MI616

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Ultrasonic Level Transmitters have an ~ 9.6" blocking distance. Mount transmitter as needed to minimize blanking field within the sump.

TETRA TECH	Float Level Switch Specification Sheet	REV.	DATE
	40 60 00 2.4.5.5	B	02/12/26

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Level	Float/Stem Material	316 SS
Sensor Type	Float	Mounting:	1/2" NPT(M)
Orientation	*See Below*		

SWITCH:

Type	Reed Switch	Max. Temp	392°F
Current Rating	30VA: 0.14A @ 200VAC	Wire Leads	22 AWG x 24" long
Quantity & Form	SPST	Approx. Deadband	1/8"

HOUSING:

Material	N/A	Conduit Connection	N/A

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Dwyer	Model No.	F7-HSS

ACCEPTABLE MANUFACTURERS:

Manufacturer OMEGA, WIKA

TAG INFORMATION:

Tag Number	Service	Orientation	Process Media	P&ID
LSH-VV8	Valve Vault 8 High Level	Horizontal	Groundwater	MI602
LSH-VV9	Valve Vault 9 High Level	Horizontal	Groundwater	MI602
LSH-VV10A	Valve Vault 10A High Level	Horizontal	Groundwater	MI603
LSH-MHA1	Manhole MH-A1 High Level	Horizontal	Groundwater	MI612
LSH-MHB1	Manhole MH-B1 High Level	Horizontal	Groundwater	MI612

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device.
   All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Pressure Range	0–900	ft W.C.
Surface Agitation Type	None	Temperature Range	55	(°F)

ELEMENT:

Measurement Type	Hydrostatic	Wetted Parts Material	316L SS
Vented/Non-Vented	Vented	Casing Material	316L SS
Rating	IP68	Cable Length	250 Ft.

TRANSMITTER:

Type	Piezo-Resistive	Output Signal	4 – 20 mA
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.25% Full Scale	Lightning Protection	Included
Cable	Tefzel (ETFE)		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

ACCESSORIES:

Termination Enclosure	Include	Bellows	Include
Cable Hanger	Include	Drying Tube Assembly	N/A

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Keller	Model No.	Levelgage Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, Rosemount

TAG INFORMATION:

Tag Number	Service	Mounting Depth (Ft. - BGS)	Cable Length (Ft.)	P&ID
LT-8	Recovery Well RW-8 Level	80	150	MI602
LT-9	Recovery Well RW-9 Level	80	150	MI602
LT-10A	Recovery Well RW-10A Level	80	150	MI603

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Pressure Range	0–900	ft W.C.
Surface Agitation Type	None	Temperature Range	55	(°F)

ELEMENT:

Measurement Type	Hydrostatic	Wetted Parts Material	316L SS
Vented/Non-Vented	Vented	Casing Material	316L SS
Rating	IP68	Cable Length	250 Ft.

TRANSMITTER:

Type	Piezo-Resistive	Output Signal	4 – 20 mA
Power Supply	24VDC Loop Powered	Indicator Scale	N/A
Accuracy	+/- 0.25% Full Scale	Lightning Protection	Included
Cable	Tefzel (ETFE)		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

ACCESSORIES:

Termination Enclosure	Include	Bellows	Include
Cable Hanger	Include	Drying Tube Assembly	N/A

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Keller	Model No.	Levelgage Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Siemens, Rosemount

TAG INFORMATION:

Tag Number	Service	Mounting Depth (Ft.)	Cable Length (Ft.)	P&ID
LT-OFB1	Outfall Basin #1 Level	10	200	MI612
LT-OFB2	Outfall Basin #2 Level	10	200	MI612
LT-OFB3	Outfall Basin #3 Level	10	200	MI612
LT-OFB4	Outfall Basin #4 & #5 Level	10	200	MI612

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.

Plant	Naval Facilities Engineering Systems Command Norfolk, Virginia	Project	Upgrade of GM38 Area Hotspot Groundwater Treatment System - 2023
Location	Naval Weapons Industrial Reserve Plant, Bethpage, NY		

PROCESS CONDITIONS:

Process Fluid	Groundwater	Specific Gravity	0.95 – 1.16
pH	5 - 7	Temperature	50 - 70 (°F)

ELEMENT:

Case Type	Solid-front w/ blowout back	Dial Size	4 1/2 (inches)
Case Material	Black Phenolic	Window Material	Shatter-Resistant Glass
Ring Style	Threaded	Pointer	Micrometer adjustable
Measuring System	Bourdon Tube	Accuracy	+/-0.5% of span (Grade 2A)
Material	316L Stainless Steel (SS)		

SOCKET:

Location	Lower	Connection Size & Type	1/2” MNPT
Material	316L SS		

DIAPHRAGM SEAL:

Top Housing Material	316L SS	Fill Fluid	Silicone
Bot Housing Material	316L SS	Process Connection	1/2” NPT female
Diaphragm Material	316L SS	Instrument Connection	1/2” NPT female

ACCESSORIES:

Snubber	No	Siphon Type & Material	N/A

OPTIONS:

Vibration Damping: Plus! Performance Option (XLL)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	Type 1279 Pressure Gauge Type 200 Diaphragm Seal

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, WIKA

TAG INFORMATION:

Tag Number	Service	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-100A	MMF Feed Pump P-100A Discharge Pressure	6”	0 - 100	65	MI605
PI-100B	MMF Feed Pump P-100A Discharge Pressure	6”	0 - 100	65	MI605
PI-231	MMF Backwash Waste Outlet Pressure	8”	0 - 100	55	MI606
PI-240A	Cartridge Filter CF-240 Inlet Pressure	12”	0 - 100	55	MI606
PI-240B	Cartridge Filter CF-240 Outlet Pressure	12”	0 - 100	50	MI606
PI-250A	Cartridge Filter CF-250 Inlet Pressure	12”	0 - 100	55	MI606
PI-250B	Cartridge Filter CF-250 Outlet Pressure	12”	0 - 100	50	MI606
PI-400A	LGAC Feed Pump P-400A Discharge Pressure	8”	0 - 60	20	MI609
PI-400B	LGAC Feed Pump P-400B Discharge Pressure	8”	0 - 60	20	MI609
PI-440	Plant Effluent Pressure	12”	0 - 60	15	MI612

Tag Number	Service	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-500A	Backwash Supply Pump P-500A Discharge Pressure	6”	0 - 60	30	MI611
PI-500B	Backwash Supply Pump P-500B Discharge Pressure	6”	0 - 60	30	MI611
PI-800	Building Sump Pumps P-800A/B Discharge Pressure	3”	0 - 60	20	MI616
PI-1A	Non-Potable Water Pump P-1 Discharge Pressure	2”	0 - 100	50	MI617
PI-1B	Non-Potable Water BLADDER TANK BT-1 Pressure	N/A	0 - 100	50	MI617

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Plant	Naval Facilities Engineering Systems Command Norfolk, Virginia	Project	Upgrade of GM38 Area Hotspot Groundwater Treatment System - 2023
Location	Naval Weapons Industrial Reserve Plant, Bethpage, NY		

PROCESS CONDITIONS:

Process Fluid	*See Chart Below*	Specific Gravity	Varies
pH	Varies	Temperature	50 - 70 (°F)

ELEMENT:

Case Type	Solid-front w/ blowout back	Dial Size	4 1/2 (inches)
Case Material	Black Phenolic	Window Material	Shatter-Resistant Glass
Ring Style	Threaded	Pointer	Micrometer adjustable
Measuring System	Bourdon Tube	Accuracy	+/-0.5% of span (Grade 2A)
Material	316L Stainless Steel (SS)		

SOCKET:

Location	Lower	Connection Size & Type	1/2” MNPT
Material	316L SS		

DIAPHRAGM SEAL:

Top Housing Material	316L SS	Fill Fluid	Silicone
Bot Housing Material	Hastelloy C-276	Process Connection	1/2” NPT female
Diaphragm Material	Hastelloy C-276	Instrument Connection	1/2” NPT female

ACCESSORIES:

Snubber	No	Siphon Type & Material	N/A

OPTIONS:

Vibration Damping: Plus! Performance Option (XLL)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	Type 1279 Pressure Gauge Type 200 Diaphragm Seal

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, WIKA

TAG INFORMATION:

Tag Number	Service	Process Fluid	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-921	Sodium Hypochlorite Room Sump Pump	NaOCl (12%)	2”	0-30	10	MI613
PI-931	Hydrogen Peroxide Room Sump Pump	H2O2 (27%)	2”	0-30	10	MI615

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Plant	Naval Facilities Engineering Systems Command Norfolk, Virginia	Project	Upgrade of GM38 Area Hotspot Groundwater Treatment System - 2023
Location	Naval Weapons Industrial Reserve Plant, Bethpage, NY		

PROCESS CONDITIONS:

Process Fluid	*See Chart Below*	Specific Gravity	Varies
pH	Varies	Temperature	50 - 70 (°F)

ELEMENT:

Case Type	Solid-front w/ blowout back	Dial Size	4 1/2 (inches)
Case Material	Black Phenolic	Window Material	Shatter-Resistant Glass
Ring Style	Threaded	Pointer	Micrometer adjustable
Measuring System	Bourdon Tube	Accuracy	+/-0.5% of span (Grade 2A)
Material	316L Stainless Steel (SS)		

SOCKET:

Location	Lower	Connection Size & Type	1/2" MNPT
Material	316L SS		

DIAPHRAGM SEAL:

Top Housing Material	316L SS	Fill Fluid	Silicone
Bot Housing Material	Carpenter 20	Process Connection	1/2" NPT female
Diaphragm Material	Carpenter 20	Instrument Connection	1/2" NPT female

ACCESSORIES:

Snubber	No	Siphon Type & Material	N/A

OPTIONS:

Vibration Damping: Plus! Performance Option (XLL)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	Type 1279 Pressure Gauge Type 200 Diaphragm Seal

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, WIKA

TAG INFORMATION:

Tag Number	Service	Process Fluid	Line Size	Calibration Range [psig]	Operating Pressure [psig]	P&ID
PI-911	Sodium Hydroxide Room Sump Pump	Caustic (25%)	2"	0-30	10	MI614

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Groundwater	Sg (ρ)	0.95 – 1.16
Temperature	50 - 70 (°F)	Pressure	*See Chart Below* (psig)

ELEMENT:

Measurement Type	Gauge	Instrument Span	*By Vendor (psig)
Sensor Type	Diaphragm	Sensor Material	316L SST
Fill Fluid	Silicone	Wetted Parts	316L SST
O-Ring Material	Buna-N	Connection Size & Type	1/2" FNPT

TRANSMITTER:

Type	"Smart" (Hart Protocol)	Output Signal	4 - 20 mA DC
Power Supply	Two-wire loop-powered	Accuracy	±0.075% of span

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	SST	Conduit Connections	2 @ 1/2" FNPT (qty & size)
Mounting Bracket	2 in. Pipe	Enclosure Rating	NEMA 4X

DIAPHRAGM SEAL (IF REQUIRED):

Seal Type	RTW Threaded	Fill Fluid	Silicone 200
Top Housing Material	316L SST	Connection Size & Type	1/2" NPT
Bot Housing Material	316L SST	Diaphragm Material	316L SST
Capillary Type	N/A	Capillary Length	N/A
Mounting	Direct Mount		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Rosemount	Model No.	2088G2S22A1S1M4B4Q4

ACCEPTABLE MANUFACTURERS:

Manufacturer	Dwyer United Electric Controls

TAG INFORMATION:

Tag Number	Service	Line Size	Calibrated Range [psig]	Operating Pressure [psig]	P&ID
PIT-8	Recovery Well RW-8 Discharge Pressure	6”	0 - 100	45	MI602
PIT-9	Recovery Well RW-9 Discharge Pressure	6”	0 - 100	55	MI602
PIT-10A	Recovery Well RW-10A Discharge Pressure	6”	0 - 100	62	MI603

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.
   Pressure Transmitter ordered with diaphragm seal pre-assembled to unit.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Compressed Air	Density	~0.0752 (lb./ft^3)
Temperature	90-100 (°F)	Pressure Range	*See Chart Below* (psig)

ELEMENT:

Measurement Type	Gauge	Instrument Span	*By Vendor (psig)
Sensor Type	Diaphragm	Sensor Material	316L SST
Fill Fluid	Silicone	Wetted Parts	316L SST
O-Ring Material	Buna-N	Process Connection	1/2" FNPT

TRANSMITTER:

Type	"Smart" (Hart Protocol)	Output Signal	4 - 20 mA DC
Power Supply	Two-wire loop-powered	Accuracy	±0.075% of span

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	SST	Conduit Connections	2 - 1/2" NPT
Mounting Bracket	2 in. Pipe	Enclosure Rating	NEMA 4X

DIAPHRAGM SEAL (IF REQUIRED):

Seal Type	N/A	Fill Fluid	N/A
Top Housing Material	N/A	Connection Size & Type	N/A
Bot Housing Material	N/A	Diaphragm Material	N/A
Capillary Type	N/A	Capillary Length	N/A
Mounting	N/A		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Rosemount	Model No.	2088G2S22A1M4B4Q4

ACCEPTABLE MANUFACTURERS:

Manufacturer: Dwyer, United Electric Controls

TAG INFORMATION:

Tag Number	Service	Line Size	Calibrated Range [psig]	Operating Pressure [psig]	P&ID
PIT-643	Compressed Air Header Pressure	2"	0 - 150	90	MI618

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Air	Density	~0.0752 (lb./ft^3)
Temperature	50 - 70 (°F)	Pressure Range	*See Chart Below* (psig)

ELEMENT:

Measurement Type	Gauge	Instrument Span	*By Vendor (psig)
Sensor Type	Diaphragm	Sensor Material	316L SST
Fill Fluid	Silicone	Wetted Parts	316L SST
O-Ring Material	Glass-filled PTFE	Process Connection	1/2" FNPT

TRANSMITTER:

Type	"Smart" (Hart Protocol)	Output Signal	4 - 20 mA DC
Power Supply	Two-wire loop-powered	Accuracy	±0.075% of span

HOUSING:

Material	Low-copper Aluminum	Finish	Polyurethane
Mounting Hardware	SST	Conduit Connections	2 - 1/2" NPT
Mounting Bracket	2 in. Pipe	Enclosure Rating	NEMA 4X

DIAPHRAGM SEAL (IF REQUIRED):

Seal Type	N/A	Fill Fluid	N/A
Top Housing Material	N/A	Connection Size & Type	N/A
Bot Housing Material	N/A	Diaphragm Material	N/A

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-Hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer Rosemount Model No. 3051CG1A22A1A S5B4Y2L4Q4

ACCEPTABLE MANUFACTURERS:

Manufacturer Dwyer, United Electric Controls

ACCESSORIES:

Rosemount 305 Integral Manifold (3-valve configuration)

TAG INFORMATION:

Tag Number	Service	Line Size	Calibrated Range	Operating Pressure	P&ID
PIT-200	Carbon Canister Inlet Pressure	8"	-25 to 25 inH2O	2" H2O Vac	MI617

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

TETRA TECH	Pressure Switch Specification Sheet	REV.	DATE
	40 95 00 2.4.6.2	A	02/19/24

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Media	Compressed Air	Sg (ρ)	~0.0752 (lb./ft^3)
Temperature	90 - 100 (°F)		

ELEMENT:

Measurement Type	Pressure	Instrument Span	0 – 200 PSI
Sensor Type	Piston Actuator	Connection Size & Type	1/2" NPT
Insertion	Inline	Orientation	Horizontal
Diaphragm Material	Buna-N		

SWITCH:

Type	Relay Output	Response Time	1 (seconds)
Contact Rating	15 Amps @ 120VAC	Quantity/Form	SPDT

HOUSING:

Material	Epoxy Coated Aluminum	Rating	NEMA 4X Watertight
Mounting Hardware	N/A	Conduit Connections	3/4" FNPT

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Ashcroft	Model No.	B-Series

ACCEPTABLE MANUFACTURERS:

Manufacturer Dwyer
United Electric Controls

TAG INFORMATION:

Tag Number	Service	Pressure Switch Model No.	Setpoint	Line Size	P&ID
PSH-644	Compressed Air Header High Pressure	B4-24-B-XNHX06-200# (See Note 2)	110 PSI	2”	MI618
PSL-645	Compressed Air Header Low Pressure	B4-24-B-XNHX06-200# (See Note 3)	45 PSI	2”	MI618

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number permanently attached to device. All instruments listed shall be from the same manufacturer.
2. Set PSH-644 for operation on increasing pressure.
3. Set PSL-645 for operation on decreasing pressure.

TETRA TECH	pH & ORP Measurement Specification Sheet	REV.	DATE
	40 60 00 2.4.7.1	B	03/28/24

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

PROCESS CONDITIONS:

Fluid	Groundwater	Sg (ρ)	~1.0
Temperature Range	55 - 75 (°F)	Pressure	0 – 65 (psig)

SENSOR #1:

Measurement Type	pH / Temperature	Measured Range Temp	32 - 230 (°F)
Measuring Electrode	Memosens CPS91E	Sensor Cable	Memosens CYK10
Measured Range pH	0 - 14		

SENSOR #2:

Measurement Type	ORP	Measured Range ORP	-1500 to 1500 (mV)
Measuring Electrode	Memosens CPS92E	Sensor Cable	Memosens CYK10

ANALYZER:

Type	Liquiline CM442	Output Signal	4-20 Milliamperes (mA)
Power Supply	120 Volts AC (VAC)	Output Signal Accuracy	< 50 µA
Measurement 1	pH	Indicator	Monochromatic LCD
Measurement 2	Temperature	Operation Manual	English
Measurement 3	ORP		

HOUSING:

Material	Polycarbonate	Conduit Connections	1/2" NPT
Mounting Hardware	SST	Enclosure Rating	NEMA 4X
Mounting Bracket	2” Pipe Kit / Mounting Plate		

ELECTRICAL:

Area Classification Class _____ Division _____ Group _____ Non-hazardous X

SENSOR ACCESSORIES:

Retractable Electrode Holder Cleanfit CPA871 (Inline)

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Endress & Hauser	Analyzer Model No.	CM442 w/(4) 4-20mA Output
Sensor #1 Model No.	CPS91E	Sensor #2 Model No.	CPS92E

ACCEPTABLE MANUFACTURERS:

Manufacturer Rosemount, Hach

TAG INFORMATION:

Tag Number	Service	Pipe Size	Inline or Tank Mount	Analyzer	P&ID
AE-101A	MMF FEED pH / Temperature Electrode	2”	Inline	AIT-101	MI605
AE-101B	MMF FEED ORP Electrode	2”	Inline	AIT-101	MI605

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description and calibrated range permanently attached to device.
2. All instruments to be from the same manufacturer.

Customer	Naval Facilities Engineering Systems Command Norfolk, Virginia	Location	Naval Weapons Industrial Reserve Plant Bethpage, New York
Project	Phase III – Groundwater Treatment System	Project No.	

ELEMENT:

Measurement Type	Temperature	Instrument Span	-40 to 140°F
Sensor Type	PT1000 RTD	Sensor Material	304 SS

TRANSMITTER:

Power Supply	24VDC	Output Signal	4 to 20 mA DC
Accuracy	±0.5° @ 25°C	Indicator Scale	Not Required

HOUSING:

Material	Polycarbonate	Finish	N/A
Mounting Hardware	None	Conduit Connections	1/2" NPT
Enclosure Rating	NEMA 4X		

THERMOWELL:

Type	N/A	Insertion (U) Dimension	N/A (inches)
Material	N/A	Lagging (T) Dimension	N/A (inches)
Connection Size & Type	N/A		

ELECTRICAL:

Area Classification Class ____ Division ____ Group ____ Non-Hazardous X

ACCESSORIES:

N/A

MANUFACTURER BASIS OF DESIGN:

Manufacturer	Dwyer	Model No.	BTT-O251

ACCEPTABLE MANUFACTURERS:

Manufacturer Omega, United Electric Controls

TAG INFORMATION:

Tag Number	Service	Operating Range	P&ID
TT-981	Electrical Room Temperature	0 – 120°F	MI620
TT-982	Process Area	0 – 120°F	MI620
TT-983	Compressor Room	0 – 120°F	MI620
TT-984	Ozone Generator Room	0 – 120°F	MI620

SPECIAL INSTRUCTIONS OR FEATURES:

1. Stainless Steel Tag inscribed with tag number, service description, and calibrated range permanently attached to device. All instruments listed shall be from the same manufacturer.

IO SUMMARY

PANEL	AI	AO	DI - 24VDC	DO - 24VDC	DI - 120VAC	DO -120VAC	PANEL TOTALS
IOP-1	6	0	7	0	6	4	23
IOP-2	21	0	21	3	4	4	53
IOP-3	3	0	23	6	0	0	32
IOP-4	8	0	26	5	7	6	52
IOP-5	3	0	5	0	0	0	8
IOP-6	3	0	5	0	0	0	8
IO TOTALS	44	0	87	14	17	14	

IOP-1 (CONTROL ROOM) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
TI-981	TI	981		ELECTRICAL ROOM TEMPERATURE	MI620	AI 4-20mA	R1	S0	CH0	5094-IF8IH	EI615	TAL, TAH		
FI-550	FI	550		BACKWASH WASTE WATER TO SEWER FLOW	MI621	AI 4-20mA	R1	S0	CH1	5094-IF8IH	EI615			PARSHALL FLUME CONTROLLER W/ 24VDC POWER
LI-OFB1	LI	OFB1		STORMWATER BASIN #1 LEVEL	MI612	AI 4-20mA	R1	S0	CH2	5094-IF8IH	EI615	LAHH		
LI-OFB2	LI	OFB2		STORMWATER BASIN #2 LEVEL	MI612	AI 4-20mA	R1	S0	CH3	5094-IF8IH	EI615	LAHH		
LI-OFB3	LI	OFB3		STORMWATER BASIN #3 LEVEL	MI612	AI 4-20mA	R1	S0	CH4	5094-IF8IH	EI615	LAHH		
LI-OFB4	LI	OFB4		STORMWATER BASIN #4/#5 LEVEL	MI612	AI 4-20mA	R1	S0	CH5	5094-IF8IH	EI615	LAHH		
-				SPARE	-	AI 4-20mA	R1	S0	CH6	5094-IF8IH	EI615			
-				SPARE	-	AI 4-20mA	R1	S0	CH7	5094-IF8IH	EI615			
JI-980	JI	980		MCC POWER SUPPLY STATUS OK	MI620	DI 24vdc	R1	S1	CH0	5094-IB16	EI615			
YA-980	YA	980		MCC SPD LOSS OF PROTECTION	MI620	DI 24vdc	R1	S1	CH1	5094-IB16	EI615			
YA-IOP1A	YA	IOP1	A	IOP-1 UPS ON BATTERY	MI620	DI 24vdc	R1	S1	CH2	5094-IB16	EI615			0 = ALARM
YA-IOP1B	YA	IOP1	B	IOP-1 UPS LOW BATTERY	MI620	DI 24vdc	R1	S1	CH3	5094-IB16	EI615			0 = ALARM
JI-IOP1	JI	IOP1		IOP-1 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R1	S1	CH4	5094-IB16	EI615			
LAH-MHA1	LAH	MHA1		PLANT EFFLUENT TO BASIN #2 & #3 MANHOLE MH A-01 HIGH LEVEL	MI612	DI 24vdc	R1	S1	CH5	5094-IB16	EI615			0 = ALARM
LAH-MHB1	LAH	MHB1		PLANT EFFLUENT TO BASIN #4 & #5 MANHOLE MH B-01 HIGH LEVEL	MI612	DI 24vdc	R1	S1	CH6	5094-IB16	EI615			0 = ALARM
-				SPARE	-	DI 24vdc	R1	S1	CH7	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH8	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH9	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH10	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH11	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH12	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH13	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH14	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH15	5094-IB16	EI615			
-				SPARE	-	DO 24vdc	R1	S2	CH0	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH1	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH2	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH3	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH4	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH5	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH6	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH7	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH8	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH9	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH10	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH11	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH12	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH13	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH14	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH15	5094-OB16	EI616			
ZIO-550A	ZIO	550	A	BWW DRAIN TO BLDG. SUMP VALVE OPEN	MI621	DI 120vac	R1	S3	CH0	5094-IA16	EI616			
ZIC-550A	ZIC	550	A	BWW DRAIN TO BLDG. SUMP VALVE CLOSED	MI621	DI 120vac	R1	S3	CH1	5094-IA16	EI616			
ZIO-550B	ZIO	550	B	BWW DRAIN TO SEWER VALVE OPEN	MI621	DI 120vac	R1	S3	CH2	5094-IA16	EI616			
ZIC-550B	ZIC	550	B	BWW DRAIN TO SEWER VALVE CLOSED	MI621	DI 120vac	R1	S3	CH3	5094-IA16	EI616			
TA-550A	TA	550	A	BWW DRAIN TO BLDG. SUMP HEAT TRACE ALARM	MI621	DI 120vac	R1	S3	CH4	5094-IA16	EI616			0 = ALARM
TA-550B	TA	550	B	BWW DRAIN TO SEWER HEAT TRACE ALARM	MI621	DI 120vac	R1	S3	CH5	5094-IA16	EI616			0 = ALARM
-				SPARE	-	DI 120vac	R1	S3	CH6	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH7	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH8	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH9	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH10	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH11	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH12	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH13	5094-IA16	EI616			

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
-				SPARE	-	DI 120vac	R1	S3	CH14	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH15	5094-IA16	EI616			
ZYO-550A	ZYO	550	A	BWW DRAIN TO BLDG. SUMP VALVE OPEN COMMAND	MI621	DO 120vac	R1	S4	CH0	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-550A	ZYC	550	A	BWW DRAIN TO BLDG. SUMP VALVE CLOSE COMMAND	MI621	DO 120vac	R1	S4	CH1	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
ZYO-550B	ZYO	550	B	BWW DRAIN TO SEWER VALVE OPEN COMMAND	MI621	DO 120vac	R1	S4	CH2	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-550B	ZYC	550	B	BWW DRAIN TO SEWER VALVE CLOSE COMMAND	MI621	DO 120vac	R1	S4	CH3	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
-				SPARE	-	DO 120vac	R1	S4	CH4	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH5	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH6	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH7	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH8	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH9	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH10	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH11	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH12	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH13	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH14	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH15	5094-OA16	EI617			
-				-	-	-	-	-	-	-	-	-	-	-
-				-	-	-	-	-	-	-	-	-	-	-

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
FI-8	FI	8		RECOVERY WELL 8 FLOW	MI604	AI 4-20mA	R2	S0	CH0	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
LI-8	LI	8		RECOVERY WELL 8 LEVEL	MI602	AI 4-20mA	R2	S0	CH1	5094-IF8IH	EI625	LALL	LCH (Pump ON) LCL (Pump OFF)	
PI-8	PI	8		RECOVERY WELL 8 DISCHARGE PRESSURE	MI602	AI 4-20mA	R2	S0	CH2	5094-IF8IH	EI625	PAL, PAH		
FI-100	FI	100		PLANT INFLUENT FLOW	MI604	AI 4-20mA	R2	S0	CH3	5094-IF8IH	EI625			MAGMETER W/120VAC POWER
LI-800	LI	800		TREATMENT BUILDING SUMP LEVEL	MI616	AI 4-20mA	R2	S0	CH4	5094-IF8IH	EI625	LALL, LAHH	LCH (LEAD PUMP ON) LCHH (LAG PUMP ON) LCL (BOTH PUMPS OFF)	
LIC-100	LIC	100		EQ. TANK T-100 LEVEL	MI605	AI 4-20mA	R2	S0	CH5	5094-IF8IH	EI625	LALL, LAHH	LCH (Pump ON) LCL (Pump OFF)	
FI-101	FI	101		MMF FEED FLOW	MI605	AI 4-20mA	R2	S0	CH6	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-440A	FI	440	A	PLANT EFFLUENT TO BASIN #1 FLOW	MI612	AI 4-20mA	R2	S0	CH7	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-440B	FI	440	B	PLANT EFFLUENT TO BASIN #2 & #3 FLOW	MI612	AI 4-20mA	R2	S1	CH0	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-440C	FI	440	C	PLANT EFFLUENT TO BASIN #4 & #5 FLOW	MI612	AI 4-20mA	R2	S1	CH1	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-500	FI	500		BWS PUMPS P-500A/B DISCHARGE FLOW	MI611	AI 4-20mA	R2	S1	CH2	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
-				SPARE	-	AI 4-20mA	R2	S1	CH3	5094-IF8IH	EI625			
-				SPARE	-	AI 4-20mA	R2	S1	CH4	5094-IF8IH	EI625			
-				SPARE	-	AI 4-20mA	R2	S1	CH5	5094-IF8IH	EI625			
TI-982	TI	982		GWTP BUILDING - PROCESS AREA	MI620	AI 4-20mA	R2	S1	CH6	5094-IF8IH	EI625	TAL, TAH		
LI-500	LI	500		BWS TANK T-500 LEVEL	MI611	AI 4-20mA	R2	S1	CH7	5094-IF8IH	EI625	LALL, LAHH	LCH (Pump ON) LCL (Pump OFF)	
AI-101	AI	101		MMF FEED pH	MI605	AI 4-20mA	R2	S2	CH0	5094-IF8IH	EI626	AAL, AAH		
TI-101	TI	101		MMF FEED TEMPERATURE	MI605	AI 4-20mA	R2	S2	CH1	5094-IF8IH	EI626			
AI-102	AI	102		MMF FEED ORP	MI605	AI 4-20mA	R2	S2	CH2	5094-IF8IH	EI626	AAL, AAH		
-				SPARE	-	AI 4-20mA	R2	S2	CH3	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH4	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH5	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH6	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH7	5094-IF8IH	EI626			
YA-IOP2A	YA	IOP2	A	IOP-2 UPS ON BATTERY	MI620	DI 24vdc	R2	S3	CH0	5094-IB16	EI626			0 = ALARM
YA-IOP2B	YA	IOP2	B	IOP-2 UPS LOW BATTERY	MI620	DI 24vdc	R2	S3	CH1	5094-IB16	EI626			0 = ALARM
HI-IOP2A	HI	IOP2	A	IOP-2 PANEL E-STOP	MI620	DI 24vdc	R2	S3	CH2	5094-IB16	EI626			0 = ESTOP
HI-IOP2B	HI	IOP2	B	IOP-2 PANEL ALARM SILENCE	MI620	DI 24vdc	R2	S3	CH3	5094-IB16	EI626			
JI-IOP2	JI	IOP2		IOP-2 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R2	S3	CH4	5094-IB16	EI626			
LAH-VV8	LAH	VV8		VALVE VAULT 8 HIGH LEVEL	MI602	DI 24vdc	R2	S3	CH5	5094-IB16	EI626			0 = ALARM
JI-8	JI	8		RW-8 LOCAL DISCONNECT STATUS	MI602	DI 24vdc	R2	S3	CH6	5094-IB16	EI626			1 = CLOSED
TA-8	TA	8		RW-8 DISCHARGE PIPING HEAT TRACE ALARM	MI612	DI 24vdc	R2	S3	CH7	5094-IB16	EI626			0 = ALARM
LAHH-101	LAHH	101		EQ. TANK T-100 HIGH-HIGH LEVEL SWITCH	MI605	DI 24vdc	R2	S3	CH8	5094-IB16	EI626			0 = ALARM
JI-100A	JI	100A		MMF FEED PUMP P-100A LOCAL DISCONNECT STATUS	MI605	DI 24vdc	R2	S3	CH9	5094-IB16	EI626			1 = CLOSED
JI-100B	JI	100B		MMF FEED PUMP P-100B LOCAL DISCONNECT STATUS	MI605	DI 24vdc	R2	S3	CH10	5094-IB16	EI626			1 = CLOSED
-				SPARE	-	DI 24vdc	R2	S3	CH11	5094-IB16	EI626			
-				SPARE	-	DI 24vdc	R2	S3	CH12	5094-IB16	EI626			
-				SPARE	-	DI 24vdc	R2	S3	CH13	5094-IB16	EI626			
LAHH-801	LAHH	801		BUILDING SUMP HIGH-HIGH LEVEL ALARM	MI616	DI 24vdc	R2	S3	CH14	5094-IB16	EI626			0 = ALARM
JI-800A	JI	800A		SUMP PUMP P-800A LOCAL DISCONNECT STATUS	MI616	DI 24vdc	R2	S3	CH15	5094-IB16	EI626			1 = CLOSED
JI-800B	JI	800B		SUMP PUMP P-800B LOCAL DISCONNECT STATUS	MI616	DI 24vdc	R2	S4	CH0	5094-IB16	EI627			1 = CLOSED
FAH-951	FAH	951		EYEWASH/SAFETY SHOWER BLDG. SUMP	MI619	DI 24vdc	R2	S4	CH1	5094-IB16	EI627			0 = ALARM
LAHH-501	LAHH	501		BSW TANK T-500 HIGH-HIGH LEVEL SWITCH	MI611	DI 24vdc	R2	S4	CH2	5094-IB16	EI627			0 = ALARM
JI-500A	JI	500A		BWS PUMP P-500A LOCAL DISCONNECT STATUS	MI611	DI 24vdc	R2	S4	CH3	5094-IB16	EI627			1 = CLOSED
JI-500B	JI	500B		BWS PUMP P-500B LOCAL DISCONNECT STATUS	MI611	DI 24vdc	R2	S4	CH4	5094-IB16	EI627			1 = CLOSED

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
JI-110	JI	110		EQ TANK MIXER EQM-110 LOCAL DISCONNECT STATUS	MI605	DI 24vdc	R2	S4	CH5	5094-IB16	EI627			1 = CLOSED
YI-P1	YI	P1		NON-POTABLE WATER PUMP RUN INDICATION	MI617	DI 24vdc	R2	S4	CH6	5094-IB16	EI627			1 = RUNNING
LAHH-991	LAHH	991		TREATMENT BUILDING LEAK DETECTION - WEST	MI620	DI 24vdc	R2	S4	CH7	5094-IB16	EI627			0 = ALARM
-				SPARE	-	DI 24vdc	R2	S4	CH8	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH9	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH10	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH11	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH12	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH13	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH14	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH15	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH0	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH1	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH2	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH3	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH4	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH5	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH6	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH7	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH8	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH9	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH10	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH11	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH12	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH13	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH14	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH15	5094-IB16	EI627			
YC-IOP2A	YC	IOP2	A	IOP-2 PANEL HORN	MI620	DO 24vdc	R3	S0	CH0	5094-OB16	EI628			
YC-IOP2B	YC	IOP2	B	IOP-2 PANEL BEACON	MI620	DO 24vdc	R3	S0	CH1	5094-OB16	EI628			
YC-P1	YC	P1		NON-POTABLE WATER PUMP ENABLE	MI617	DO 24vdc	R3	S0	CH2	5094-OB16	EI628			INTERPOSING RELAY
-				SPARE	-	DO 24vdc	R3	S0	CH3	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH4	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH5	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH6	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH7	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH8	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH9	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH10	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH11	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH12	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH13	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH14	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH15	5094-OB16	EI628			
ZIO-400A	ZIO	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVE OPENED	MI610	DI 120vac	R3	S1	CH0	5094-IA16	EI628			
ZIC-400A	ZIC	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVE CLOSED	MI610	DI 120vac	R3	S1	CH1	5094-IA16	EI628			
ZIO-400	ZIO	400		LGAC TO BWS TANK T-500 VALVE OPENED	MI610	DI 120vac	R3	S1	CH2	5094-IA16	EI628			
ZIC-400	ZIC	400		LGAC TO BWS TANK T-500 VALVE CLOSED	MI610	DI 120vac	R3	S1	CH3	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH4	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH5	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH6	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH7	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH8	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH9	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH10	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH11	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH12	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH13	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH14	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH15	5094-IA16	EI628			

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
ZYO-400A	ZYO	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVE OPEN COMMAND	MI610	DO 120vac	R3	S2	CH0	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-400A	ZYC	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVEE CLOSE COMMAND	MI610	DO 120vac	R3	S2	CH1	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
ZYO-400	ZYO	400		LGAC TO BWS TANK T-500 VALVE OPEN COMMAND	MI610	DO 120vac	R3	S2	CH2	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-400	ZYC	400		LGAC TO BWS TANK T-500 VALVE CLOSE COMMAND	MI610	DO 120vac	R3	S2	CH3	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
-				SPARE	-	DO 120vac	R3	S2	CH4	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH5	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH6	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH7	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH8	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH9	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH10	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH11	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH12	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH13	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH14	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH15	5094-OA16	EI629			
FQ-8	FQ	8		RECOVERY WELL 8 FLOW TOTALIZATION	MI604	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-100	FQ	100		PLANT INFLUENT FLOW TOTALIZATION	MI604	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-101	FQ	101		MMF FEED FLOW TOTALIZATION	MI605	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-440A	FQ	440	A	PLANT EFFLUENT TO BASIN #1 FLOW TOTALIZATION	MI612	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-440B	FQ	440	B	PLANT EFFLUENT TO BASIN #2 & #3 FLOW TOTALIZATION	MI612	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-440C	FQ	440	C	PLANT EFFLUENT TO BASIN #4 & #5 FLOW TOTALIZATION	MI612	HMI	-	-	-	-	-	-	-	CALCULATED
HI-8A	HI	8	A	RW-8 IN AUTO	MI602	NET-IN	-	-	-	-	-	-	-	-
HI-8B	HI	8	B	RW-8 IN HAND	MI602	NET-IN	-	-	-	-	-	-	-	-
II-8	II	8		RW-8 PUMP CURRENT INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SI-8	SI	8		RW-8 PUMP SPEED INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SC-8	SC	8		RW-8 PUMP SPEED CONTROL	MI602	NET-OUT	-	-	-	-	-	-	-	-
HS-8	HS	8		RW-8 AUTO/MANUAL SELECT	MI602	HMI	-	-	-	-	-	-	-	-
YA-8	YA	8		RW-8 FAULT INDICATION	MI602	NET-IN								-
YI-8	YI	8		RW-8 RUN INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
YC-8	YC	8		RW-8 RUN COMMAND	MI602	NET-OUT	-	-	-	-	-	-	-	-
HS-100	HS	100		P-100A /B SELECT	MI605	HMI	-	-	-	-	-	-	-	-
HI-100AA	HI	100A	A	MMF FEED PUMP P-100A IN AUTO	MI605	NET-IN	-	-	-	-	-	-	-	-
HI-100AB	HI	100A	B	MMF FEED PUMP P-100A IN HAND	MI605	NET-IN	-	-	-	-	-	-	-	-
II-100A	II	100A		P-100A PUMP CURRENT INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SI-100A	SI	100A		P-100A PUMP SPEED INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SC-100A	SC	100A		P-100A PUMP SPEED CONTROL	MI605	NET-OUT	-	-	-	-	-	-	-	-
HS-100A	HS	100A		P-100A AUTO/MANUAL SELECT	MI605	HMI	-	-	-	-	-	-	-	-
YA-100A	YA	100A		P-100A FAULT INDICATION	MI605	NET-IN								-
YI-100A	YI	100A		P-100A RUN INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
YC-100A	YC	100A		P-100A RUN COMMAND	MI605	NET-OUT	-	-	-	-	-	-	-	-
HI-100BA	HI	100B	A	MMF FEED PUMP P-100A IN AUTO	MI605	NET-IN	-	-	-	-	-	-	-	-
HI-100BB	HI	100B	B	MMF FEED PUMP P-100A IN HAND	MI605	NET-IN	-	-	-	-	-	-	-	-
II-100B	II	100B		P-100B PUMP CURRENT INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SI-100B	SI	100B		P-100B PUMP SPEED INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SC-100B	SC	100B		P-100B PUMP SPEED CONTROL	MI605	NET-OUT	-	-	-	-	-	-	-	-
HS-100B	HS	100B		P-100B AUTO/MANUAL SELECT	MI605	HMI	-	-	-	-	-	-	-	-
YA-100B	YA	100B		P-100B FAULT INDICATION	MI605	NET-IN								-
YI-100B	YI	100B		P-100B RUN INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
YC-100B	YC	100B		P-100B RUN COMMAND	MI605	NET-OUT	-	-	-	-	-	-	-	-
HS-500	HS	500		P-500A/B SELECT	MI611	HMI	-	-	-	-	-	-	-	-
HI-500AA	HI	500A	A	BWS PUMP P-500A IN AUTO	MI611	NET-IN	-	-	-	-	-	-	-	-
HI-500AB	HI	500A	B	BWS PUMP P-500A IN HAND	MI611	NET-IN	-	-	-	-	-	-	-	-
II-500A	II	500A		P-500A PUMP CURRENT INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
SI-500A	SI	500A		P-500A PUMP SPEED INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
SC-500A	SC	500A		P-500A PUMP SPEED CONTROL	MI611	NET-OUT	-	-	-	-	-	-	-	-
HS-500A	HS	500A		P-500A AUTO/MANUAL SELECT	MI611	HMI	-	-	-	-	-	-	-	-
YA-500A	YA	500A		P-500A FAULT INDICATION	MI611	NET-IN								-
YI-500A	YI	500A		P-500A RUN INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
YC-500A	YC	500A		P-500A RUN COMMAND	MI611	NET-OUT	-	-	-	-	-	-	-	-
HI-500BA	HI	500B	A	BWS PUMP P-500B IN AUTO	MI611	NET-IN	-	-	-	-	-	-	-	-
HI-500BB	HI	500B	B	BWS PUMP P-500B IN HAND	MI611	NET-IN	-	-	-	-	-	-	-	-
II-500B	II	500B		P-500B PUMP CURRENT INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
SI-500B	SI	500B		P-500B PUMP SPEED INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
SC-500B	SC	500B		P-500B PUMP SPEED CONTROL	MI611	NET-OUT	-	-	-	-	-	-	-	-
HS-500B	HS	500B		P-500B AUTO/MANUAL SELECT	MI611	HMI	-	-	-	-	-	-	-	-
YA-500B	YA	500B		P-500B FAULT INDICATION	MI611	NET-IN								-
YI-500B	YI	500B		P-500B RUN INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
YC-500B	YC	500B		P-500B RUN COMMAND	MI611	NET-OUT	-	-	-	-	-	-	-	-
HS-800	HS	800		P-800A/B SELECT	MI616	HMI	-	-	-	-	-	-	-	-
HI-800AA	HI	800A	A	SUMP PUMP P-800A IN AUTO	MI616	NET-IN	-	-	-	-	-	-	-	-
HI-800AB	HI	800A	B	SUMP PUMP P-800A IN HAND	MI616	NET-IN	-	-	-	-	-	-	-	-
HS-800A	HS	800A		P-800A AUTO/MANUAL SELECT	MI616	HMI	-	-	-	-	-	-	-	-
II-800A	II	800A		P-800A CURRENT INDICATION	MI616	NET-IN								-
YA-800A	YA	800A		P-800A FAULT INDICATION	MI616	NET-IN								-
YI-800A	YI	800A		P-800A RUN INDICATION	MI616	NET-IN	-	-	-	-	-	-	-	-
YC-800A	YC	800A		P-800A RUN COMMAND	MI616	NET-OUT	-	-	-	-	-	-	-	-
HI-800BA	HI	800B	A	SUMP PUMP P-800B IN AUTO	MI616	NET-IN	-	-	-	-	-	-	-	-
HI-800BB	HI	800B	B	SUMP PUMP P-800B IN HAND	MI616	NET-IN	-	-	-	-	-	-	-	-
HS-800B	HS	800B		P-800B AUTO/MANUAL SELECT	MI616	HMI	-	-	-	-	-	-	-	-
II-800B	II	800B		P-800B CURRENT INDICATION	MI616	NET-IN								-
YA-800B	YA	800B		P-800B FAULT INDICATION	MI616	NET-IN								-
YI-800B	YI	800B		P-800B RUN INDICATION	MI616	NET-IN	-	-	-	-	-	-	-	-
YC-800B	YC	800B		P-800B RUN COMMAND	MI616	NET-OUT	-	-	-	-	-	-	-	-
HI-110A	HI	110	A	EQM-110 SUMP PUMP P-800B IN AUTO	MI605	NET-IN	-	-	-	-	-	-	-	-
HI-110B	HI	110	B	EQM-110 SUMP PUMP P-800B IN HAND	MI605	NET-IN	-	-	-	-	-	-	-	-
HS-110	HS	110		EQM-110 AUTO/MANUAL SELECT	MI605	HMI	-	-	-	-	-	-	-	-
II-110	II	110		EQM-110 CURRENT INDICATION	MI605	NET-IN								-
YA-110	YA	110		EQM-110 FAULT INDICATION	MI605	NET-IN								-
YI-110	YI	110		EQM-110 RUN INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
YC-110	YC	110		EQM-110 RUN COMMAND	MI605	NET-OUT	-	-	-	-	-	-	-	-
-					-		-	-	-	-	-	-	-	-

IOP-3 (CHEMICAL AREA) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
-				SPARE	-	AI 4-20mA	R4	S0	CH0	5094-IF8IH	EI635			
LI-920	LI	920		SODIUM HYPOCHLORITE TANK T-910 LEVEL	MI613	AI 4-20mA	R4	S0	CH1	5094-IF8IH	EI635	LAL, LAH		LAL FOR CHEMICAL DELIVERY
LI-910	LI	910		CAUSTIC TANK T-920 LEVEL	MI614	AI 4-20mA	R4	S0	CH2	5094-IF8IH	EI635	LAL, LAH		LAL FOR CHEMICAL DELIVERY
PDI-240	PDI	240		CARTRIDGE FILTER CF-240/250 PRESSURE DIFFERENTIAL	MI606	AI 4-20mA	R4	S0	CH3	5094-IF8IH	EI635	PDAH		
-				SPARE	-	AI 4-20mA	R4	S0	CH4	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S0	CH5	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S0	CH6	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S0	CH7	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH0	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH1	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH2	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH3	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH4	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH5	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH6	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH7	5094-IF8IH	EI635			
-				SPARE	-	AO 4-20mA	R4	S2	CH0	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH1	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH2	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH3	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH4	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH5	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH6	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH7	5094-OF8	EI636			
YA-IOP3A	YA	IOP3	A	IOP-3 UPS ON BATTERY	MI620	DI 24vdc	R4	S3	CH0	5094-IB16	EI636			0 = ALARM
YA-IOP3B	YA	IOP3	B	IOP-3 UPS LOW BATTERY	MI620	DI 24vdc	R4	S3	CH1	5094-IB16	EI636			0 = ALARM
HI-IOP3A	HI	IOP3	A	IOP-3 PANEL E-STOP	MI620	DI 24vdc	R4	S3	CH2	5094-IB16	EI636			0 = ESTOP
HI-IOP3B	HI	IOP3	B	IOP-3 PANEL ALARM SILENCE	MI620	DI 24vdc	R4	S3	CH3	5094-IB16	EI636			
JI-IOP3	JI	IOP3		IOP-3 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R4	S3	CH4	5094-IB16	EI636			
LAH-921	LAH	921		SODIUM HYPOCHLORITE TANK T-920 LEAK ALARM	MI613	DI 24vdc	R4	S3	CH5	5094-IB16	EI636			
LAH-922	LAH	922		SODIUM HYPOCHLORITE TANK T-920 HIGH LEVEL	MI613	DI 24vdc	R4	S3	CH6	5094-IB16	EI636			
LAH-923	LAH	923		SODIUM HYPOCHLORITE METERING PUMP SKID LEAK ALARM	MI613	DI 24vdc	R4	S3	CH7	5094-IB16	EI636			
FAH-954	FAH	954		EYEWASH/SAFETY SHOWER HYPO ROOM	MI619	DI 24vdc	R4	S3	CH8	5094-IB16	EI636			0 = ALARM
LAH-911	LAH	911		CAUSTIC TANK T-910 LEAK ALARM	MI614	DI 24vdc	R4	S3	CH9	5094-IB16	EI636			0 = ALARM
LAH-912	LAH	912		CAUSTIC TANK T-910 HIGH LEVEL	MI614	DI 24vdc	R4	S3	CH10	5094-IB16	EI636			0 = ALARM
LAH-913	LAH	913		CAUSTIC METERING PUMP SKID LEAK ALARM	MI614	DI 24vdc	R4	S3	CH11	5094-IB16	EI636			0 = ALARM
FAH-955	FAH	955		EYEWASH/SAFETY SHOWER CAUSTIC ROOM	MI619	DI 24vdc	R4	S3	CH12	5094-IB16	EI636			0 = ALARM
FAH-956	FAH	956		EYEWASH/SAFETY SHOWER PEROXIDE ROOM	MI619	DI 24vdc	R4	S3	CH13	5094-IB16	EI636			0 = ALARM
HI-AP1	HI	AP1		CHEMICAL UNLOADING ALARM PANEL AP-1 ALARM SILENCE	MI620	DI 24vdc	R4	S3	CH14	5094-IB16	EI636			0 = ALARM
LAHH-911	LAHH	911		CAUSTIC ROOM LEAK ALARM	MI614	DI 24vdc	R4	S3	CH15	5094-IB16	EI636			0 = ALARM
LAHH-921	LAHH	921		HYPO ROOM LEAK ALARM	MI613	DI 24vdc	R4	S4	CH0	5094-IB16	EI637			0 = ALARM
LAHH-931	LAHH	931		PEROXIDE ROOM LEAK ALARM	MI615	DI 24vdc	R4	S4	CH1	5094-IB16	EI637			0 = ALARM
HI-911	HI	911		CAUSTIC ROOM SUMP PUMP P-911 ENABLED	MI614	DI 24vdc	R4	S4	CH2	5094-IB16	EI637	YA		> 15 MINUTES
HI-921	HI	921		HYPO ROOM SUMP PUMP P-921 ENABLED	MI613	DI 24vdc	R4	S4	CH3	5094-IB16	EI637	YA		> 15 MINUTES
HI-931	HI	931		PEROXIDE ROOM SUMP PUMP P-931 ENABLED	MI615	DI 24vdc	R4	S4	CH4	5094-IB16	EI637	YA		> 15 MINUTES
FAH-952	FAH	952		EYEWASH/SAFETY SHOWER MMF AREA	MI619	DI 24vdc	R4	S4	CH5	5094-IB16	EI637			0 = ALARM
FAL-101	FAL	101		MMF FEED LOW FLOW (CHEMICAL PUMP SHUTDOWN RELAY ACTIVATED)	MI6015	DI 24vdc	R4	S4	CH6	5094-IB16	EI637			0 = ALARM
-				SPARE	-	DI 24vdc	R4	S4	CH7	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH8	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH9	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH10	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH11	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH12	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH13	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH14	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH15	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH0	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH1	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH2	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH3	5094-IB16	EI637			

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
-				SPARE	-	DI 24vdc	R4	S5	CH4	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH5	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH6	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH7	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH8	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH9	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH10	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH11	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH12	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH13	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH14	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH15	5094-IB16	EI637			
YC-IOP3A	YC	IOP3	A	IOP-3 PANEL HORN	MI620	DO 24vdc	R5	S0	CH0	5094-OB16	EI638			
YC-IOP3B	YC	IOP3	B	IOP-3 PANEL BEACON	MI620	DO 24vdc	R5	S0	CH1	5094-OB16	EI638			
YC-AP1	YC	AP1		CHEMICAL UNLOADING ALARM PANEL AP-1 HORN	MI620	DO 24vdc	R5	S0	CH2	5094-OB16	EI638			
YC-920	YC	920		SODIUM HYPOCHLORITE TANK T-920 HIGH LEVEL LIGHT	MI620	DO 24vdc	R5	S0	CH3	5094-OB16	EI638			
YC-910	YC	910		CAUSTIC TANK T-910 HIGH LEVEL LIGHT	MI620	DO 24vdc	R5	S0	CH4	5094-OB16	EI638			
YC-930	YC	930		PEROXIDE TANK T-930 HIGH LEVEL LIGHT	MI620	DO 24vdc	R5	S0	CH5	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH6	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH7	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH8	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH9	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH10	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH11	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH12	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH13	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH14	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH15	5094-OB16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH0	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH1	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH2	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH3	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH4	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH5	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH6	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH7	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH8	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH9	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH10	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH11	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH12	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH13	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH14	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH15	5094-IA16	EI638			
-				SPARE	-	DO 120vac	R5	S2	CH0	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH1	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH2	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH3	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH4	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH5	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH6	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH7	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH8	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH9	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH10	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH11	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH12	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH13	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH14	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH15	5094-OA16	EI639			
UI-210	UI	210		MMF SKID CONTROL PANEL	MI606	ETHERNET	-	-	-	-	-	-	-	-

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
HS-920	HS	920		SODIUM HYPOCHLORITE PUMP P-920 A/B SELECT	MI613	HMI	-	-	-	-	-	-	-	-
SI-920A	SI	920A		P-920A PUMP SPEED INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
SC-920A	SC	920A		P-920A PUMP SPEED CONTROL	MI613	NET-OUT	-	-	-	-	-	-	-	-
YI-920A	YI	920A		P-920A RUN INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
YC-920A	YC	920A		P-920A RUN COMMAND	MI613	HMI	-	-	-	-	-	-	-	-
SI-920B	SI	920B		P-920B PUMP SPEED INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
SC-920B	SC	920B		P-920B PUMP SPEED CONTROL	MI613	NET-OUT	-	-	-	-	-	-	-	-
YI-920B	YI	920B		P-920B RUN INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
YC-920B	YC	920B		P-920B RUN COMMAND	MI613	HMI	-	-	-	-	-	-	-	-
HS-910	HS	910		CAUSTIC PUMP P-910 A/B SELECT	MI614	HMI	-	-	-	-	-	-	-	-

IOP-4 (LGAC-AOP AREA) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
PI-200	PI	200		CARBON CANISTER INLET PRESSURE	MI617	AI 4-20mA	R6	S0	CH0	5094-IF8IH	EI645	PAL, PAH		
LI-400	LI	400		LGAC FEED TANK T-400 LEVEL	MI609	AI 4-20mA	R6	S0	CH1	5094-IF8IH	EI645	LALL, LAHH	LCH (Pump ON) LCL (Pump OFF)	
FI-400	FI	400		LGAC FEED FLOW	MI609	AI 4-20mA	R6	S0	CH2	5094-IF8IH	EI645	FAL		MAGMETER W/120VAC POWER
-				SPARE	-	AI 4-20mA	R6	S0	CH3	5094-IF8IH	EI645			
LI-550	LI	550		BWW TANK T-550 LEVEL	MI621	AI 4-20mA	R6	S0	CH4	5094-IF8IH	EI645	LAH, LAHH		
PI-643	PI	643		COMPRESSED AIR HEADER PRESSURE	MI618	AI 4-20mA	R6	S0	CH5	5094-IF8IH	EI645	PAL, PAH		
TI-983	TI	983		COMPRESSOR ROOM TEMPERATURE	MI620	AI 4-20mA	R6	S0	CH6	5094-IF8IH	EI645	TAL, TAH		
TI-984	TI	984		OZONE GENERATOR ROOM TEMPERATURE	MI620	AI 4-20mA	R6	S0	CH7	5094-IF8IH	EI645	TAL, TAH		
LIC-650	LIC	650		Air Compressor Cooling Water Tank T-650 LEVEL	MI618	AI 4-20mA	R6	S1	CH0	5094-IF8IH	EI645	LALL, LAHH	LCL, LCH	OPERATE WATER INLET VALVES BASED ON TANK LEVEL
-				SPARE	-	AI 4-20mA	R6	S1	CH1	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH2	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH3	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH4	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH5	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH6	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH7	5094-IF8IH	EI645			
-				SPARE	-	AO 4-20mA	R6	S2	CH0	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH1	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH2	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH3	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH4	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH5	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH6	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH7	5094-OF8	EI646			
YA-IOP4A	YA	IOP4	A	IOP-4 UPS ON BATTERY	MI620	DI 24vdc	R6	S3	CH0	5094-IB16	EI646			0 = ALARM
YA-IOP4B	YA	IOP4	B	IOP-4 UPS LOW BATTERY	MI620	DI 24vdc	R6	S3	CH1	5094-IB16	EI646			0 = ALARM
HI-IOP4A	HI	IOP4	A	IOP-4 PANEL E-STOP	MI620	DI 24vdc	R6	S3	CH2	5094-IB16	EI646			0 = ESTOP
HI-IOP4B	HI	IOP4	B	IOP-4 PANEL ALARM SILENCE	MI620	DI 24vdc	R6	S3	CH3	5094-IB16	EI646			
JI-IOP4	JI	IOP4		IOP-4 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R6	S3	CH4	5094-IB16	EI646			
LAHH-401	LAHH	401		LGAC FEED TANK T-400 HIGH-HIGH LEVEL SWITCH	MI609	DI 24vdc	R6	S3	CH5	5094-IB16	EI646			0 = ALARM
JI-400A	JI	400A		LGAC FEED PUMP P-400A LOCAL DISCONNECT STATUS	MI609	DI 24vdc	R6	S3	CH6	5094-IB16	EI646			1 = CLOSED
JI-400B	JI	400B		LGAC FEED PUMP P-400B LOCAL DISCONNECT STATUS	MI609	DI 24vdc	R6	S3	CH7	5094-IB16	EI646			1 = CLOSED
YI-610A	YI	610	A	AIR COMPRESSOR AC-610 RUNNING	MI618	DI 24vdc	R6	S3	CH8	5094-IB16	EI646			
YI-610B	YI	610	B	AIR COMPRESSOR AC-610 WARNING	MI618	DI 24vdc	R6	S3	CH9	5094-IB16	EI646			
YI-610C	YI	610	C	AIR COMPRESSOR AC-610 SHUTDOWN	MI618	DI 24vdc	R6	S3	CH10	5094-IB16	EI646			
YI-620A	YI	620	A	AIR COMPRESSOR AC-620 RUNNING	MI618	DI 24vdc	R6	S3	CH11	5094-IB16	EI646			
YI-620B	YI	620	B	AIR COMPRESSOR AC-620 WARNING	MI618	DI 24vdc	R6	S3	CH12	5094-IB16	EI646			
YI-620C	YI	620	C	AIR COMPRESSOR AC-620 SHUTDOWN	MI618	DI 24vdc	R6	S3	CH13	5094-IB16	EI646			
FAH-957	FAH	957		EYEWASH/SAFETY SHOWER AOP REACTOR ROOM	MI619	DI 24vdc	R6	S3	CH14	5094-IB16	EI646			0 = ALARM
FAH-958	FAH	958		EYEWASH/SAFETY SHOWER OZONE GENERATOR ROOM	MI619	DI 24vdc	R6	S3	CH15	5094-IB16	EI646			0 = ALARM
LAHH-551	LAHH	551		BWW TANK T-550 HIGH-HIGH LEVEL SWITCH	MI621	DI 24vdc	R6	S4	CH0	5094-IB16	EI647			0 = ALARM
-				SPARE	-	DI 24vdc	R6	S4	CH1	5094-IB16	EI647			
PAH-644	PAH	644		COMPRESSED AIR HEADER PRESSURE ALARM HIGH	MI618	DI 24vdc	R6	S4	CH2	5094-IB16	EI647			0 = ALARM
PAL-645	PAL	645		COMPRESSED AIR HEADER PRESSURE ALARM LOW	MI618	DI 24vdc	R6	S4	CH3	5094-IB16	EI647			0 = ALARM
PDAH-400	PDAH	400		LGAC-410/420/430 PRESSURE DIFFERENTIAL HIGH	MI610	DI 24vdc	R6	S4	CH4	5094-IB16	EI647			0 = ALARM
-				SPARE	-	DI 24vdc	R6	S4	CH5	5094-IB16	EI647			
-				SPARE	-	DI 24vdc	R6	S4	CH6	5094-IB16	EI647			
LAHH-651	LAHH	651		Air Compressor Cooling Water Tank T-650 HIGH LEVEL SWITCH	MI618	DI 24vdc	R6	S4	CH7	5094-IB16	EI647			0 = ALARM
LAHH-992	LAHH	992		TREATMENT BUILDING LEAK DETECTION - EAST	MI620	DI 24vdc	R6	S4	CH8	5094-IB16	EI647			0 = ALARM
YA-990	YA	990		FIRE ALARM ACTIVE	MI620	DI 24vdc	R6	S4	CH9	5094-IB16	EI647			1 = ALARM
FAH-953	FAH	953		EYEWASH/SAFETY SHOWER NEAR COMPRESSOR ROOM	MI619	DI 24vdc	R6	S4	CH10	5094-IB16	EI647			0 = ALARM

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
JI-200A	JI	200A		CARBON CANISTER BLOWER B-200A LOCAL DISCONNECT STATUS	MI617	DI 24vdc	R6	S4	CH11	5094-IB16	EI647			1 = CLOSED
JI-200B	JI	200B		CARBON CANISTER BLOWER B-200B LOCAL DISCONNECT STATUS	MI617	DI 24vdc	R6	S4	CH12	5094-IB16	EI647			1 = CLOSED
-				SPARE	-	DI 24vdc	R6	S4	CH13	5094-IB16	EI647			
-				SPARE	-	DI 24vdc	R6	S4	CH14	5094-IB16	EI647			
-				SPARE	-	DI 24vdc	R6	S4	CH15	5094-IB16	EI647			
YC-IOP4A	YC	IOP4	A	IOP-4 PANEL HORN	MI620	DO 24vdc	R6	S5	CH0	5094-OB16	EI647			
YC-IOP4B	YC	IOP4	B	IOP-4 PANEL BEACON	MI620	DO 24vdc	R6	S5	CH1	5094-OB16	EI647			
ZYO-651	ZYO	651		POTABLE WATER VALVE OPEN COMMAND	MI618	DO 24vdc	R6	S5	CH2	5094-OB16	EI647			
ZYO-652	ZYO	652		TREATED WATER VALVE OPEN COMMAND	MI618	DO 24vdc	R6	S5	CH3	5094-OB16	EI647			
HS-300	HS	300		AOP SYSTEM ENABLE	MI607	DO 24vdc	R6	S5	CH4	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH5	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH6	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH7	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH8	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH9	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH10	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH11	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH12	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH13	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH14	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH15	5094-OB16	EI647			
ZIO-350A	ZIO	350	A	AOP RECYCLE TO EQ. TANK VALVE OPENED	MI608	DI 120vac	R6	S6	CH0	5094-IA16	EI648			
ZIC-350A	ZIC	350	A	AOP RECYCLE TO EQ. TANK VALVE CLOSED	MI608	DI 120vac	R6	S6	CH1	5094-IA16	EI648			
ZIO-350B	ZIO	350	B	AOP TO LGAC FEED TANK T-400 VALVE OPENED	MI608	DI 120vac	R6	S6	CH2	5094-IA16	EI648			
ZIC-350B	ZIC	350	B	AOP TO LGAC FEED TANK T-400 VALVE CLOSED	MI608	DI 120vac	R6	S6	CH3	5094-IA16	EI648			
YI-300A	YI	300	A	AOP SYSTEM RUNNING	MI607	DI 120vac	R6	S6	CH4	5094-IA16	EI648			
YI-300B	YI	300	B	AOP SYSTEM WARNING	MI607	DI 120vac	R6	S6	CH5	5094-IA16	EI648			
YI-300C	YI	300	C	AOP SYSTEM SHUTDOWN	MI607	DI 120vac	R6	S6	CH6	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH7	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH8	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH9	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH10	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH11	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH12	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH13	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH14	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH15	5094-IA16	EI648			
HS-610	HS	610		AIR COMPRESSOR AC-610 REMOTE START/STOP	MI618	DO 120vac	R6	S7	CH0	5094-IA16	EI648			
HS-620	HS	620		AIR COMPRESSOR AC-620 REMOTE START/STOP	MI618	DO 120vac	R6	S7	CH1	5094-IA16	EI648			
ZYO-350A	ZYO	350	A	AOP RECYCLE TO EQ. TANK VALVE OPEN COMMAND	MI608	DO 120vac	R6	S7	CH2	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-350A	ZYC	350	A	AOP RECYCLE TO EQ. TANK VALVE CLOSE COMMAND	MI608	DO 120vac	R6	S7	CH3	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
ZYO-350B	ZYO	350	B	AOP TO LGAC FEED TANK VALVE OPEN COMMAND	MI608	DO 120vac	R6	S7	CH4	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-350B	ZYC	350	B	AOP TO LGAC FEED TANK VALVE CLOSE COMMAND	MI608	DO 120vac	R6	S7	CH5	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
-				SPARE	-	DO 120vac	R6	S7	CH6	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH7	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH8	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH9	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH10	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH11	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH12	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH13	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH14	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH15	5094-IA16	EI648			
FQ-400	FQ	400		LGAC FEED FLOW TOTALIZATION	MI609	HMI	-	-	-	-	-	-	-	CALCULATED

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
HS-400	HS	400		P-400A/B SELECT	MI609	HMI	-	-	-	-	-	-	-	-
HI-400AA	HI	400A	A	LGAC FEED PUMP P-400A IN AUTO	MI609	NET-IN	-	-	-	-	-	-	-	-
HI-400AB	HI	400A	B	LGAC FEED PUMP P-400A IN HAND	MI609	NET-IN	-	-	-	-	-	-	-	-
II-400A	II	400A		P-400A PUMP CURRENT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SI-400A	SI	400A		P-400A PUMP SPEED INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SC-400A	SC	400A		P-400A PUMP SPEED CONTROL	MI609	NET-OUT	-	-	-	-	-	-	-	-
HS-400A	HS	400A		P-400A AUTO/MANUAL SELECT	MI609	HMI	-	-	-	-	-	-	-	-
YA-400A	YA	400A		P-400A FAULT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YI-400A	YI	400A		P-400A RUN INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YC-400A	YC	400A		P-400A RUN COMMAND	MI609	NET-OUT	-	-	-	-	-	-	-	-
HI-400BA	HI	400B	A	LGAC FEED PUMP P-400B IN AUTO	MI609	NET-IN	-	-	-	-	-	-	-	-
HI-400BB	HI	400B	B	LGAC FEED PUMP P-400B IN HAND	MI609	NET-IN	-	-	-	-	-	-	-	-
II-400B	II	400B		P-400B PUMP CURRENT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SI-400B	SI	400B		P-400B PUMP SPEED INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SC-400B	SC	400B		P-400B PUMP SPEED CONTROL	MI609	NET-OUT	-	-	-	-	-	-	-	-
HS-400B	HS	400B		P-400B AUTO/MANUAL SELECT	MI609	HMI	-	-	-	-	-	-	-	-
YA-400B	YA	400B		P-400B FAULT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YI-400B	YI	400B		P-400B RUN INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YC-400B	YC	400B		P-400B RUN COMMAND	MI609	NET-OUT	-	-	-	-	-	-	-	-
UI-610	UI	610		AIR COMPRESSOR C-610	MI618	ETHERNET	-	-	-	-	-	-	-	-
UI-620	UI	620		AIR COMPRESSOR C-620	MI618	ETHERNET	-	-	-	-	-	-	-	-
UI-300	UI	300		AOP/OZONE/REACTOR SYSTEM	MI607 MI608	ETHERNET	-	-	-	-	-	-	-	-
HS-200	HS	200		B-200A/B SELECT	MI617	HMI	-	-	-	-	-	-	-	-
HI-200AA	HI	200A	A	CARBON CANISTER BLOWER B-200A IN AUTO	MI617	NET-IN	-	-	-	-	-	-	-	-
HI-200AB	HI	200A	B	CARBON CANISTER BLOWER B-200A IN HAND	MI617	NET-IN	-	-	-	-	-	-	-	-
HS-200A	HS	200A		B-200A AUTO/MANUAL SELECT	MI617	HMI	-	-	-	-	-	-	-	-
II-200A	II	200A		B-200A CURRENT INDICATION	MI617	NET-IN								-
YA-200A	YA	200A		B-200A FAULT INDICATION	MI617	NET-IN								-
YI-200A	YI	200A		B-200A RUN INDICATION	MI617	NET-IN	-	-	-	-	-	-	-	-
YC-200A	YC	200A		B-200A RUN COMMAND	MI617	NET-OUT	-	-	-	-	-	-	-	-
HI-200BA	HI	200B	A	CARBON CANISTER BLOWER B-200B IN AUTO	MI617	NET-IN	-	-	-	-	-	-	-	-
HI-200BB	HI	200B	B	CARBON CANISTER BLOWER B-200B IN HAND	MI617	NET-IN	-	-	-	-	-	-	-	-
HS-200B	HS	200B		B-200B AUTO/MANUAL SELECT	MI617	HMI	-	-	-	-	-	-	-	-
II-200B	II	200B		B-200B CURRENT INDICATION	MI617	NET-IN								-
YA-200B	YA	200B		B-200B FAULT INDICATION	MI617	NET-IN								-
YI-200B	YI	200B		B-200B RUN INDICATION	MI617	NET-IN	-	-	-	-	-	-	-	-
YC-200B	YC	200B		B-200B RUN COMMAND	MI617	NET-OUT	-	-	-	-	-	-	-	-
-				-	-	-	-	-	-	-	-	-	-	-

IOP-5 (RW-9) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
LI-9	LI	9		RECOVERY WELL 9 LEVEL	MI602	AI 4-20mA	R7	S0	CH0	5094-IF8IH	EI655	LALL	LCH (Pump ON) LCL (Pump OFF)	
FI-9	FI	9		RECOVERY WELL 9 FLOW	MI602	AI 4-20mA	R7	S0	CH1	5094-IF8IH	EI655	FAL		MAGMETER W/120VAC POWER
PI-9	PI	9		RECOVERY WELL 9 DISCHARGE PRESSURE	MI602	AI 4-20mA	R7	S0	CH2	5094-IF8IH	EI655	PAL, PAH		
-				SPARE	-	AI 4-20mA	R7	S0	CH3	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH4	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH5	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH6	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH7	5094-IF8IH	EI655			
YA-IOP5A	YA	IOP5	A	IOP-5 UPS ON BATTERY	MI620	DI 24vdc	R7	S1	CH0	5094-IB16	EI655			0 = ALARM
YA-IOP5B	YA	IOP5	B	IOP-5 UPS LOW BATTERY	MI620	DI 24vdc	R7	S1	CH1	5094-IB16	EI655			0 = ALARM
JI-IOP5	JI	IOP5		IOP-5 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R7	S1	CH2	5094-IB16	EI655			
LAH-VV9	LAH	VV9		VALVE VAULT 9 HIGH LEVEL	MI602	DI 24vdc	R7	S1	CH3	5094-IB16	EI655			0 = ALARM
-				SPARE	-	DI 24vdc	R7	S1	CH4	5094-IB16	EI655			
TA-9	TA	9		RW-9 DISCHARGE PIPING HEAT TRACE ALARM	MI602	DI 24vdc	R7	S1	CH5	5094-IB16	EI655			1 = ALARM
-				SPARE	-	DI 24vdc	R7	S1	CH6	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH7	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH8	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH9	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH10	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH11	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH12	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH13	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH14	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH15	5094-IB16	EI655			
FQ-9	FQ	9		RECOVERY WELL 9 FLOW TOTALIZATION	MI602	HMI	-	-	-	-	-	-	-	CALCULATED
HI-9A	HI	9	A	RW-9 IN AUTO	MI602	NET-IN	-	-	-	-	-	-	-	-
HI-9B	HI	9	B	RW-9 IN HAND	MI602	NET-IN	-	-	-	-	-	-	-	-
II-9	II	9		RW-9 PUMP CURRENT INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SI-9	SI	9		RW-9 PUMP SPEED INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SC-9	SC	9		RW-9 PUMP SPEED CONTROL	MI602	NET-OUT	-	-	-	-	-	-	-	-
HS-9	HS	9		RW-9 AUTO/MANUAL SELECT	MI602	HMI	-	-	-	-	-	-	-	-
YA-9	YA	9		RW-9 FAULT INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
YI-9	YI	9		RW-9 RUN INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
YC-9	YC	9		RW-9 RUN COMMAND	MI602	NET-OUT	-	-	-	-	-	-	-	-

IOP-6 (RW-10A) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
LI-10A	LI	10A		RECOVERY WELL 10A LEVEL	MI603	AI 4-20mA	R8	S0	CH0	5094-IF8IH	EI665	LALL	LCH (Pump ON) LCL (Pump OFF)	
FI-10A	FI	10A		RECOVERY WELL 10A FLOW	MI603	AI 4-20mA	R8	S0	CH1	5094-IF8IH	EI665	FAL		MAGMETER W/120VAC POWER
PI-10A	PI	10A		RECOVERY WELL 10A DISCHARGE PRESSURE	MI603	AI 4-20mA	R8	S0	CH2	5094-IF8IH	EI665	PAL, PAH		
-				SPARE	-	AI 4-20mA	R8	S0	CH3	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH4	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH5	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH6	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH7	5094-IF8IH	EI665			
YA-IOP6A	YA	IOP6	A	IOP-6 UPS ON BATTERY	MI620	DI 24vdc	R8	S1	CH0	5094-IB16	EI665			0 = ALARM
YA-IOP6B	YA	IOP6	B	IOP-6 UPS LOW BATTERY	MI620	DI 24vdc	R8	S1	CH1	5094-IB16	EI665			0 = ALARM
JI-IOP6	JI	IOP6		IOP-6 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R8	S1	CH2	5094-IB16	EI665			
LAH-VV10A	LAH	VV10A		VALVE VAULT 10A HIGH LEVEL	MI603	DI 24vdc	R8	S1	CH3	5094-IB16	EI665			0 = ALARM
-				SPARE	-	DI 24vdc	R8	S1	CH4	5094-IB16	EI665			
TA-10A	TA	10A		RW-10A DISCHARGE PIPING HEAT TRACE ALARM	MI603	DI 24vdc	R8	S1	CH5	5094-IB16	EI665			1 = ALARM
-				SPARE	-	DI 24vdc	R8	S1	CH6	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH7	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH8	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH9	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH10	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH11	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH12	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH13	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH14	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH15	5094-IB16	EI665			
FQ-10A	FQ	10A		RECOVERY WELL 10A FLOW TOTALIZATION	MI603	HMI	-	-	-	-	-	-	-	CALCULATED
HI-10AA	HI	10A	A	RW-10A IN AUTO	MI603	NET-IN	-	-	-	-	-	-	-	
HI-10AB	HI	10A	B	RW-10A IN HAND	MI603	NET-IN	-	-	-	-	-	-	-	
II-10A	II	10A		RW-10A PUMP CURRENT INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
SI-10A	SI	10A		RW-10A PUMP SPEED INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
SC-10A	SC	10A		RW-10A PUMP SPEED CONTROL	MI603	NET-OUT	-	-	-	-	-	-	-	
HS-10A	HS	10A		RW-10A AUTO/MANUAL SELECT	MI603	HMI	-	-	-	-	-	-	-	
YA-10A	YA	10A		RW-10A FAULT INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
YI-10A	YI	10A		RW-10A RUN INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
YC-10A	YC	10A		RW-10A RUN COMMAND	MI603	NET-OUT	-	-	-	-	-	-	-	

SECTION 40 60 00

PROCESS CONTROL DESCRIPTION

PART 1. GENERAL

1.1 DESCRIPTION

This Section covers the operating functions of all equipment and controls of the instruments for the Groundwater Treatment Plant (GWTP).

The GWTP consists of various unit processes as listed below and as depicted on Contract Drawings MI601 thru MI621. Control descriptions for these processes are described herein (Para 3.2 thru 3.21).

A. Extraction/recovery Systems (MI602 THRU MI604)

B. Equalization Tank / Filter Feed System (MI605)

C. Multi-media Filtration (MMF) System (MI606)

D. Bag Filter System (MI606)

E. Ozone Generation System (MI607)

F. Advanced Oxidation Process (AOP) System (MI608)

G. Ozone Destruction System (MI608)

H. Liquid Phase Granular Activated Carbon (LGAC) Feed System (MI609)

I. Liquid Phase Granular Activated Carbon (LGAC)System (MI610)

J. Effluent System (MI612)

K. MMF/LGAC Backwash System (MI611)

L. Backwash Waste / Discharge System (MI621

M. Hypochlorite Feed System (MI613)

N. Caustic Feed System (MI614)

O. Hydrogen Peroxide System (MI615)

P. Building Sump (MI616)

Q. Process Tanks Venting System (MI617)

R. Non potable water system (MI617)

S. Air Compressor System (MI618)

T. Eyewash and Safety Showers System (MI619)

U. Utility Monitoring & Control System (UMCS) and Fire Alarm Panel (FAP) (MI620)

This Section also specifies following requirements:

A. Loss of Power Mode Operation

B. Restart Mode

C. E-Stop Operation

D. Human Machine Interface

E. Trending, Historical Archiving

F. Reporting

G. Web Interface

H. Alarming Software and Configuration

I. Loss of Communication

Operator controls and indications described herein shall be at the Supervisory Control and Data Acquisition (SCADA) System interface to the Programmable Logic Controller (PLC).

All PLC functions described herein refer to the process PLC located in the Operator Control Room.

CONTRACTOR shall be responsible for ensuring that all control loops operate properly and safely, regardless of equipment supplier, vendor, or subcontractor. CONTRACTOR shall coordinate repair or replacement of any faulty process equipment, control equipment, wiring, or other system components.

The Drawings and Specifications are intended to provide minimum process control requirements only. CONTRACTOR is responsible for determining the configuration, design, layout, and details of all control loops.

1.2 DEFINITIONS

A. Soft Controls: Software, or Soft, controls will be programmed controls available to the operator through four Human Machine Interface (HMI) terminals located within the Treatment Facility or two SCADA workstations located in the Operator Control Room.

B. Hard Controls: Hard controls refer to devices such as pushbuttons, hand switches, and potentiometers.

1.3 ABBREVIATIONS:

A. RW- Recovery Well

B. HMI – Human Machine Interface

C. LCS – Local Control Station

D. MCC – Motor Control Center

E. H-O-A – Hand-Off-Auto Selector Switch

F. PC – Personal Computer

G. PI – Proportional / Integral

H. PLC – Programmable Logic Controller

I. VFD - Variable Frequency Drive

J. SCADA – Supervisory Control and Data Acquisition

K. N.O. – Normally Open Contact

L. N.C. – Normally Closed Contact

1.4 SUBMITTALS

A. Reference Specification 40 60 00, Section 1.2 Submittals

B. An interlock list (table) for all non-vendor supplied equipment and instrumentation. The interlock list shall clearly define all interlocks, alarms, and outcomes with regard to process equipment.

PART 2. NOT USED

PART 3. EXECUTION

3.1 GENERAL OPERATING DISCRIPTION

A. Supervisory Control and Data Acquisition (SCADA) System:

a. The purpose of the process control system is to monitor and control a groundwater treatment process consisting of groundwater extraction, treatment, and discharge to outfall basins.

b. The SCADA System shall provide a graphical interface for monitoring, control, and alarming of the system. The SCADA System shall allow for

adjustment of set points and timers as applicable for alarms and control loops, trending of values, and historical archiving of parameter data.

c. Access to the SCADA System will be available to the operator either from all HMIs located within the Treatment Building, SCADA workstations located in the Operator Control Room, or portable HMI at Recovery Wells RW9 and RW-10A.

B. Motors: Unless otherwise noted herein, the following shall be true for all process motor driven devices:

a. Process motors shall be provided with a Hand-Off-Auto (H-O-A) selector switch mounted on the door of its respective Motor Control Center (MCC) compartment. There will be Start/Stop pushbuttons at the motors.

i. In HAND, the motor will operate manually in this mode using Start-Stop pushbuttons.

ii. Any motor utilizing a VFD will be configured to operate at a low speed (Hz) in HAND mode.

b. In OFF, motor operation shall be disabled, and the motor starter shall be de- energized.

c. In AUTO, the motor starter shall be under the control of the PLC. Both Manual and Auto mode will be provided at the HMI

i. In Manual Mode at HMI, equipment will be operated with interlocks or interlocks can be bypassed if required (with a list of active/bypassed interlocks that is operator selectable for each piece of equipment).

ii. In Auto mode at HMI, equipment will run in fully automatic mode with all interlocks in place (bypassing interlocks is not permissible).

d. All process motor starters shall have auxiliary contacts for “run” indication via Ethernet to the PLC. If a motor is called to start and the return input from the auxiliary contact is not made within 5 seconds, a mismatch alarm shall annunciate at the HMI. These Alarms are indicated as YA-xxx in the Alarm List.

e. All process motor driven devices under PLC control shall have a disconnect switch adjacent to the device. This shall interrupt power to the motor and lockout the device. An auxiliary contact shall provide a discrete input signal to the PLC indicating the disconnect switch position.

f. Unless otherwise noted, all process motors shall be furnished with a local control station that includes Start-Stop (S/S) pushbuttons. The Start-Stop pushbuttons shall be wired back to the motor control circuit and can only operate when a given motor's H-O-A switch is the "HAND" position.

C. Setpoints and Settings: All set points, settings and timers shown on the HMI shall be adjustable between +/100% of the initial setting listed. Limits to setting entries shall be refined in the field during startup and configured.

D. For each motor, graphically represent the physical position of its associated H-O-A selector switch. In addition, provide HMI Start/Stop and Auto/Manual buttons for all process pumps/motors. When an H-O-A selector switch is in the "Auto" position, the operator shall have the ability to select Auto/Manual on the HMI. HMI "Manual" allows the operator to Start/Stop the motor from the HMI. In addition, HMI "Manual" operation shall give an operator the ability to bypass certain interlocks if necessary. "Interlock Bypass" mode shall be achieved by giving an operator the ability to mouse click on a pump/motor, which will display its "Interlock List". The operator shall then have the ability to select which Interlocks to Bypass. Anytime a pump/motor has any Interlocks bypassed in the HMI "Manual" state, the HMI shall provide a visual indication of this state. HMI "Auto" allows automatic PLC control of the motor and shall not allow the bypass of any Interlocks.

E. For each valve, provide HMI Open/Close and Auto/Manual buttons. HMI Auto/Manual operation shall be identical to the description for the motors in Part D above.

F. Duplex pumping system: Various systems have two pumps. Generally, one pump is capable of handling the designed flow and the second pump is standby. If one pump fails to operate, a pump fail alarm shall be generated (YA-xxx) and the Operator will be notified to bring the second pump online manually. If necessary, the standby pump can be started manually from the HMI if the H-O-A selector switch is in "Auto" and the HMI selector is set to "Manual".

G. Variable Frequency Drive (VFD): Unless otherwise stated, all VFDs shall operate in proportional- integral (PI) algorithm to modulate the speed of the operating motors to meet and maintain the system setpoint. Operator shall have the capability at one of the two SCADA workstations or any of the HMI's located on the plant floor to monitor and adjust these parameters. All VFDs shall utilize Ethernet for communication with the treatment building PLC and shall be configured to enter a "Faulted" state in the event of Ethernet communication failure. Regardless of operating mode, all VFD's shall be programmed with a "one-shot" in the PLC program to initially start at 15Hz.

H. Mismatch alarms: All command outputs from SCADA, analog or discrete, shall have an associated "Mismatch Alarm." The mismatch alarm shall compare the

desired output (e.g., VFD speed, valve position, run command) to the measured variable (VFD speed, valve position, run status) and, if after an adjustable period of time the measured value is not within 5% of the desired value, annunciate an alarm. Valve Alarms are indicated as ZA-xxx in the Alarm List.

I. If a system shuts down due to a critical alarm and there is no operator present (e.g. - weekend or after normal working hours), the system shall not be restarted until someone is physically present at the site.

J. Out of Range Alarms: For all analog 4-20mA values, provide "Out of Range Alarms" if the signal value drops below 4ma or above 20mA for more than 5 seconds.

K. Trending: All analog values and controller setpoints shall be trended locally on the SCADA/Historian software. All pumps on/Off and valve Open/Close status shall also be trended.

L. Totalizations: Flows with an "FQI" designation (gallons) and motor runtimes (hours) shall be totalized and displayed on the screen. Provide runtime totalizations for all pumps and blowers. Provide "run time" values for each carbon vessel by monitoring valve positions to identify "run" status. Totalization values shall not be resettable.

3.2 GROUNDWATER EXTRACTION / RECOVERY SYSTEM (MI602 THRU MI604)

A. Three extraction wells RW-8, RW-9, and RW-10A, will be installed for the groundwater collection system, as follows:

a. Recovery Well RW-8 located approximately 8 feet to west of the Groundwater Treatment Plant (GWTP). RW-8 is approximately 120-feet below ground surface and is capable of pumping 450 to 650 gallons per minute (gpm).

b. Recovery Well RW-9 located approximately 2,500 feet east of the Groundwater Treatment Plant (GWTP) along Alken Avenue. RW-9 is approximately 120-feet below ground surface and is capable of pumping 450 to 650 gallons per minute (gpm).

c. Recovery Well RW-10A located approximately 4,000 feet east of the Groundwater Treatment Plant (GWTP) just south of N. Pine Street. RW-10A is approximately 120-feet below ground surface and is capable of pumping 600 to 700 gallons per minute (gpm).

B. All recovery wells have a submersible pump and a pressure transducer to indicate well level (LT-8, LT-9 & LT-10A), a pump discharge pressure transmitter (PIT-8, PIT-9 & {PIT-10A), and a valve vault high level switch (LSH-VV8, LSH-VV9 & LSH-VV10A). At RW -9 and RW-10A, a magnetic flow meter (FE/FIT-9 & FE/FIT-10A) monitors the pump flow rate and there is a manual sample point located in valve vault. RW-8 will have a magnetic flowmeter located inside the GWTP.

C. All recovery well pumps are operated in AUTO mode based on Operator adjustment of its VFD speed (frequency) through the HMI. Operator will initially start the well pump at 30 Hz, increasing the speed until flow is maintained.

D. All piping inside well vault and manholes will be insulated and heat traced. Heat trace is monitored at PLC as failsafe discrete inputs.

E. High level alarms at all valve vaults are monitored at PLC as N.C. discrete inputs. Setpoint = 6” above finished floor.

F. Recovery wells RW-9 and RW-10A Recovery well RW-8 discharge line enter the GWTP thru south side and then manifold into one pipe with RW-8 (east side) before discharging into Equalization Tank T-100. Prior to discharging into Equalization Tank T-100, there is an influent flow meter FIT-100 to measure flow rate and totalized flow (FQ-100) of all wells as the combined “plant inflow”.

G. The treatment plant is designed to treat a maximum flow of 1500 gpm.

H. Analog Control Loops: See Table 1 (as attached) regarding Extraction Wells operating set points.

I. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

   b. Local Operation: Reference Section 3.1 (B) for motor control.

J. Automatic Operation:

   a. Recovery wells shall be allowed to operate when all of the following conditions are satisfied:

      i. EQ Tank level (LIT-100) is less than 16.0’ (EWs-Auto Level), and

      ii. Building sump level is not at high-high water level (LAHH-800 or LAHH-801).

   b. Each well pump will be operated at a constant well level in between respective LCH and LCL. Both flow and well level set points are pre-established based on the groundwater model data.

   c. Each well pump will start at pump on set point level (LCH-XX) and turnoff (LCL-XX) at pump-off set points.

   d. If a flow of less than 50 gpm is detected at a flow meter (RW-8, RW-9 or RW-10A) for more than 10 seconds, respective pump will be

shut down, and a PUMP FAIL (FAL-XX) alarm will be generated. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

e. If a pump discharge pipe has a heat trace power off at vault for >120 seconds, an alarm (TA-XX) will be generated. However, the pump will continue to operate in HMI "Auto" mode thus avoiding any pipe freezing issue. The alarm can be reset by the Operator once the condition is cleared.

K. Interlocks:

a. All recovery well pumps shall be interlocked (shutdown) and allowed to restart if any of the following non-critical conditions occur:

i. Equalization Tank T-100 High-Level (LAH-100) is ON for >30 seconds. The RW pumps will restart when EQ tank level drops below RWs-Auto OFF level for more than 5 minutes.

ii. The building sump High-High Level (LAH-800) is ON for >60 seconds. All of these pumps will restart when sump level drops to sump Low level for >30 seconds.

b. All recovery well pumps shall be interlocked (shutdown) and not allowed to restart if any of the following critical conditions occur. An operator must be present at the facility anytime a critical plant shutdown condition occurs in order to properly inspect and restart the equipment. <u>Under no circumstances shall any plant shutdown condition be reset remotely.</u>

i. Equalization Tank T-100 High-High Level (LAHH-100 or LAHH-101) is ON for >30 seconds.

ii. The building sump High-High Level (LAHH-800 OR LAHH-801) is ON for >30 seconds.

iii. If treatment building secondary containment High Level (LAH-991 or LAH-992) is ON.

iv. If high water level in any valve vault (LAH-VV8, LAH-VV9 or LAH-VV10A) is on for more than 10 seconds.

v. High level in any outfall basin (LAHH-OFB1, LAHH-OFB2, LAHH-OFB3 and LAHH-OFB4) for more than 60 seconds.

3.3 EQUALIZATION TANK / FILTER FEED SYSTEM (MI605)

A. All recovery wells will discharge groundwater in Equalization Tank T-100. This tank will also receive water from recycle of water from MMF feed pumps P-100A/B, MMF / Cartridge Filters outlet, AOP system outlet and plant

effluent during recycle (startup/testing phase) or plant upset conditions. This tank will have a continuous water level transmitter (LE/LIT-100) and a backup high-high-level switch (LSHH-101).

B. Tank T-100 has a side-mounted mixer (EQM-110) Mixer EQM-110 will have a single speed motor and will run continuously unless Tank T-100 level drops below X'.

C. Two MMF feed pumps (P-100A and P-100B) will be provided with VFDs. These pumps will transfer water from T-100 to MMF vessels. The common pump discharge line will have a slipstream to recycle line for pH and ORP probes (AE-101A & AE-101B) to measure pH, ORP and temperature, a flow meter (FIT-101) to measure MMF feed flow rate, a manual flow control valve (one per pump), and a recycle line back to T-100. Both flow control valves and recycle valve may need to be adjusted at start-up to establish a desired pre-treatment flow rate depending on the collection system flow.

D. One pump is capable of pumping up to 1500 gpm flow. This is based on a maximum estimated plant inflow of 1500 gpm flow. Thus, these pumps will operate as Primary and Standby.

E. Tank T-100 will receive caustic solution (refer to the respective chemical feed systems) based on MMF feed flow pH and oxidation-reduction potential (ORP) readings, respectively. This tank's pH will be maintained at 8.0 and ORP at approximately 300 (settings to be determined [TBD] at start-up). PLC will monitor and control pH and ORP (set points, control, and gain; Operator selectable).

F. MMF Feed Flow pH analyzer (AE-101A) will have low and high pH alarms as AAL-101A and AAH-101A, respectively. These will initially be set at ± 0.2 units of the pH setpoint.

G. MMF Feed Flow ORP analyzer (AE-101A) will have low and high ORP alarms as AAL-101B and AAH-101B, respectively. These will initially be set at ± 50 units of the ORP setpoint.

H. Analog Signal/Control Loops: LIT-100, FIT-101, SIC-100A/B, AIT-101A/B

I. Tank T-100 overflow pipe's bottom elevation is at 11.75' high. Level transmitter (LIT-100) set points are as follows:

   a. Low-Low level Alarm LALL-100 = 1.0'

   b. PUMPS P-100A/B OFF Level LCL-100 = 1.5'

   c. Eq Pump control initial set point = 10.0'

   d. Pumps P-100A/B On Level = 10.5'

   e. RWs-Auto OFF level = >9.0'

f. High level alarm LAH-100 = 15.5′.

g. High-High level alarm LAHH-100 = 16.5′.

J. Backup High-High level alarm LAH-101 is set at 16.5′.

K. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

b. Local Operation: Reference Section 3.1 (B) for motor control.

L. Automatic Operation

a. MMF Feed pumps shall be allowed to operate when all equipment has its respective H-O-A selector switch in the "Auto" position, and all of the following conditions are satisfied:

i. Tank T-100 level is not Low-Low, and

ii. Tank T-400 is not High, and

iii. Caustic (P-910A/B) and hypochlorite (P-920A/B) feed system H-O-A selector switches are in the "Auto" position, and

iv. LGAC feed pumps (P-400A/B) H-O-A selector switches are in the "Auto" position.

b. Normally primary pump (P-100A) starts at PUMP ON level, and VFD varies the speed to maintain T-100 level to an initial set point of "10" feet. This pump's speed can be lowered until the flow at FIT-101 reaches 600 gpm (or 40% of maximum VFD speed). If tank level starts dropping, pump will shut down at its OFF level.

c. The pumps will be manually alternated once per month by the operator. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

d. If a flow of <100 gpm is detected at flow meter FIT-101 for more than 10 seconds, the operating pump will be shut down, respective PUMP FAIL alarm (FAL-101A or 101B) will be generated, and the Operator will be alerted via the HMI to manually switch over and start the standby pump. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

M. Interlocks:

a. Equalization Tank system (P-100A/B, all chemical feed systems, and mixer) shall be interlocked (shut down) as follows:

i. Tank T-100 level is at Low-Low level Alarm LALL-100.

ii. Cartridge Filters CF-240/250 is at High Differential Pressure PDAH-240.

iii. Tank T-400 is at High-High level Alarm LAHH-400 or LAHH-401.

iv. The Equalization Tank/ Filter Feed system will not be allowed to restart until interlock conditions are cleared and alarms are reset by the Operator. Operator must be at the plant to clear the interlock conditions and re-start the plant. The system shall never be restarted remotely.

3.4 MULTI-MEDIA FILTRATION (MMF) SYSTEM (MI606)

A. Three MMFs (MMF-210, MMF-220 and MMF-230) on a skid will be provided. Two MMFs stay in operation while third is in standby mode.

B. A local PLC based control panel operates all the MMFs electric butterfly valves and allows an automatic backwash sequence based on either a high differential pressure, timer, or manual “backwash initiate” input. This panel also generates alarms and interlocks. This panel is monitored by plant PLC and sends signals for enable/disable for backwash cycle via Ethernet link to plant control system.

C. All three MMFs will have automated air operated ON/OFF valves on water inlet (YV-210A, YV-220A and YV-230A), water outlet (YV-210B, YV-220B and YV-230B), backwash inlet (YV-210, YV-220 and YV-230) and backwash water outlet (YV-210C, YV-220C and YV-230C).

D. Each vessel will have a local differential pressure indicator (PDI-210, PDI-220 and PDI-230). These instruments will send high pressure alarms (PDAH-210, PDAH-220 and PDAH-230), initially set at 20 psig, to the local panel. If the pressure drops across a MMF exceeds that set point, that filter goes in backwash mode and standby MMF goes in operation mode. In addition, a pressure transmitter will be installed on MMFs inlet and outlet lines (PIT-210 and PIT-230). All of these instruments send signals to a local control panel. In addition, plant PLC will compute a differential pressure reading (PIT-210 minus PIT-230) and trend and correlate with the operating MMF’s differential pressure.

E. Each MMF can also be operated in in a timer or manual mode, operator selected at the local panel.

F. All automated BFVs will have opened and closed limit switches sending status signals to the local panel. As described above, when MMF control panel sends a command to open or close a valve and the corresponding limit switch input

is not received within 5 seconds, a mismatch alarm will be generated from the PLC. These are indicated as ZA-xxx in the Alarm List.

G. Plant PLC monitors all signals and enables/disable this local control panel. In this mode, a MMF must remain in operation for at least 8 hours.

H. Analog Signals: PIT-210 and PIT-230

I. Manual Operation: MMF can be operated in manual mode for a short period for test purposes only.

J. Automatic Operation:

a. MMF can be operated when the MMF system is in “Auto” state as described below.

i. Any two MMF vessels water inlet valves (YV-210A & YV-210B, YV-220A & YV-220B, YV-230A & YV-230B) are positioned to process water and the other set is closed AND all backwash inlet/outlet automated valves on all MMFs are closed, OR

ii. At least two of the MMFs are available to process water (no high differential pressure alarm or being backwashed).

K. The MMFs are operated as follows:

a. Two MMFs are online while third one is on standby.

b. When the pressure drop across a filter exceeds a preset value (10 to 15) pounds per square inch gauge (psig), it will require backwashing.

c. Backwashing shall be initiated automatically based on one of three 3 modes (operator selectable): timer, pre-determined pressure drops, or total gallons of water treated.

d. One filter can proceed through its backwash cycle while the other two filters are in service. Refer to MMF/LGAC Backwash System for backwash operation details.

i. Thus, when MMF-210 goes in backwash mode, YV-210A and YV-210B are closed; YV-210 and YV-210C are open, thus bringing the standby MMF online automatically.

ii. Similarly, when MMF-220 goes in backwash mode, YV-220A and YV-220B are closed; YV-220 and YV-220C are open, bringing the standby MMF online automatically.

iii. Similarly, when MMF-230 goes in backwash mode, YV-230A and YV-230B are closed; YV-230 and YV-230C are open, bringing the standby MMF online automatically.

e. If a high-pressure alarm (PDAH-210, PDAH-220 or PDAH-230) is detected for >60 seconds, (either in timer mode or total water treated mode), the operating MMF shall be placed in backwash mode and the standby MMF shall be placed in service.

f. If one of the filters has a differential pressure high alarm while the second filter is being backwashed, shutdown P-100A/B. P-100A/B can be restarted when one of the filters is back in service.

g. Reinitiate backwash if backwash fails first time.

h. Trend MMF's pressure drop value as MMF-210-dP, MMF-220-dP and MMF-230-dP (PIT-210 minus PIT-230). Plant operator can then compare them with PDI-210, PDI-220 or PDI-230 readings (local display).

i. Provide selector switches at HMI for the operator to operate or backwash MMF.

L. Interlocks:

a. Refer to MMF system's submittal for related interlocks.

3.5 BAG FILTER SYSTEM (MI606)

A. There will be a duplex cartridge filter system. Only one bag filter stays in operation while second is in standby mode. The Operator will manually switch to the standby filter on a high pressure drop at DPIT-240 (initially set at 20 psi, to be finalized during startup).

3.6 ADVANCED OXIDATION PROCESS (AOP) SYSTEM (MI607 AND MI608)

A. There will be a Vendor supplied AOP reactor(s) sized for 500 – 1000 gpm flow, complete with ozone generation system, ozone injectors, hydrogen peroxide injector, static mixers, gas/liquid separator with ozone destructor automated forward / recycle valves, interconnecting piping, valves, and instrumentation.

B. The ozone generation system consists of an oxygen generator unit, ozone generation unit, water chiller, controls and instrumentation as required by the selected AOP System Vendor.

C. A local PLC based control panel operates the AOP system. This panel also generates alarms and interlocks. This panel is monitored by plant PLC and sends signals for enable/disable for AOP System via Ethernet I/P communications to plant control system. All monitored and alarm signals will be generated during discussions with the selected AOP Vendor.

D. Automated recycle (MOV-350A) and forward (MOV-350B) valves are provided with the AOP system so that no untreated water can be discharged to LGAC units.

a. Normally recycle valve MOV-350A stays closed while forward valve MOV-350B stays open (interlocked so that normally only one of them stays open). It is normal for both valves to be open for a short period of time during valve actuation to avoid dead heading pump P-100A or P-100B.

b. Whenever pump P-100A or 100B starts, the recycle valve (MOV-350A) opens and forward valve (MOV-350B) closes for approximately X minutes (selectable at AOP Control Panel). This is to allow AOP lamps to warm up, flow to establish through the AOP system, and hydrogen peroxide to react with water.

c. Recycle valve MOV-350A is interlocked with Eq. Tank T-100 level – if High-High tank level alarm (LAHH-100 or LAHH-101) exists do not allow recycle valve to open and shut down the Treatment Plant.

E. Automatic Operation:

a. The AOP can be operated when the AOP system is in “Auto” state as per the vendor supplied signal.

b. The AOPs will be controlled by a Vendor-supplied control panel. The treatment plant PLC will have hard-wired communication to both AOP PLCs for monitoring and control. The treatment plant PLC will control remote start/stop, system running, system shutdown, and system warning of the AOPs. In addition, the treatment plant PLC is connected to the AOP units via Ethernet in order to monitor various data and alarms generated within each AOP. Refer to AOP Specification Section 46 30 13 for additional details.

c. Monitor and trend each lamp run time, current, voltage and total wattage.

d. The above information is provided as a general guideline and shall be verified by the selected Vendor.

F. Interlocks:

a. The AOP system is designed for various interlocks within the Vendor-provided PLC software (refer to vendor’s manual). In addition, the AOP system shall be interlocked (shut down) as follows:

b. MMF feed flow is < X gpm, FSL-101 (hard-wired).

c. Hydrogen peroxide feed pump P-930A/B is not running or has a Low Flow alarm (FAL-934)

d. Hydrogen peroxide concentration is low.

e. Refer to AOP Feed system for related interlocks.

3.7 LIQUID PHASE GRANULAR ACTIVATED (LGAC) FEED SYSTEM (MI609)

A. The AOP reactor(s) will discharge treated water into LGAC Feed Tank T-400. This tank will have a continuous water level transmitter (LE/LIT-400) and a backup high-high-level switch (LSHH-401).

B. Two LGAC feed pumps (P-400A and P-400B) will be provided with VFDs. These pumps will transfer water from T-400 to the LGAC vessels. The common pump discharge line will have a flow meter (FIT-400) to measure LGAC feed flow rate, a manual flow control valve (one per pump). Both flow control valves may need to be adjusted at start-up to establish a desired flow rate depending on the feed tank influent flow.

C. One pump is capable of pumping up to 1800 gpm flow. Thus, these pumps will operate as Primary and Standby.

D. Analog Signal/Control Loops: LIT-400, FIT-400, SIC-400A/B

E. Tank T-400 overflow pipe’s bottom elevation is at 18’ high. Level transmitter (LIT-400) set points are as follows:

   a. Low-Low level Alarm LALL-400 = 1.0’

   b. PUMPS P-400A/B OFF Level LCL-400 = 1.5’

   c. LGAC Feed Pump control initial set point = 10.0’

   d. Pumps P-400A/B On Level = 10.5’

   e. High level alarm LAH-400 = 15.5’.

   f. High-High level alarm LAHH-400 = 16.5’.

F. Backup High-High level alarm LAH-401 is set at 16.5’.

G. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

   b. Local Operation: Reference Section 3.1 (B) for motor control.

H. Automatic Operation

   a. LGAC Feed pumps shall be allowed to operate when all equipment has its respective H- O-A selector switch in the “Auto” position and all of the following conditions are satisfied:

      i. Tank T-400 level is not Low-Low, and

      ii. Tank T-500 is not High, and

iii. Outfall Basins 1 thru 5 are not High-High.

b. Normally primary pump (P-400A) starts at PUMP ON level, and VFD varies the speed to maintain T-400 level to an initial set point of "10" feet. This pump's speed can be lowered until the flow at FIT-400 reaches 600 gpm (or 40% of maximum VFD speed). If tank level starts dropping, pump will shut down at its OFF level.

c. The pumps will be manually alternated once per month by the operator. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

d. If a flow of <100 gpm is detected at flow meter FIT-400 for more than 10 seconds, the operating pump will be shut down, respective PUMP FAIL alarm (FAL-400A or 400B) will be generated, and the Operator will be alerted via the HMI to manually switch over and start the standby pump. The failed pump shall not operate in HMI "Auto" mode until the alarm is reset by the Operator.

I. Interlocks:

a. LGAC Feed system (P-400A/B) shall be interlocked (shut down) as follows:

i. Tank T-400 level is at Low-Low level Alarm LALL-400.

ii. Tank T-400 is at High-High level Alarm LAHH-400 or LAHH-401.

iii. The LGAC Feed system will not be allowed to restart until interlock conditions are cleared and alarms are reset by the Operator. Operator must be at the plant to clear the interlock conditions and re-start the plant. The system shall never be restarted remotely.

3.8 LIQUID PHASE GRANULAR ACTIVATED (LGAC) CARBON SYSTEM (MI610)

G. Three LGAC filters will be provided.

H. LGAC-410, LGAC-420 and LGAC-430 have several manual operated valves so these can be operated as lead-lag mode based on differential pressure switch (PDSH-400).

I. When a differential pressure across a LGAC exceeds 15 psi, then it is the time to backwash that LGAC for 15 minutes (manual mode). During backwash mode, only one LGAC will stay in operation.

Refer to MMF/LGAC Backwash System for LGAC backwash operation.

3.9 PLANT EFFLUENT SYSTEM (MI610, MI611 & MI612)

A. Treated water from the LGAC system enters T-500. This tank will also serve as the Backwash Supply Tank, refer to MMF/LGAC Backwash System. This tank will have a continuous water level transmitter (LE/LIT-500) and a backup high-high level switch (LSHH-501).

B. A ON/OFF valve MOV-400 on the plant effluent and an ON/OFF valve MOV-400A on plant recycle line will be provided. This recycle line is provided to adjust the treatment system during startup and upset conditions.

C. Treated water from the LGAC system enters effluent piping where manual valves BFV-440A, 440B and BFV-440C are used to divert water to Outfall Basin 1, Basins 2 & 3, and Basins 4 & 5.

D. The water flow rate to each basin is measured through FIT-440A, FIT-440B, and FIT-440C.

E. Exiting the plant, the water will initially be discharged to five Outfall basins, configured as follows:

   a. Outfall Basin #1

   b. MH A-01 (Basins #2 & #3), equipped with High-High level alarms to control potential flooding of the drainage system.

   c. MH B-01 (Basins #4 & #5), equipped with High-High level alarms to control potential flooding of the drainage system.

F. Transmitters LT-OFB1, LT-OFB2, LT-OFB3, and LT-OFB4 monitor the water level in the five basins. Excessive water level in the basin trigger shutdown of the recovery well pumps RW-8, RW-9, and RW-10A.

G. If pH <6.0 or >9.0 is detected at AE-101A/AIT-101 (MMF feed flow) for >120 seconds, an alarm shall be generated (AAL/AAH-101). If this alarm stays on >5 minutes, plant recycle valve MOV-400A will open and effluent valve MOV-400 will close. Once this pH returns to 6.0-9.0 range for >5 minutes, recycle valve MOV-400A will close and effluent valve MOV-400 will open.

3.10 MMF/LGAC BACKWASH SYSTEM (MI611)

A. T-500 is also used to supply backwash water for backwashing the MMF and LGAC vessels. This tank’s maximum operating volume is about 9,950 gallons (below overflow pipe). A maximum of 5,000 gallons of water is needed to backwash one of the LGAC or MMF described under MMF/LGAC Backwash System. Thus, a minimum of 7’of water depth in this tank is needed for the backwash event.

B. To backwash either MMFs or LGACs, two pumps P-500A/B will be provided. Normally one pump will run while the other is a standby spare. These pumps

will receive water from T-500 and pump water through the MMFs or LGACs and discharge into the Backwash Waste Tank T-550.

C. Both MMFs and LGACs will require a backwash step procedure (flow and duration) to be provided by the respective equipment vendor. Flow rate will be set via the operating pump's (P-500A/B) VFD.

D. Only one MMF vessel can be backwashed at a time, and the backwash will depend on water levels in tanks T-500 and T-550. MMF and LGAC systems shall have an interlock prohibiting the simultaneous backwash of a vessel in both systems. This is due to the MMF backwash cycle being an Automatic function while the GAC backwash is manually initiated.

E. Analog Signal/Control Loops: LIT-500, FI-500, SC-500, LIT-550.

F. Tank T-500 overflow pipe's bottom elevation is at 13.5' high. Level transmitter (LIT-500) set points are as follows:

   a. Low-Low level Alarm LALL-500 = 1.0'

   b. Low level Alarm LAL-500 = 1.5'

   c. Pump P-500/A/B OFF Level = 7.0'

   d. Pump On Level = 9.5'

   e. High level alarm LAH-500 = 10.50'.

   f. High-High level alarm LAHH-500 = 11.50'.

G. Backup High-high level alarm switch LSHH-501 is set at 11.5'.

H. Manual Operation:

   a. Manual operation shall be utilized for testing and maintenance purposes only.

      i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

   a. Backwash Supply Pumps (P-500A/B) shall be operated when the MMF/LGAC Backwash system is in "Auto" state as described below.

      i. Backwash Waste Tank T-550 level LIT-550 is <2', and

      ii. T-500 level is >7.0' thus allowing sufficient backwash supply water for backwashing any one of the MMF or LGAC vessels.

   b. Only one of the backwash pumps operates at a time.

c. The backwash pump is operated when the MMF or LGAC requires backwash, as discussed previously. Backwash flow and duration will be as per the MMF and LGAC vendor submittals.

d. Provide MMF BW Ready and LGAC BW Ready status at PLC.

e. The Operator will alternate the pumps manually once per month. A notification will be displayed on the HMI alerting the operator to the upcoming switchover. Only one pump will run at a time while the second pump will remain as a standby pump.

J. Interlocks:

a. Backwash pump shall be interlocked (not allowed to operate) as below:

i. Dirty Backwash Water Tank High-high level Alarm LAHH-550 or LAHH-551.

ii. T-500 level is <6.5’.

K. The LGAC backwash system is expected to be required only periodically (e.g., every three to six months) and will be conducted manually. During the backwash of an LGAC unit, the plant may continue to run, but at a reduced flowrate (e.g., 700 GPM to 1,400 GPM).

L. Pump P-500A or -500B is then used to provide low pressure water to backwash the LGACs. For the pump selected for operation, the corresponding suction and discharge valves should be opened. For example, for P-500A operation, open BFV-500A-1 and BFV-500A-2 and BFV-XXX (LGAC backwash supply valve).

M. During backwash of the selected LGAC, the process flow valves for that unit are first closed to isolate the LGAC from the process water and then the backwash valves are open. For example, for LGAC-410, BFV-400A and -400B are first closed, this isolates the unit from the process flow. Then BFV-400C and BFV-400D are opened. After backwash, the valve positions are reversed, isolating the backwash system first.

N. The backwash cycle normally lasts approximately 15 minutes but can be extended by allowing the Backwash Waste Tank to drain.

O. The Backwash Waste Tank T-550 receives backwash water from the MMF and LGAC units. The tank can handle 4-times the volume of the Backwash Supply Tank and thereby minimize potential overflow of the Backwash Waste Tank.

3.11 BACKWASH WASTE / DISCHARGE SYSTEM(MI621)

A. Backwash Waste Tank T-550 will receive backwash water from the MMFs and LGACs. This tank will have a continuous water level transmitter (LE/LIT-550) and a backup high-high level switch (LSHH-551).

B. Decanted water from T-550 will return to the treatment building sump via automated ball valve MOV-550A, while backwash wastewater is discharge to the local sewer system through automated ball valve MOV-550B. A Parshall flume flow meter FIT-550 monitors the wastewater flow to the sewer system.

C. Tank T-550 overflow pipe's bottom elevation is at 23.75' high. Level transmitter (LIT-550) set points are as follows:

a. Low-Low level Alarm LALL-550 = 0.75'

b. MOV-550A CLOSE Level = XX'

c. MOV-550A OPEN Level = XX'

d. MOV-550B CLOSE Level = XX'

e. MOV-550B OPEN Level = XX'

f. High level Alarm LAH-550 = 22'.

g. High-High level Alarm LAHH-550 = 25'.

D. Backup High-high level alarm switch LSHH-551 is set at 25.5'.

E. Interlocks:

a. MOV-550A shall be interlocked (not allowed to operate) as below:

i. Treatment Building Sump High-High level alarm LAHH-800 or LAHH-801

3.12 CAUSTIC FEED SYSTEM (MI614)

A. The caustic (25% sodium hydroxide) feed system will include a double wall feed tank (T-910) and two metering pumps (P-910 A/B). This pump will supply caustic to tank T-100 via secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-910), a level switch (LSH-911) to detect any leak in secondary containment, and a backup high-level switch (LSH-912). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: LIT-910, SIC-910A/B

F. T-910 is 10.5′ high. Level transmitter (LIT-910) set points are as follows:

a. Low-Low level Alarm LALL-910 = 1.0′

b. Low level Alarm LAL-910 = 1.5′ (PUMP OFF Level)

c. Chemical Order Level Alarm (25%) = 2.5′

d. Pump On Level = Based on process demand

e. Tank Fill Alarm (90%) = 9.0′

f. High-High level alarm LAHH-910 = 9.5′.

G. Backup High level alarm switch LSH-912 is set at 9.5′.

H. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

a. Both metering pumps P-910A/B will be powered from local 115 VAC, 1 phase receptacles and controlled by the PLC via Ethernet I/P communications based on a 4-20 mA signal from pH probe AE-101A located in MMF Feed Pumps discharge piping. There will be a selector switch at PLC panel to operate the desired pump.

b. The caustic feed system shall be in “Auto” state as follows:

i. Leak detection alarm LAH-911 is not on.

ii. PLC receives a signal that P-910 A or B is ready to run (powered).

iii. Mixer EQM-110 is running.

c. The PLC will start/stop the pump and vary pump speed to maintain a pH set point (initially 10.20) in MMF Feed Flow piping. The pump will have a local stroke length adjustment that will be initially set at startup.

J. Interlocks:

a. The Caustic feed system will be interlocked (P-910A/B shutdown) as follows:

i. Pre-treatment pumps P-100A and 100B are not running.

ii. Caustic tank T-910 Low level Alarm LAL-910.

iii. MMF feed flow is < X gpm, FSL-101 (hard-wired).

K. The Caustic Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-911 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-911 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

b. The Caustic room has a High-High level switch LSHH-911 that will generate an alarm when there is a major leak.

3.13 HYPOCHLORITE FEED SYSTEM (MI613)

A. The sodium hypochlorite (12% solution) feed system will include a double wall feed tank (T- 920) and two metering pumps (P-920A/B). This feed pump will supply hypochlorite solution to static mixer SM-200 at the MFF inlet via a secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-920), a level switch (LSH-921) to detect leak in secondary containment, and a backup high-level switch (LSH-922). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: LIT-920, SIC-920A/B

F. T-920 is 5.5' high. Level transmitter (LIT-920) set points are as follows:

a. Low-Low level Alarm LALL-920 = 1.0'

b. Low level LAL-920 = 1.25' (PUMP OFF Level)

c. Chemical Order Level Alarm (25%) = 2.5'

d. Pump On Level = Based on process demand

e. Tank Fill Alarm (90%) = 4.75′

f. High-High level alarm LAHH-920 = 4.75′.

G. Backup High level alarm switch LSH-922 is set at 9.0′.

H. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

I. Automatic Operation:

a. Both metering pumps P-920A/B will be powered from local 115 VAC, 1 phase receptacles and controlled by the PLC via Ethernet I/P communications based on a 4-20 mA ORP signal from ORP probe AE-101B located in MMF Feed Pumps discharge piping. There will be a selector switch at PLC panel to operate the desired pump.

b. The hypochlorite feed system shall be in an "Auto" state as follows:

i. Leak detection alarm LAH-921 is not on.

ii. PLC receives a signal that P-920A/B is ready to run (powered).

iii. One of the MMF Feed Pumps P-500A/B is running.

c. The PLC will start/stop the pump and vary pump speed to maintain a set point ORP (initially 350) in MMF Feed Flow piping. The pump will have a local stroke length adjustment that will be initially set at startup.

J. Interlocks:

a. This feed system will be interlocked (P-920A/B shutdown) as follows:

i. Pre-treatment pumps P-100A and 100B are not running.

ii. Sodium hypochlorite tank T-920 Low level LAL-920

iii. MMF feed flow is < X gpm, FSL-101 (hard-wired).

K. The Hypochlorite Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-921 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-921 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

ii. The Caustic room has a High-High level switch LSHH-921 that will generate an alarm when there is a major leak.

3.14 HYDROGEN PEROXIDE FEED SYSTEM (MI615)

A. The hydrogen peroxide (27% solution) feed system will include a double wall feed tank (T-930) and two metering pumps (P-930 A/B). This feed pump will supply hydrogen peroxide solution to static mixer SM-300 at the AOP Rector System via a secondary contained tubing.

B. The tank will have a continuous level transmitter (LE/LIT-930), a leak detector unit (LE-931) with annunciator to detect leak in secondary containment, and a high-level switch (LSH-932) and backup high-high-level switch (LSHH-932). The tank will also have a local reverse float gage to indicate liquid level.

C. Metering pumps will be mounted inside a containment skid with a calibration chamber, back pressure valve, pressure relief line, isolation valves and pulsation damper.

D. One pump is capable of pumping up to 8 gph flow. Second pump is standby and can be used should the primary pump fail to operate. Operator can switch these pumps at PLC.

E. Analog Signals/Control Loops: FIT-934, LIT-930, PIT-933, SIC-930A/B will be monitored and controlled by the AOP System Control panel.

F. T-930 is 8.5' high. Level transmitter (LIT-930) set points are set by the AOP system vendor.

G. The AOP Reactor System PLC will control the operation and feed of hydrogen peroxide to the AOP Reactor, see Vendor Submittal for Details.

H. Interlocks:

a. The hydrogen peroxide feed system will be interlocked from Plant PLC (P-930A/B shutdown) as follows:

i. MMF feed flow is < X gpm, FSL-101 (hard-wired)

I. The Plant PLC will monitor the following hydrogen peroxide system parameters via an Ethernet link:

a. Tank T-930 leak detection (LAH-931)

b. Tank T-930 level, low-level, high-level and high-high-level (LI, LAL, LAH and LAHH-930)

c. Backup high-level and high-high-level switches (LAH-932, LAHH-932)

d. Metering pumps (P-930A/B) containment leak detection (LAH-935)

J. The Hydrogen Peroxide Feed System room will have a sump & pump to contain any leaks or spills.

a. The sump Pump P-931 will be powered from local 115 VAC, 1 phase receptacle and controlled by internal level switch. There will be an enable switch to allow the pump to operate in case of liquid in the sump.

i. The Enable switch HS-931 is monitored by the PLC and if it is "Enabled" for >15 minutes an alarm shall be generated.

K. The Caustic room has a High-High level switch LSHH-931 that will generate an alarm when there is a major leak.

3.15 AIR COMPRESSOR SYSTEM (MI618)

A. This system will include two air compressors (AC-610 and AC-620) each with an internal drier, filter and a dedicated controller. An air compressor cooling water tank T-650 will provide once-through cooling for the compressors using treated water from the LGAC units.

B. Both compressors' discharge pipes will be manifolded and then it goes thru an air receiver (T-640) and various pressure switches to supply air to the Oxygen Generator.

C. Each air compressor system will be controlled automatically by vendor-supplied PLC software to maintain a desired pressure range in the compressed air header.

D. Air receiver (T-640) will have a solenoid actuated auto drain valve. This intelligent drain function monitors condensate build-up with liquid level sensors and evacuates the condensate only, when necessary, thereby avoiding compressed air waste and providing for considerable energy savings.

E. Low- and high-pressure switches (PSH-644 and PSL-645) and a pressure transmitter (PIT-643) will be provided. This compressor will supply air to the Oxygen Generator.

F. Analog Signal/Control Loop: PIT-643

G. Manual Operation: Air compressor shall not be operated in manual mode.

H. Automatic Operation:

a. An air compressor will run to maintain a pre-set desired pressure set point at PSL-645 (45 psi) and shuts down at PSH-644 (110 psi).

b. Treatment Building PLC to trend PIT-643.

c. Air compressors will be alternated on a weekly basis.

I. Plant PLC will be connected with both air Compressor control panels via an Ethernet cable to start/stop, monitor data and alarms. Refer to the vendor's manual for additional operation and alarm details.

J. Air compressors (AC-610 and AC-620) are connected to cooling water supplied from Tank T-650. This tank supplies once-through cooling water for the compressors using treated water from the LGAC units. This tank will have a continuous water level transmitter (LE/LIT-650) and a backup high-level switch (LSH-651). Normally tank T-650 fills with treated water from the LGAC vessels via solenoid valve SV-652. If valve SV-652 fails to open (tank level not increasing) when it is commanded to open, valve SV-651 opens to allow potable water to fill the tank as a backup.

K. Analog Signal/Control Loops: LIT-650

L. Tank T-650 overflow pipe's bottom elevation is at 4.9' high. Level transmitter (LIT-650) set points are as follows:

a. Low-Low level Alarm LALL-650 = 0.5'

b. Low level Alarm LAL-650 = 1.0'

c. SV-652 CLOSE Level = 4.0'

d. SV-652 OPEN Level = 1.5'

e. SV-651 CLOSE Level = 4.0' (fill water backup only)

f. SV-651 OPEN Level = 1.5' (fill water back only)

g. High level alarm LAH-100 = 4.5'

h. High-High level Alarm LAHH-650 = 4.75'

3.16 BUILDING SUMP SYSTEM AND BUILDING CONTAINMENT SYSTEM (MI616/MI620)

A. To contain a leak from the largest tank (15,000 gallon) within the GWTP building, a secondary containment volume in excess of 17,000 gallons will be provided within the process area floor by raising the GWTP building's foundation wall six inches higher than the plant floor.

a. All interior rooms will be at the same elevation as foundation walls.

b. All process tanks and pumps will be placed on a six-inch-high concrete housekeeping pad.

c. No process or contaminated water will be allowed to discharge into sanitary sewer system.

B. There will be a process sump (5,700-gallon capacity) that will include two submersible pumps (P-800A and P-800B). A floor trench system in the main treatment plant area will collect equipment drain, overflow and periodic plant cleaning wash water and drain into this sump. The process area floor will be sloped toward a floor trench draining into a process sump. The chemical room sumps can be pumped into this sump.

C. Normally decant water from the backwash waste tank T-550 will be discharging into this sump on a continuous basis.

D. The sump pumps will operate as Lead/Lag and alternate every cycle. There will be one level transmitter (LIT-800) inside this sump to operate these pumps automatically. A backup high-high-level switch (LSHH-801) is inside this sump in case of transmitter failure.

E. Normally sump pumps will pump into the Eq Tank T-100. However, Sump discharge line also has a camlock fitting to discharge sump content directly into a tanker.

F. All recovery well pumps shall be shut down if sump level is High-High (refer to Section 3.2).

G. Sump depth is 10.33.’ Level alarms will be set as follows:

a. LALL-800 = 10” above sump floor – Sump low-low level alarm

b. LCL- 800 = 12” above sump floor (pump P-800A/B OFF level).

c. LCH- 800 = 48” above sump floor (lead pump ON level)

d. LCHH-800 = 60” above sump floor (lag pump ON level).

e. LAHH- 800 = 108” above sump floor (Plant shut down level).

H. Backup High-high level alarm switch LSHH-801 is set at 108”

I. Manual Operation:

a. Manual operation shall be utilized for testing and maintenance purposes only.

i. Local Operation: Reference Section 3.1 (B) for motor control.

J. Automatic Operation:

a. One or both pumps will be operated automatically based on the sump level. These pumps will operate in lead-lag operation. Provide the Operator an HMI button to allow for Lead-Lag selection of the pumps.

K. Interlocks:

a. The sump pumps shall be interlocked (not allowed to run) as follows:

i. Eq. Tank level is High-High (LAHH-100 or LAHH-101).

3.17 EYE WASH/SAFETY SHOWER SYSTEM (MI619)

A. Eight eye wash/safety shower systems will be provided, and each will contain a flow switch (FSH-951 thru 958). When any of the seven flow switches change state, an alarm will be generated. If this alarm is not acknowledged within 10 minutes, the plant will be shut down.

3.18 PROCESS TANK VENTING SYSTEM (MI617)

A. Equalization and LGAC Feed tank’s interior air is constantly drawn through a carbon canister (while fresh air is allowed to enter from outside) by a blower with a standby spare. The air will discharge through a louver to atmosphere. This system will run continuously while the plant is in operation.

B. There will be a combination pressure-vacuum relief valves (PSV-200) on the carbon canister.

C. A pressure transmitter (PIT-200) will monitor the pressure on the suction side of the carbon canister.

D. The Operator will start the carbon canister system via the HMI screen. The carbon canister system must be running before for the Treatment System to operate.

E. If the operating blower faults (YA-200A/B) or stops running (YI-200A/B) the PLC will automatically start the standby blower. The failed blower shall not start until the alarm is reset by the Operator.

F. Low or High carbon canister suction pressure will generate an alarm (PAL-200 or PAH-200), and the Treatment Plant will shut down. Setpoint to be determined during startup.

3.19 NON-POTABLE WATER SYSTEM (MI617)

A. To wash down the plant floor or tank, an equipment, a non-potable water (NPW) system will be provided. This water will be taken from the plant effluent/backwash supply tank T-500. There will be a booster pump (P-1), a bladder tank (BT-1) and a pressure transducer (PT-P1) to operate this pump. Several hose bibbs will be located inside the plant.

3.20 GAS MONITORS (MI607)

A. Two ambient oxygen monitors will be provided by the AOP reactor system vendor. One monitor (AIT-501) will be in the Ozone Generation Room, and another monitor (AIT-502) will be in the AOP Reactors Room. These monitors will be monitored by the AOP reactor system PLC panel as inputs AI-501 and AI-502, see AOP vendor submittal for details.

B. These monitors will send high gas concentration level alarms to AOP reactor system PLC as AAH-501, AAHH-501, AALL-502, AAL-502, AAH-502 and AAHH-502 (set point to be determined by AOP vendor). AOP system PLC will then communicate alarms with Plant PLC system to start opening louvers and all exhaust fans.

3.21 BUILDING AUTOMATION SYSTEM & FIRE ALARM CONTROL PANEL (MI620)

A. GWTP’s HVAC systems, exhaust fans, motor operated louvers and heaters will be controlled by a building automation system (BAS) located inside this plant. Refer to the specifications.

B. There will be a fire alarm control panel (FACP) located inside this plant. This will monitor fire water flow, sprinkler systems operation and generate a fire alarm. This FACP will be connected to a remote alarm monitoring company via two dedicated phone lines. FACP will also send a fire alarm signal to BAS to shut down the fans and close all the louvers in case of a fire. FACP will also send a fire alarm signal to the Plant PLC to shut down the process equipment in case of a fire.

C. The BAS panel will be connected to plant PLC via an ethernet cable. PLC will then monitor various BAS systems’ operation and send control to BAS in case of a gas release.

3.22 LOSS OF POWER MODE

A. The PLC shall utilize Ethernet communication to monitor the incoming utility power via the power meter located in Motor Control Center “MCC”.

B. If a loss of utility power is detected, the Win911 alarming software shall be configured to immediately call out “Loss of Power” alarm to designated recipients.

C. While in Loss of Power Mode, all motors will shut down, all vendor supplied equipment shall shut down and the PLC shall have all discrete outputs programmed to a de-energized state. This action shall cause all valves to move to their fail position.

D. The PLC shall continue to monitor process conditions and generate additional alarms based on out-of-range conditions for 30 minutes.

3.23 PLANT RESTART

A. Provide a Plant Restart button at PLC. This should place all pumping systems in AUTO mode in a sequence as follows: start the carbon canister system, start building sump pumps followed by air compressor, then filter feed system, then EQ system, then all recovery wells and finally remaining pumping systems. Starting of these systems shall be separated by 30 seconds. Individual pumping system will start operating based on their respective tanks levels and other conditions as defined above. Sludge dewatering system is a batch mode operation.

B. If the plant is shut down due to power outage, it may be restarted automatically when power is restored (Operator selectable).

C. If the plant shuts down due to any process related alarms (as provided in attached list), plant should be restarted by the Operator physically evaluating all equipment at the site and acknowledging all alarms.

D. For the first several months, this will be the protocol to understand the frequency of occurrences and overall impact on the treatment plant. Depending on the frequency and outcome of these occurrences, it may be determined whether a Remote Alarm Acknowledgement and Remote Plant Restart is acceptable.

E. If the sump High-High alarm exists, the plant shall never be restarted remotely.

3.24 E-STOP MODE

A. E-Stops will be located within the treatment plant at control panels IOP-2 (process area), IOP-3 (chemical area) and IOP-4 (LGAC/AOP area).

B. Any E-Stop condition shall place the treatment plant into “E-Stop Mode” and generate a visual alarm (strobe light) at IOPs. The PLC shall shut down all vendor supplied equipment and have all discrete outputs programmed to a de-energized state. This action shall cause all motors to stop running, all vendor supplied panels disabled and all valves to move to their fail position.

C. The PLC shall continue to monitor process conditions and generate additional alarms based on out-of-range conditions.

D. The treatment plant shall remain in E-Stop mode until an operator physically evaluates the cause of the E-Stop and determines conditions are safe to resume operation.

3.25 HUMAN MACHINE INTERFACE REQUIREMENTS

A. Provide graphical screens (including but not limited to, process overview, individual unit process overviews, equipment overlays, controller faceplates, diagnostic and network status screens) necessary to provide a

complete operator interface to the system. Refer to Specifications for additional details.

3.26 TRENDING, HISTORICAL ARCHIVING REQUIREMENTS:

A. Provide trending and historical archiving of all analog values as well as selected discrete values. Actual values to be archived shall be assessed during the shop drawing review period. Provide a system capable of archiving any analog or discrete value that is registered at the HMI including trending functions (value versus time) for any such value for a minimum of 6 months before being erased.

3.27 REPORTS

A. Configure at minimum daily, weekly, and monthly reports outlining groundwater flows from each recovery well, CTR1 pumping system, and treated water discharge flows. Configure reports so that average instantaneous flows (gpm) per day, per week, and per month and totalized flows (gallons) per day, per week, and per month will be recorded and reported at each flow point. Exact format will be established during the shop drawing review period.

3.28 WEB INTERFACE REQUIREMENTS

A. Provide equipment, software or custom programming to limit remote access functionality for the SCADA system. The system configuration should limit inbound traffic to the Control Room SCADA and PLC equipment. Outbound traffic for remate alarm notification should not be restricted. Establish and configure appropriate security settings and confirm all with OWNER prior to enabling remote communications.

3.29 ALARMING SOFTWARE AND CONFIGURATION REQUIREMENTS

A. Configure the alarming software to capture alarms as listed in Table 2 attached after this Section. This list also provides desired responses. Coordinate with the OWNER to establish a callout escalation and configure the alarming software as required.

B. All Alarms shall be captured by the SCADA system. Additional action may be required as outlined below in the Alarm Listing.

C. All low and low-low level alarms shall be generated after preceding feed pump has operated for a minimum of 120 seconds.

3.30 LOSS OF COMMUNICATION

A. If any of the following devices stop communicating with the PLC, the plant should **not** shut down:

a. Any individual VFD,

b. Any recovery well,

c. Any remote control panel (IOp-5 or IOP-6)

TABLE 1 RECOVERY WELL PUMPS OPERATING SET POINTS

PUMPING SYSTEM	LEVEL PROBE DEPTH (FEET)	PUMP ON LEVEL (FEET)	PUMP OFF LEVEL (FEET)	PUMP SETTING POINT (FEET)	COMMENTS
RW-8	80′ BGS	X	X	120′ BGS	
RW-9	80′ BGS	X	X	120′ BGS	
RW-10A	80′ BGS	X	X	120′ BGS	

TABLE 2 - LIST OF GWTP ALARMS AND DESIRED RESPONSES

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
FAL-8	RW-8	FLOW	X	X	X		
LALL-8	RW-8	LEVEL	X	X			
LAL-8	RW-8	LEVEL	X				
LAH-8	RW-8	LEVEL	X				
LAH-VV8	VV-8	LEVEL	X				
YA-8	RW-8	POWER	X				
TA-8	VV-8 HEAT TRACE	POWER	X				
PAL-8	RW-8	PRESSURE	X				
PAH-8	RW-8	PRESSURE	X				
FAL-9	RW-9	FLOW	X	X	X		
LALL-9	RW-9	LEVEL	X	X			
LAL-9	RW-9	LEVEL	X				
LAH-9	RW-9	LEVEL	X				
LAH-VV9	VV-9	LEVEL	X				
YA-9	RW-9	POWER	X				
TA-9	VV-9 HEAT TRACE	POWER	X				
PAL-9	RW-9	PRESSURE	X				
PAH-9	RW-9	PRESSURE	X				

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
FAL-10A	RW-10A	FLOW	X	X	X		
LALL-10A	RW-10A	LEVEL	X	X			
LAL-10A	RW-10A	LEVEL	X				
LAH-10A	RW-10A	LEVEL	X				
LAH-VV10A	VV-10A	LEVEL	X				
YA-10A	RW-10A	POWER	X				
TA-10A	VV-10A HEAT TRACE	POWER	X				
PAL-10A	RW-10A	PRESSURE	X				
PAH-10A	RW-10A	PRESSURE	X				
FAL-100	PLANT INFLUENT	FLOW	X	X	X		
LAHH-100	T-100	LEVEL	X	X	X		
LAH-100	T-100	LEVEL	X				
LAL-100	T-100	LEVEL	X				
LALL-100	T-100	LEVEL	X	X	X		
LAHH-101	T-100	LEVEL	X	X	X		
YA-100A	P-100A	POWER	X	X			
YA-100B	P-100B	POWER	X	X			
FAL-101A	P-100A	FLOW	X	X	X		
FAL-101B	P-100B	FLOW	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
AAL-101	MMF FEED	pH	X	X	X	AOP RECYCLE	
AAH-101	MMF FEED	pH	X	X	X	AOP RECYCLE	
AAL-102	MMF FEED	ORP	X	X	X	AOP RECYCLE	
AAH-102	MMF FEED	ORP	X	X	X	AOP RECYCLE	
FAL-101	MMF FEED (CHEMICAL PUMPS SHUTDOWN)	FLOW	X	X	X		X
YA-110	EQM-110	POWER	X	X			
PAL-210	MMF-210/220/230	PRESSURE	X				
PAH-210	MMF-210/220/230	PRESSURE	X	X			
KA-210	MMF-210	TIME	X				
PDAH-210	MMF-210	DELTA P	X	X			
KA-220	MMF-220	TIME	X				
PDAH-220	MMF-220	DELTA P	X	X			
KA-230	MMF-230	TIME	X				
PDAH-230	MMF-230	DELTA P	X	X			
PAL-230	MMF-210/220/230	PRESSURE	X				
PAH-230	MMF-210/220/230	PRESSURE	X	X			
PDAH-240	CF-240/250	DELTA P	X	X			
YI-300B	AOP	SYSTEM WARNING	X	X			

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YI-300C	AOP	SYSTEM SHUTDOWN	X	X			
AAH-501	AOP	AMBIENT O2	X	X			
AAHH-501	AOP	AMBIENT O2	X	X			
AALL-502	AOP	AMBIENT O2	X	X			
AAL-502	AOP	AMBIENT O2	X	X			
AAH-502	AOP	AMBIENT O2	X	X			
AAHH-502	AOP	AMBIENT O2	X	X			
TALL-710	OD-4000	TEMP	X	X			
TAHH-710	OD-4000	TEMP	X	X			
LAHH-400	T-400	LEVEL	X	X	X		
LAH-400	T-400	LEVEL	X				
LAL-400	T-400	LEVEL	X				
LALL-400	T-400	LEVEL	X	X	X		
LAHH-401	T-400	LEVEL	X	X	X		
YA-400A	P-400A	POWER	X	X			
YA-400B	P-400B	POWER	X	X			
FAL-400A	P-400A	FLOW	X	X	X		
FAL-400B	P-400B	FLOW	X	X	X		
PDAH-400	LGAC-410/420/430	PRESSURE	X	X			

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAHH-500	T-500	LEVEL	X	X	X		
LAH-500	T-500	LEVEL	X				
LAL-500	T-500	LEVEL	X				
LALL-500	T-500	LEVEL	X	X	X		
LAHH-501	T-500	LEVEL	X	X	X		
YA-500A	P-500A	POWER	X	X			
YA-500B	P-500B	POWER	X	X			
FAL-500A	P-500A	FLOW	X	X	X		
FAL-500B	P-500B	FLOW	X	X	X		
LAH-MHA1	MH-A1	LEVEL	X	X			
LAH-MHB1	MH-B1	LEVEL	X	X			
LAH-OFB1	OFB1	LEVEL	X	X	X		
LAH-OFB2	OFB2	LEVEL	X	X	X		
LAH-OFB3	OFB3	LEVEL	X	X	X		
LAH-OFB4	OFB4/OFB5	LEVEL	X	X	X		
LAH-912	T-910	LEVEL	X	X	X		
LAH-910	T-910	LEVEL	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAL-910	T-910	LEVEL	X	X			
LAH-911	T-910	LEAK	X	X	X		
LAH-913	P-910A/B	LEAK	X	X	X		
LAHH-911	HYPO ROOM	LEAK	X	X	X		
YA-911	P-911	POWER	X	X			
LAH-922	T-920	LEVEL	X	X	X		
LAH-920	T-920	LEVEL	X	X	X		
LAL-920	T-920	LEVEL	X	X			
LAH-921	T-920	LEAK	X	X	X		
LAH-923	P-920A/B	LEAK	X	X	X		
LAHH-921	HYPO ROOM	LEAK	X	X	X		
YA-921	P-921	POWER	X	X			
LAHH-932	T-930	LEVEL	X	X	X		
LAH-932	T-930	LEVEL	X	X	X		
LAHH-930A	T-930	LEVEL	X	X	X		
LAH-930A	T-930	LEVEL	X	X	X		
LAL-930A	T-930	LEVEL	X	X			
LALL-930A	T-930	LEVEL	X	X			
LAH-931A	T-930	LEAK	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
LAH-935A	P-930A/B	LEAK	X	X	X		
LAHH-931	PEROXIDE ROOM	LEAK	X	X	X		
YA-931	P-931	POWER	X	X			
YA-800A	P-800A	POWER	X	X			
YA-800B	P-800B	POWER	X	X			
LAHH-800	SUMP	LEVEL	X	X	X		X (A)
LAH-800	SUMP	LEVEL	X	X			
LAL-800	SUMP	LEVEL	X	X			
LALL-800	SUMP	LEVEL	X	X			
LAHH-801	SUMP	LEVEL	X	X	X		X (A)
PAH-200	C-200	PRESSURE	X	X			
PAL-200	C-200	PRESSURE	X	X			
YA-200A	B-200A	POWER	X	X			
YA-200B	B-200B	POWER	X	X			
LAHH-650	T-650	LEVEL	X	X	X		
LAH-650	T-650	LEVEL	X	X			
LAL-650	T-650	LEVEL	X	X			
LALL-650	T-650	LEVEL	X	X	X		
LAH-651	T-650	LEVEL	X	X	X		

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YI-610B	AC-610	SYSTEM WARNING	X	X	X		
YI-610C	AC-610	SYSTEM SHUTDOWN	X	X	X		
YI-620B	AC-620	SYSTEM WARNING	X	X	X		
YI-620C	AC-620	SYSTEM SHUTDOWN	X	X	X		
PAL-643	AC-610/620	PRESSURE	X	X	X		
PAH-643	AC-610/620	PRESSURE	X	X			
PAH-644	AC-610/620	PRESSURE	X	X	X		
PAL-645	AC-610/620	PRESSURE	X	X			
FAH-951 thru 958	ANY EYEWASH STATION	FACILITY	X	X	X		
YA-980	MCC	SPD	X				
TAH-981	ELECTRICAL ROOM	TEMP	X				
TAH-982	PROCESS AREA	TEMP	X				
TAH-983	COMPRESSOR ROOM	TEMP	X				
TAH-984	OZONE GENERATOR ROOM	TEMP	X				
LAHH-991	CONTAINMENT WEST	LEAK	X	X	X		X
LAHH-991	CONTAINMENT EAST	LEAK	X	X	X		X
HI-IOP2A THRU IOP4A	ANY E-STOP	FACILITY	X	X	X		X
JA-IOP1 THRU IOP6	I/O PANEL	DC POWER	X				

ALARM	EQUIPMENT	SERVICE	SCADA/OIT ALARM	PLANT STROBE LIGHT	CALL OUT	PLANT RECYCLE	PLANT SHUTDOWN
YA-990	FACP	FIRE ALARM	X	X	X		X
LAHH-550	T-550	LEVEL	X	X	X		
LAH-550	T-550	LEVEL	X				
LAL-550	T-550	LEVEL	X				
LALL-550	T-550	LEVEL	X	X	X		
LAHH-551	T-550	LEVEL	X	X	X		
TA-550A	VV-550 HEAT TRACE	POWER	X				
TA-550B	VV-550 HEAT TRACE	POWER	X				

(A) - Shutdown GWTP incoming flow (ALL recovery wells) only.

IO SUMMARY

PANEL	AI	AO	DI - 24VDC	DO - 24VDC	DI - 120VAC	DO -120VAC	PANEL TOTALS
IOP-1	6	0	7	0	6	4	23
IOP-2	21	0	21	3	4	4	53
IOP-3	3	0	23	6	0	0	32
IOP-4	8	0	26	5	7	6	52
IOP-5	3	0	5	0	0	0	8
IOP-6	3	0	5	0	0	0	8
IO TOTALS	44	0	87	14	17	14	

IOP-1 (CONTROL ROOM) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
TI-981	TI	981		ELECTRICAL ROOM TEMPERATURE	MI620	AI 4-20mA	R1	S0	CH0	5094-IF8IH	EI615	TAL, TAH		
FI-550	FI	550		BACKWASH WASTE WATER TO SEWER FLOW	MI621	AI 4-20mA	R1	S0	CH1	5094-IF8IH	EI615			PARSHALL FLUME CONTROLLER W/ 24VDC POWER
LI-OFB1	LI	OFB1		STORMWATER BASIN #1 LEVEL	MI612	AI 4-20mA	R1	S0	CH2	5094-IF8IH	EI615	LAHH		
LI-OFB2	LI	OFB2		STORMWATER BASIN #2 LEVEL	MI612	AI 4-20mA	R1	S0	CH3	5094-IF8IH	EI615	LAHH		
LI-OFB3	LI	OFB3		STORMWATER BASIN #3 LEVEL	MI612	AI 4-20mA	R1	S0	CH4	5094-IF8IH	EI615	LAHH		
LI-OFB4	LI	OFB4		STORMWATER BASIN #4/#5 LEVEL	MI612	AI 4-20mA	R1	S0	CH5	5094-IF8IH	EI615	LAHH		
-				SPARE	-	AI 4-20mA	R1	S0	CH6	5094-IF8IH	EI615			
-				SPARE	-	AI 4-20mA	R1	S0	CH7	5094-IF8IH	EI615			
JI-980	JI	980		MCC POWER SUPPLY STATUS OK	MI620	DI 24vdc	R1	S1	CH0	5094-IB16	EI615			
YA-980	YA	980		MCC SPD LOSS OF PROTECTION	MI620	DI 24vdc	R1	S1	CH1	5094-IB16	EI615			
YA-IOP1A	YA	IOP1	A	IOP-1 UPS ON BATTERY	MI620	DI 24vdc	R1	S1	CH2	5094-IB16	EI615			0 = ALARM
YA-IOP1B	YA	IOP1	B	IOP-1 UPS LOW BATTERY	MI620	DI 24vdc	R1	S1	CH3	5094-IB16	EI615			0 = ALARM
JI-IOP1	JI	IOP1		IOP-1 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R1	S1	CH4	5094-IB16	EI615			
LAH-MHA1	LAH	MHA1		PLANT EFFLUENT TO BASIN #2 & #3 MANHOLE MH A-01 HIGH LEVEL	MI612	DI 24vdc	R1	S1	CH5	5094-IB16	EI615			0 = ALARM
LAH-MHB1	LAH	MHB1		PLANT EFFLUENT TO BASIN #4 & #5 MANHOLE MH B-01 HIGH LEVEL	MI612	DI 24vdc	R1	S1	CH6	5094-IB16	EI615			0 = ALARM
-				SPARE	-	DI 24vdc	R1	S1	CH7	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH8	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH9	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH10	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH11	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH12	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH13	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH14	5094-IB16	EI615			
-				SPARE	-	DI 24vdc	R1	S1	CH15	5094-IB16	EI615			
-				SPARE	-	DO 24vdc	R1	S2	CH0	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH1	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH2	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH3	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH4	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH5	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH6	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH7	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH8	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH9	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH10	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH11	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH12	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH13	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH14	5094-OB16	EI616			
-				SPARE	-	DO 24vdc	R1	S2	CH15	5094-OB16	EI616			
ZIO-550A	ZIO	550	A	BWW DRAIN TO BLDG. SUMP VALVE OPEN	MI621	DI 120vac	R1	S3	CH0	5094-IA16	EI616			
ZIC-550A	ZIC	550	A	BWW DRAIN TO BLDG. SUMP VALVE CLOSED	MI621	DI 120vac	R1	S3	CH1	5094-IA16	EI616			
ZIO-550B	ZIO	550	B	BWW DRAIN TO SEWER VALVE OPEN	MI621	DI 120vac	R1	S3	CH2	5094-IA16	EI616			
ZIC-550B	ZIC	550	B	BWW DRAIN TO SEWER VALVE CLOSED	MI621	DI 120vac	R1	S3	CH3	5094-IA16	EI616			
TA-550A	TA	550	A	BWW DRAIN TO BLDG. SUMP HEAT TRACE ALARM	MI621	DI 120vac	R1	S3	CH4	5094-IA16	EI616			0 = ALARM
TA-550B	TA	550	B	BWW DRAIN TO SEWER HEAT TRACE ALARM	MI621	DI 120vac	R1	S3	CH5	5094-IA16	EI616			0 = ALARM
-				SPARE	-	DI 120vac	R1	S3	CH6	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH7	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH8	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH9	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH10	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH11	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH12	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH13	5094-IA16	EI616			

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
-				SPARE	-	DI 120vac	R1	S3	CH14	5094-IA16	EI616			
-				SPARE	-	DI 120vac	R1	S3	CH15	5094-IA16	EI616			
ZYO-550A	ZYO	550	A	BWW DRAIN TO BLDG. SUMP VALVE OPEN COMMAND	MI621	DO 120vac	R1	S4	CH0	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-550A	ZYC	550	A	BWW DRAIN TO BLDG. SUMP VALVE CLOSE COMMAND	MI621	DO 120vac	R1	S4	CH1	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
ZYO-550B	ZYO	550	B	BWW DRAIN TO SEWER VALVE OPEN COMMAND	MI621	DO 120vac	R1	S4	CH2	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-550B	ZYC	550	B	BWW DRAIN TO SEWER VALVE CLOSE COMMAND	MI621	DO 120vac	R1	S4	CH3	5094-OA16	EI617			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
-				SPARE	-	DO 120vac	R1	S4	CH4	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH5	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH6	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH7	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH8	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH9	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH10	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH11	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH12	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH13	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH14	5094-OA16	EI617			
-				SPARE	-	DO 120vac	R1	S4	CH15	5094-OA16	EI617			
-				-	-	-	-	-	-	-	-	-	-	-
-				-	-	-	-	-	-	-	-	-	-	-

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
FI-8	FI	8		RECOVERY WELL 8 FLOW	MI604	AI 4-20mA	R2	S0	CH0	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
LI-8	LI	8		RECOVERY WELL 8 LEVEL	MI602	AI 4-20mA	R2	S0	CH1	5094-IF8IH	EI625	LALL	LCH (Pump ON) LCL (Pump OFF)	
PI-8	PI	8		RECOVERY WELL 8 DISCHARGE PRESSURE	MI602	AI 4-20mA	R2	S0	CH2	5094-IF8IH	EI625	PAL, PAH		
FI-100	FI	100		PLANT INFLUENT FLOW	MI604	AI 4-20mA	R2	S0	CH3	5094-IF8IH	EI625			MAGMETER W/120VAC POWER
LI-800	LI	800		TREATMENT BUILDING SUMP LEVEL	MI616	AI 4-20mA	R2	S0	CH4	5094-IF8IH	EI625	LALL, LAHH	LCH (LEAD PUMP ON) LCHH (LAG PUMP ON) LCL (BOTH PUMPS OFF)	
LIC-100	LIC	100		EQ. TANK T-100 LEVEL	MI605	AI 4-20mA	R2	S0	CH5	5094-IF8IH	EI625	LALL, LAHH	LCH (Pump ON) LCL (Pump OFF)	
FI-101	FI	101		MMF FEED FLOW	MI605	AI 4-20mA	R2	S0	CH6	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-440A	FI	440	A	PLANT EFFLUENT TO BASIN #1 FLOW	MI612	AI 4-20mA	R2	S0	CH7	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-440B	FI	440	B	PLANT EFFLUENT TO BASIN #2 & #3 FLOW	MI612	AI 4-20mA	R2	S1	CH0	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-440C	FI	440	C	PLANT EFFLUENT TO BASIN #4 & #5 FLOW	MI612	AI 4-20mA	R2	S1	CH1	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
FI-500	FI	500		BWS PUMPS P-500A/B DISCHARGE FLOW	MI611	AI 4-20mA	R2	S1	CH2	5094-IF8IH	EI625	FAL		MAGMETER W/120VAC POWER
-				SPARE	-	AI 4-20mA	R2	S1	CH3	5094-IF8IH	EI625			
-				SPARE	-	AI 4-20mA	R2	S1	CH4	5094-IF8IH	EI625			
-				SPARE	-	AI 4-20mA	R2	S1	CH5	5094-IF8IH	EI625			
TI-982	TI	982		GWTP BUILDING - PROCESS AREA	MI620	AI 4-20mA	R2	S1	CH6	5094-IF8IH	EI625	TAL, TAH		
LI-500	LI	500		BWS TANK T-500 LEVEL	MI611	AI 4-20mA	R2	S1	CH7	5094-IF8IH	EI625	LALL, LAHH	LCH (Pump ON) LCL (Pump OFF)	
AI-101	AI	101		MMF FEED pH	MI605	AI 4-20mA	R2	S2	CH0	5094-IF8IH	EI626	AAL, AAH		
TI-101	TI	101		MMF FEED TEMPERATURE	MI605	AI 4-20mA	R2	S2	CH1	5094-IF8IH	EI626			
AI-102	AI	102		MMF FEED ORP	MI605	AI 4-20mA	R2	S2	CH2	5094-IF8IH	EI626	AAL, AAH		
-				SPARE	-	AI 4-20mA	R2	S2	CH3	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH4	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH5	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH6	5094-IF8IH	EI626			
-				SPARE	-	AI 4-20mA	R2	S2	CH7	5094-IF8IH	EI626			
YA-IOP2A	YA	IOP2	A	IOP-2 UPS ON BATTERY	MI620	DI 24vdc	R2	S3	CH0	5094-IB16	EI626			0 = ALARM
YA-IOP2B	YA	IOP2	B	IOP-2 UPS LOW BATTERY	MI620	DI 24vdc	R2	S3	CH1	5094-IB16	EI626			0 = ALARM
HI-IOP2A	HI	IOP2	A	IOP-2 PANEL E-STOP	MI620	DI 24vdc	R2	S3	CH2	5094-IB16	EI626			0 = ESTOP
HI-IOP2B	HI	IOP2	B	IOP-2 PANEL ALARM SILENCE	MI620	DI 24vdc	R2	S3	CH3	5094-IB16	EI626			
JI-IOP2	JI	IOP2		IOP-2 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R2	S3	CH4	5094-IB16	EI626			
LAH-VV8	LAH	VV8		VALVE VAULT 8 HIGH LEVEL	MI602	DI 24vdc	R2	S3	CH5	5094-IB16	EI626			0 = ALARM
JI-8	JI	8		RW-8 LOCAL DISCONNECT STATUS	MI602	DI 24vdc	R2	S3	CH6	5094-IB16	EI626			1 = CLOSED
TA-8	TA	8		RW-8 DISCHARGE PIPING HEAT TRACE ALARM	MI612	DI 24vdc	R2	S3	CH7	5094-IB16	EI626			0 = ALARM
LAHH-101	LAHH	101		EQ. TANK T-100 HIGH-HIGH LEVEL SWITCH	MI605	DI 24vdc	R2	S3	CH8	5094-IB16	EI626			0 = ALARM
JI-100A	JI	100A		MMF FEED PUMP P-100A LOCAL DISCONNECT STATUS	MI605	DI 24vdc	R2	S3	CH9	5094-IB16	EI626			1 = CLOSED
JI-100B	JI	100B		MMF FEED PUMP P-100B LOCAL DISCONNECT STATUS	MI605	DI 24vdc	R2	S3	CH10	5094-IB16	EI626			1 = CLOSED
-				SPARE	-	DI 24vdc	R2	S3	CH11	5094-IB16	EI626			
-				SPARE	-	DI 24vdc	R2	S3	CH12	5094-IB16	EI626			
-				SPARE	-	DI 24vdc	R2	S3	CH13	5094-IB16	EI626			
LAHH-801	LAHH	801		BUILDING SUMP HIGH-HIGH LEVEL ALARM	MI616	DI 24vdc	R2	S3	CH14	5094-IB16	EI626			0 = ALARM
JI-800A	JI	800A		SUMP PUMP P-800A LOCAL DISCONNECT STATUS	MI616	DI 24vdc	R2	S3	CH15	5094-IB16	EI626			1 = CLOSED
JI-800B	JI	800B		SUMP PUMP P-800B LOCAL DISCONNECT STATUS	MI616	DI 24vdc	R2	S4	CH0	5094-IB16	EI627			1 = CLOSED
FAH-951	FAH	951		EYEWASH/SAFETY SHOWER BLDG. SUMP	MI619	DI 24vdc	R2	S4	CH1	5094-IB16	EI627			0 = ALARM
LAHH-501	LAHH	501		BSW TANK T-500 HIGH-HIGH LEVEL SWITCH	MI611	DI 24vdc	R2	S4	CH2	5094-IB16	EI627			0 = ALARM
JI-500A	JI	500A		BWS PUMP P-500A LOCAL DISCONNECT STATUS	MI611	DI 24vdc	R2	S4	CH3	5094-IB16	EI627			1 = CLOSED
JI-500B	JI	500B		BWS PUMP P-500B LOCAL DISCONNECT STATUS	MI611	DI 24vdc	R2	S4	CH4	5094-IB16	EI627			1 = CLOSED

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
JI-110	JI	110		EQ TANK MIXER EQM-110 LOCAL DISCONNECT STATUS	MI605	DI 24vdc	R2	S4	CH5	5094-IB16	EI627			1 = CLOSED
YI-P1	YI	P1		NON-POTABLE WATER PUMP RUN INDICATION	MI617	DI 24vdc	R2	S4	CH6	5094-IB16	EI627			1 = RUNNING
LAHH-991	LAHH	991		TREATMENT BUILDING LEAK DETECTION - WEST	MI620	DI 24vdc	R2	S4	CH7	5094-IB16	EI627			0 = ALARM
-				SPARE	-	DI 24vdc	R2	S4	CH8	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH9	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH10	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH11	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH12	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH13	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH14	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S4	CH15	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH0	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH1	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH2	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH3	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH4	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH5	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH6	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH7	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH8	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH9	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH10	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH11	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH12	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH13	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH14	5094-IB16	EI627			
-				SPARE	-	DI 24vdc	R2	S5	CH15	5094-IB16	EI627			
YC-IOP2A	YC	IOP2	A	IOP-2 PANEL HORN	MI620	DO 24vdc	R3	S0	CH0	5094-OB16	EI628			
YC-IOP2B	YC	IOP2	B	IOP-2 PANEL BEACON	MI620	DO 24vdc	R3	S0	CH1	5094-OB16	EI628			
YC-P1	YC	P1		NON-POTABLE WATER PUMP ENABLE	MI617	DO 24vdc	R3	S0	CH2	5094-OB16	EI628			INTERPOSING RELAY
-				SPARE	-	DO 24vdc	R3	S0	CH3	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH4	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH5	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH6	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH7	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH8	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH9	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH10	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH11	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH12	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH13	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH14	5094-OB16	EI628			
-				SPARE	-	DO 24vdc	R3	S0	CH15	5094-OB16	EI628			
ZIO-400A	ZIO	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVE OPENED	MI610	DI 120vac	R3	S1	CH0	5094-IA16	EI628			
ZIC-400A	ZIC	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVE CLOSED	MI610	DI 120vac	R3	S1	CH1	5094-IA16	EI628			
ZIO-400	ZIO	400		LGAC TO BWS TANK T-500 VALVE OPENED	MI610	DI 120vac	R3	S1	CH2	5094-IA16	EI628			
ZIC-400	ZIC	400		LGAC TO BWS TANK T-500 VALVE CLOSED	MI610	DI 120vac	R3	S1	CH3	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH4	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH5	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH6	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH7	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH8	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH9	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH10	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH11	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH12	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH13	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH14	5094-IA16	EI628			
-				SPARE	-	DI 120vac	R3	S1	CH15	5094-IA16	EI628			

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
ZYO-400A	ZYO	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVE OPEN COMMAND	MI610	DO 120vac	R3	S2	CH0	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-400A	ZYC	400	A	EFFLUENT RECYCLE TO EQ. TANK VALVEE CLOSE COMMAND	MI610	DO 120vac	R3	S2	CH1	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
ZYO-400	ZYO	400		LGAC TO BWS TANK T-500 VALVE OPEN COMMAND	MI610	DO 120vac	R3	S2	CH2	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-400	ZYC	400		LGAC TO BWS TANK T-500 VALVE CLOSE COMMAND	MI610	DO 120vac	R3	S2	CH3	5094-OA16	EI629			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
-				SPARE	-	DO 120vac	R3	S2	CH4	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH5	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH6	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH7	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH8	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH9	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH10	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH11	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH12	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH13	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH14	5094-OA16	EI629			
-				SPARE	-	DO 120vac	R3	S2	CH15	5094-OA16	EI629			
FQ-8	FQ	8		RECOVERY WELL 8 FLOW TOTALIZATION	MI604	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-100	FQ	100		PLANT INFLUENT FLOW TOTALIZATION	MI604	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-101	FQ	101		MMF FEED FLOW TOTALIZATION	MI605	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-440A	FQ	440	A	PLANT EFFLUENT TO BASIN #1 FLOW TOTALIZATION	MI612	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-440B	FQ	440	B	PLANT EFFLUENT TO BASIN #2 & #3 FLOW TOTALIZATION	MI612	HMI	-	-	-	-	-	-	-	CALCULATED
FQ-440C	FQ	440	C	PLANT EFFLUENT TO BASIN #4 & #5 FLOW TOTALIZATION	MI612	HMI	-	-	-	-	-	-	-	CALCULATED
HI-8A	HI	8	A	RW-8 IN AUTO	MI602	NET-IN	-	-	-	-	-	-	-	-
HI-8B	HI	8	B	RW-8 IN HAND	MI602	NET-IN	-	-	-	-	-	-	-	-
II-8	II	8		RW-8 PUMP CURRENT INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SI-8	SI	8		RW-8 PUMP SPEED INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SC-8	SC	8		RW-8 PUMP SPEED CONTROL	MI602	NET-OUT	-	-	-	-	-	-	-	-
HS-8	HS	8		RW-8 AUTO/MANUAL SELECT	MI602	HMI	-	-	-	-	-	-	-	-
YA-8	YA	8		RW-8 FAULT INDICATION	MI602	NET-IN								-
YI-8	YI	8		RW-8 RUN INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
YC-8	YC	8		RW-8 RUN COMMAND	MI602	NET-OUT	-	-	-	-	-	-	-	-
HS-100	HS	100		P-100A /B SELECT	MI605	HMI	-	-	-	-	-	-	-	-
HI-100AA	HI	100A	A	MMF FEED PUMP P-100A IN AUTO	MI605	NET-IN	-	-	-	-	-	-	-	-
HI-100AB	HI	100A	B	MMF FEED PUMP P-100A IN HAND	MI605	NET-IN	-	-	-	-	-	-	-	-
II-100A	II	100A		P-100A PUMP CURRENT INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SI-100A	SI	100A		P-100A PUMP SPEED INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SC-100A	SC	100A		P-100A PUMP SPEED CONTROL	MI605	NET-OUT	-	-	-	-	-	-	-	-
HS-100A	HS	100A		P-100A AUTO/MANUAL SELECT	MI605	HMI	-	-	-	-	-	-	-	-
YA-100A	YA	100A		P-100A FAULT INDICATION	MI605	NET-IN								-
YI-100A	YI	100A		P-100A RUN INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
YC-100A	YC	100A		P-100A RUN COMMAND	MI605	NET-OUT	-	-	-	-	-	-	-	-
HI-100BA	HI	100B	A	MMF FEED PUMP P-100A IN AUTO	MI605	NET-IN	-	-	-	-	-	-	-	-
HI-100BB	HI	100B	B	MMF FEED PUMP P-100A IN HAND	MI605	NET-IN	-	-	-	-	-	-	-	-
II-100B	II	100B		P-100B PUMP CURRENT INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SI-100B	SI	100B		P-100B PUMP SPEED INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
SC-100B	SC	100B		P-100B PUMP SPEED CONTROL	MI605	NET-OUT	-	-	-	-	-	-	-	-
HS-100B	HS	100B		P-100B AUTO/MANUAL SELECT	MI605	HMI	-	-	-	-	-	-	-	-
YA-100B	YA	100B		P-100B FAULT INDICATION	MI605	NET-IN								-
YI-100B	YI	100B		P-100B RUN INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
YC-100B	YC	100B		P-100B RUN COMMAND	MI605	NET-OUT	-	-	-	-	-	-	-	-
HS-500	HS	500		P-500A/B SELECT	MI611	HMI	-	-	-	-	-	-	-	-
HI-500AA	HI	500A	A	BWS PUMP P-500A IN AUTO	MI611	NET-IN	-	-	-	-	-	-	-	-
HI-500AB	HI	500A	B	BWS PUMP P-500A IN HAND	MI611	NET-IN	-	-	-	-	-	-	-	-
II-500A	II	500A		P-500A PUMP CURRENT INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
SI-500A	SI	500A		P-500A PUMP SPEED INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
SC-500A	SC	500A		P-500A PUMP SPEED CONTROL	MI611	NET-OUT	-	-	-	-	-	-	-	-
HS-500A	HS	500A		P-500A AUTO/MANUAL SELECT	MI611	HMI	-	-	-	-	-	-	-	-
YA-500A	YA	500A		P-500A FAULT INDICATION	MI611	NET-IN								-
YI-500A	YI	500A		P-500A RUN INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
YC-500A	YC	500A		P-500A RUN COMMAND	MI611	NET-OUT	-	-	-	-	-	-	-	-
HI-500BA	HI	500B	A	BWS PUMP P-500B IN AUTO	MI611	NET-IN	-	-	-	-	-	-	-	-
HI-500BB	HI	500B	B	BWS PUMP P-500B IN HAND	MI611	NET-IN	-	-	-	-	-	-	-	-
II-500B	II	500B		P-500B PUMP CURRENT INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
SI-500B	SI	500B		P-500B PUMP SPEED INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
SC-500B	SC	500B		P-500B PUMP SPEED CONTROL	MI611	NET-OUT	-	-	-	-	-	-	-	-
HS-500B	HS	500B		P-500B AUTO/MANUAL SELECT	MI611	HMI	-	-	-	-	-	-	-	-
YA-500B	YA	500B		P-500B FAULT INDICATION	MI611	NET-IN								-
YI-500B	YI	500B		P-500B RUN INDICATION	MI611	NET-IN	-	-	-	-	-	-	-	-
YC-500B	YC	500B		P-500B RUN COMMAND	MI611	NET-OUT	-	-	-	-	-	-	-	-
HS-800	HS	800		P-800A/B SELECT	MI616	HMI	-	-	-	-	-	-	-	-
HI-800AA	HI	800A	A	SUMP PUMP P-800A IN AUTO	MI616	NET-IN	-	-	-	-	-	-	-	-
HI-800AB	HI	800A	B	SUMP PUMP P-800A IN HAND	MI616	NET-IN	-	-	-	-	-	-	-	-
HS-800A	HS	800A		P-800A AUTO/MANUAL SELECT	MI616	HMI	-	-	-	-	-	-	-	-
II-800A	II	800A		P-800A CURRENT INDICATION	MI616	NET-IN								-
YA-800A	YA	800A		P-800A FAULT INDICATION	MI616	NET-IN								-
YI-800A	YI	800A		P-800A RUN INDICATION	MI616	NET-IN	-	-	-	-	-	-	-	-
YC-800A	YC	800A		P-800A RUN COMMAND	MI616	NET-OUT	-	-	-	-	-	-	-	-
HI-800BA	HI	800B	A	SUMP PUMP P-800B IN AUTO	MI616	NET-IN	-	-	-	-	-	-	-	-
HI-800BB	HI	800B	B	SUMP PUMP P-800B IN HAND	MI616	NET-IN	-	-	-	-	-	-	-	-
HS-800B	HS	800B		P-800B AUTO/MANUAL SELECT	MI616	HMI	-	-	-	-	-	-	-	-
II-800B	II	800B		P-800B CURRENT INDICATION	MI616	NET-IN								-
YA-800B	YA	800B		P-800B FAULT INDICATION	MI616	NET-IN								-
YI-800B	YI	800B		P-800B RUN INDICATION	MI616	NET-IN	-	-	-	-	-	-	-	-
YC-800B	YC	800B		P-800B RUN COMMAND	MI616	NET-OUT	-	-	-	-	-	-	-	-
HI-110A	HI	110	A	EQM-110 SUMP PUMP P-800B IN AUTO	MI605	NET-IN	-	-	-	-	-	-	-	-
HI-110B	HI	110	B	EQM-110 SUMP PUMP P-800B IN HAND	MI605	NET-IN	-	-	-	-	-	-	-	-
HS-110	HS	110		EQM-110 AUTO/MANUAL SELECT	MI605	HMI	-	-	-	-	-	-	-	-
II-110	II	110		EQM-110 CURRENT INDICATION	MI605	NET-IN								-
YA-110	YA	110		EQM-110 FAULT INDICATION	MI605	NET-IN								-
YI-110	YI	110		EQM-110 RUN INDICATION	MI605	NET-IN	-	-	-	-	-	-	-	-
YC-110	YC	110		EQM-110 RUN COMMAND	MI605	NET-OUT	-	-	-	-	-	-	-	-
-					-		-	-	-	-	-	-	-	-

IOP-3 (CHEMICAL AREA) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
-				SPARE	-	AI 4-20mA	R4	S0	CH0	5094-IF8IH	EI635			
LI-920	LI	920		SODIUM HYPOCHLORITE TANK T-910 LEVEL	MI613	AI 4-20mA	R4	S0	CH1	5094-IF8IH	EI635	LAL, LAH		LAL FOR CHEMICAL DELIVERY
LI-910	LI	910		CAUSTIC TANK T-920 LEVEL	MI614	AI 4-20mA	R4	S0	CH2	5094-IF8IH	EI635	LAL, LAH		LAL FOR CHEMICAL DELIVERY
PDI-240	PDI	240		CARTRIDGE FILTER CF-240/250 PRESSURE DIFFERENTIAL	MI606	AI 4-20mA	R4	S0	CH3	5094-IF8IH	EI635	PDAH		
-				SPARE	-	AI 4-20mA	R4	S0	CH4	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S0	CH5	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S0	CH6	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S0	CH7	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH0	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH1	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH2	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH3	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH4	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH5	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH6	5094-IF8IH	EI635			
-				SPARE	-	AI 4-20mA	R4	S1	CH7	5094-IF8IH	EI635			
-				SPARE	-	AO 4-20mA	R4	S2	CH0	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH1	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH2	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH3	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH4	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH5	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH6	5094-OF8	EI636			
-				SPARE	-	AO 4-20mA	R4	S2	CH7	5094-OF8	EI636			
YA-IOP3A	YA	IOP3	A	IOP-3 UPS ON BATTERY	MI620	DI 24vdc	R4	S3	CH0	5094-IB16	EI636			0 = ALARM
YA-IOP3B	YA	IOP3	B	IOP-3 UPS LOW BATTERY	MI620	DI 24vdc	R4	S3	CH1	5094-IB16	EI636			0 = ALARM
HI-IOP3A	HI	IOP3	A	IOP-3 PANEL E-STOP	MI620	DI 24vdc	R4	S3	CH2	5094-IB16	EI636			0 = ESTOP
HI-IOP3B	HI	IOP3	B	IOP-3 PANEL ALARM SILENCE	MI620	DI 24vdc	R4	S3	CH3	5094-IB16	EI636			
JI-IOP3	JI	IOP3		IOP-3 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R4	S3	CH4	5094-IB16	EI636			
LAH-921	LAH	921		SODIUM HYPOCHLORITE TANK T-920 LEAK ALARM	MI613	DI 24vdc	R4	S3	CH5	5094-IB16	EI636			
LAH-922	LAH	922		SODIUM HYPOCHLORITE TANK T-920 HIGH LEVEL	MI613	DI 24vdc	R4	S3	CH6	5094-IB16	EI636			
LAH-923	LAH	923		SODIUM HYPOCHLORITE METERING PUMP SKID LEAK ALARM	MI613	DI 24vdc	R4	S3	CH7	5094-IB16	EI636			
FAH-954	FAH	954		EYEWASH/SAFETY SHOWER HYPO ROOM	MI619	DI 24vdc	R4	S3	CH8	5094-IB16	EI636			0 = ALARM
LAH-911	LAH	911		CAUSTIC TANK T-910 LEAK ALARM	MI614	DI 24vdc	R4	S3	CH9	5094-IB16	EI636			0 = ALARM
LAH-912	LAH	912		CAUSTIC TANK T-910 HIGH LEVEL	MI614	DI 24vdc	R4	S3	CH10	5094-IB16	EI636			0 = ALARM
LAH-913	LAH	913		CAUSTIC METERING PUMP SKID LEAK ALARM	MI614	DI 24vdc	R4	S3	CH11	5094-IB16	EI636			0 = ALARM
FAH-955	FAH	955		EYEWASH/SAFETY SHOWER CAUSTIC ROOM	MI619	DI 24vdc	R4	S3	CH12	5094-IB16	EI636			0 = ALARM
FAH-956	FAH	956		EYEWASH/SAFETY SHOWER PEROXIDE ROOM	MI619	DI 24vdc	R4	S3	CH13	5094-IB16	EI636			0 = ALARM
HI-AP1	HI	AP1		CHEMICAL UNLOADING ALARM PANEL AP-1 ALARM SILENCE	MI620	DI 24vdc	R4	S3	CH14	5094-IB16	EI636			0 = ALARM
LAHH-911	LAHH	911		CAUSTIC ROOM LEAK ALARM	MI614	DI 24vdc	R4	S3	CH15	5094-IB16	EI636			0 = ALARM
LAHH-921	LAHH	921		HYPO ROOM LEAK ALARM	MI613	DI 24vdc	R4	S4	CH0	5094-IB16	EI637			0 = ALARM
LAHH-931	LAHH	931		PEROXIDE ROOM LEAK ALARM	MI615	DI 24vdc	R4	S4	CH1	5094-IB16	EI637			0 = ALARM
HI-911	HI	911		CAUSTIC ROOM SUMP PUMP P-911 ENABLED	MI614	DI 24vdc	R4	S4	CH2	5094-IB16	EI637	YA		> 15 MINUTES
HI-921	HI	921		HYPO ROOM SUMP PUMP P-921 ENABLED	MI613	DI 24vdc	R4	S4	CH3	5094-IB16	EI637	YA		> 15 MINUTES
HI-931	HI	931		PEROXIDE ROOM SUMP PUMP P-931 ENABLED	MI615	DI 24vdc	R4	S4	CH4	5094-IB16	EI637	YA		> 15 MINUTES
FAH-952	FAH	952		EYEWASH/SAFETY SHOWER MMF AREA	MI619	DI 24vdc	R4	S4	CH5	5094-IB16	EI637			0 = ALARM
FAL-101	FAL	101		MMF FEED LOW FLOW (CHEMICAL PUMP SHUTDOWN RELAY ACTIVATED)	MI6015	DI 24vdc	R4	S4	CH6	5094-IB16	EI637			0 = ALARM
-				SPARE	-	DI 24vdc	R4	S4	CH7	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH8	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH9	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH10	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH11	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH12	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH13	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH14	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S4	CH15	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH0	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH1	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH2	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH3	5094-IB16	EI637			

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
-				SPARE	-	DI 24vdc	R4	S5	CH4	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH5	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH6	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH7	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH8	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH9	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH10	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH11	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH12	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH13	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH14	5094-IB16	EI637			
-				SPARE	-	DI 24vdc	R4	S5	CH15	5094-IB16	EI637			
YC-IOP3A	YC	IOP3	A	IOP-3 PANEL HORN	MI620	DO 24vdc	R5	S0	CH0	5094-OB16	EI638			
YC-IOP3B	YC	IOP3	B	IOP-3 PANEL BEACON	MI620	DO 24vdc	R5	S0	CH1	5094-OB16	EI638			
YC-AP1	YC	AP1		CHEMICAL UNLOADING ALARM PANEL AP-1 HORN	MI620	DO 24vdc	R5	S0	CH2	5094-OB16	EI638			
YC-920	YC	920		SODIUM HYPOCHLORITE TANK T-920 HIGH LEVEL LIGHT	MI620	DO 24vdc	R5	S0	CH3	5094-OB16	EI638			
YC-910	YC	910		CAUSTIC TANK T-910 HIGH LEVEL LIGHT	MI620	DO 24vdc	R5	S0	CH4	5094-OB16	EI638			
YC-930	YC	930		PEROXIDE TANK T-930 HIGH LEVEL LIGHT	MI620	DO 24vdc	R5	S0	CH5	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH6	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH7	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH8	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH9	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH10	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH11	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH12	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH13	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH14	5094-OB16	EI638			
-				SPARE	-	DO 24vdc	R5	S0	CH15	5094-OB16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH0	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH1	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH2	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH3	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH4	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH5	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH6	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH7	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH8	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH9	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH10	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH11	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH12	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH13	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH14	5094-IA16	EI638			
-				SPARE	-	DI 120vac	R5	S1	CH15	5094-IA16	EI638			
-				SPARE	-	DO 120vac	R5	S2	CH0	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH1	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH2	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH3	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH4	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH5	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH6	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH7	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH8	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH9	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH10	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH11	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH12	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH13	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH14	5094-OA16	EI639			
-				SPARE	-	DO 120vac	R5	S2	CH15	5094-OA16	EI639			
UI-210	UI	210		MMF SKID CONTROL PANEL	MI606	ETHERNET	-	-	-	-	-	-	-	-

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
HS-920	HS	920		SODIUM HYPOCHLORITE PUMP P-920 A/B SELECT	MI613	HMI	-	-	-	-	-	-	-	-
SI-920A	SI	920A		P-920A PUMP SPEED INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
SC-920A	SC	920A		P-920A PUMP SPEED CONTROL	MI613	NET-OUT	-	-	-	-	-	-	-	-
YI-920A	YI	920A		P-920A RUN INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
YC-920A	YC	920A		P-920A RUN COMMAND	MI613	HMI	-	-	-	-	-	-	-	-
SI-920B	SI	920B		P-920B PUMP SPEED INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
SC-920B	SC	920B		P-920B PUMP SPEED CONTROL	MI613	NET-OUT	-	-	-	-	-	-	-	-
YI-920B	YI	920B		P-920B RUN INDICATION	MI613	NET-IN	-	-	-	-	-	-	-	-
YC-920B	YC	920B		P-920B RUN COMMAND	MI613	HMI	-	-	-	-	-	-	-	-
HS-910	HS	910		CAUSTIC PUMP P-910 A/B SELECT	MI614	HMI	-	-	-	-	-	-	-	-

IOP-4 (LGAC-AOP AREA) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
PI-200	PI	200		CARBON CANISTER INLET PRESSURE	MI617	AI 4-20mA	R6	S0	CH0	5094-IF8IH	EI645	PAL, PAH		
LI-400	LI	400		LGAC FEED TANK T-400 LEVEL	MI609	AI 4-20mA	R6	S0	CH1	5094-IF8IH	EI645	LALL, LAHH	LCH (Pump ON) LCL (Pump OFF)	
FI-400	FI	400		LGAC FEED FLOW	MI609	AI 4-20mA	R6	S0	CH2	5094-IF8IH	EI645	FAL		MAGMETER W/120VAC POWER
-				SPARE	-	AI 4-20mA	R6	S0	CH3	5094-IF8IH	EI645			
LI-550	LI	550		BWW TANK T-550 LEVEL	MI621	AI 4-20mA	R6	S0	CH4	5094-IF8IH	EI645	LAH, LAHH		
PI-643	PI	643		COMPRESSED AIR HEADER PRESSURE	MI618	AI 4-20mA	R6	S0	CH5	5094-IF8IH	EI645	PAL, PAH		
TI-983	TI	983		COMPRESSOR ROOM TEMPERATURE	MI620	AI 4-20mA	R6	S0	CH6	5094-IF8IH	EI645	TAL, TAH		
TI-984	TI	984		OZONE GENERATOR ROOM TEMPERATURE	MI620	AI 4-20mA	R6	S0	CH7	5094-IF8IH	EI645	TAL, TAH		
LIC-650	LIC	650		Air Compressor Cooling Water Tank T-650 LEVEL	MI618	AI 4-20mA	R6	S1	CH0	5094-IF8IH	EI645	LALL, LAHH	LCL, LCH	OPERATE WATER INLET VALVES BASED ON TANK LEVEL
-				SPARE	-	AI 4-20mA	R6	S1	CH1	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH2	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH3	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH4	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH5	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH6	5094-IF8IH	EI645			
-				SPARE	-	AI 4-20mA	R6	S1	CH7	5094-IF8IH	EI645			
-				SPARE	-	AO 4-20mA	R6	S2	CH0	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH1	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH2	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH3	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH4	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH5	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH6	5094-OF8	EI646			
-				SPARE	-	AO 4-20mA	R6	S2	CH7	5094-OF8	EI646			
YA-IOP4A	YA	IOP4	A	IOP-4 UPS ON BATTERY	MI620	DI 24vdc	R6	S3	CH0	5094-IB16	EI646			0 = ALARM
YA-IOP4B	YA	IOP4	B	IOP-4 UPS LOW BATTERY	MI620	DI 24vdc	R6	S3	CH1	5094-IB16	EI646			0 = ALARM
HI-IOP4A	HI	IOP4	A	IOP-4 PANEL E-STOP	MI620	DI 24vdc	R6	S3	CH2	5094-IB16	EI646			0 = ESTOP
HI-IOP4B	HI	IOP4	B	IOP-4 PANEL ALARM SILENCE	MI620	DI 24vdc	R6	S3	CH3	5094-IB16	EI646			
JI-IOP4	JI	IOP4		IOP-4 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R6	S3	CH4	5094-IB16	EI646			
LAHH-401	LAHH	401		LGAC FEED TANK T-400 HIGH-HIGH LEVEL SWITCH	MI609	DI 24vdc	R6	S3	CH5	5094-IB16	EI646			0 = ALARM
JI-400A	JI	400A		LGAC FEED PUMP P-400A LOCAL DISCONNECT STATUS	MI609	DI 24vdc	R6	S3	CH6	5094-IB16	EI646			1 = CLOSED
JI-400B	JI	400B		LGAC FEED PUMP P-400B LOCAL DISCONNECT STATUS	MI609	DI 24vdc	R6	S3	CH7	5094-IB16	EI646			1 = CLOSED
YI-610A	YI	610	A	AIR COMPRESSOR AC-610 RUNNING	MI618	DI 24vdc	R6	S3	CH8	5094-IB16	EI646			
YI-610B	YI	610	B	AIR COMPRESSOR AC-610 WARNING	MI618	DI 24vdc	R6	S3	CH9	5094-IB16	EI646			
YI-610C	YI	610	C	AIR COMPRESSOR AC-610 SHUTDOWN	MI618	DI 24vdc	R6	S3	CH10	5094-IB16	EI646			
YI-620A	YI	620	A	AIR COMPRESSOR AC-620 RUNNING	MI618	DI 24vdc	R6	S3	CH11	5094-IB16	EI646			
YI-620B	YI	620	B	AIR COMPRESSOR AC-620 WARNING	MI618	DI 24vdc	R6	S3	CH12	5094-IB16	EI646			
YI-620C	YI	620	C	AIR COMPRESSOR AC-620 SHUTDOWN	MI618	DI 24vdc	R6	S3	CH13	5094-IB16	EI646			
FAH-957	FAH	957		EYEWASH/SAFETY SHOWER AOP REACTOR ROOM	MI619	DI 24vdc	R6	S3	CH14	5094-IB16	EI646			0 = ALARM
FAH-958	FAH	958		EYEWASH/SAFETY SHOWER OZONE GENERATOR ROOM	MI619	DI 24vdc	R6	S3	CH15	5094-IB16	EI646			0 = ALARM
LAHH-551	LAHH	551		BWW TANK T-550 HIGH-HIGH LEVEL SWITCH	MI621	DI 24vdc	R6	S4	CH0	5094-IB16	EI647			0 = ALARM
-				SPARE	-	DI 24vdc	R6	S4	CH1	5094-IB16	EI647			
PAH-644	PAH	644		COMPRESSED AIR HEADER PRESSURE ALARM HIGH	MI618	DI 24vdc	R6	S4	CH2	5094-IB16	EI647			0 = ALARM
PAL-645	PAL	645		COMPRESSED AIR HEADER PRESSURE ALARM LOW	MI618	DI 24vdc	R6	S4	CH3	5094-IB16	EI647			0 = ALARM
PDAH-400	PDAH	400		LGAC-410/420/430 PRESSURE DIFFERENTIAL HIGH	MI610	DI 24vdc	R6	S4	CH4	5094-IB16	EI647			0 = ALARM
-				SPARE	-	DI 24vdc	R6	S4	CH5	5094-IB16	EI647			
-				SPARE	-	DI 24vdc	R6	S4	CH6	5094-IB16	EI647			
LAHH-651	LAHH	651		Air Compressor Cooling Water Tank T-650 HIGH LEVEL SWITCH	MI618	DI 24vdc	R6	S4	CH7	5094-IB16	EI647			0 = ALARM
LAHH-992	LAHH	992		TREATMENT BUILDING LEAK DETECTION - EAST	MI620	DI 24vdc	R6	S4	CH8	5094-IB16	EI647			0 = ALARM
YA-990	YA	990		FIRE ALARM ACTIVE	MI620	DI 24vdc	R6	S4	CH9	5094-IB16	EI647			1 = ALARM
FAH-953	FAH	953		EYEWASH/SAFETY SHOWER NEAR COMPRESSOR ROOM	MI619	DI 24vdc	R6	S4	CH10	5094-IB16	EI647			0 = ALARM

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
JI-200A	JI	200A		CARBON CANISTER BLOWER B-200A LOCAL DISCONNECT STATUS	MI617	DI 24vdc	R6	S4	CH11	5094-IB16	EI647			1 = CLOSED
JI-200B	JI	200B		CARBON CANISTER BLOWER B-200B LOCAL DISCONNECT STATUS	MI617	DI 24vdc	R6	S4	CH12	5094-IB16	EI647			1 = CLOSED
-				SPARE	-	DI 24vdc	R6	S4	CH13	5094-IB16	EI647			
-				SPARE	-	DI 24vdc	R6	S4	CH14	5094-IB16	EI647			
-				SPARE	-	DI 24vdc	R6	S4	CH15	5094-IB16	EI647			
YC-IOP4A	YC	IOP4	A	IOP-4 PANEL HORN	MI620	DO 24vdc	R6	S5	CH0	5094-OB16	EI647			
YC-IOP4B	YC	IOP4	B	IOP-4 PANEL BEACON	MI620	DO 24vdc	R6	S5	CH1	5094-OB16	EI647			
ZYO-651	ZYO	651		POTABLE WATER VALVE OPEN COMMAND	MI618	DO 24vdc	R6	S5	CH2	5094-OB16	EI647			
ZYO-652	ZYO	652		TREATED WATER VALVE OPEN COMMAND	MI618	DO 24vdc	R6	S5	CH3	5094-OB16	EI647			
HS-300	HS	300		AOP SYSTEM ENABLE	MI607	DO 24vdc	R6	S5	CH4	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH5	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH6	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH7	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH8	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH9	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH10	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH11	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH12	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH13	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH14	5094-OB16	EI647			
-				SPARE	-	DO 24vdc	R6	S5	CH15	5094-OB16	EI647			
ZIO-350A	ZIO	350	A	AOP RECYCLE TO EQ. TANK VALVE OPENED	MI608	DI 120vac	R6	S6	CH0	5094-IA16	EI648			
ZIC-350A	ZIC	350	A	AOP RECYCLE TO EQ. TANK VALVE CLOSED	MI608	DI 120vac	R6	S6	CH1	5094-IA16	EI648			
ZIO-350B	ZIO	350	B	AOP TO LGAC FEED TANK T-400 VALVE OPENED	MI608	DI 120vac	R6	S6	CH2	5094-IA16	EI648			
ZIC-350B	ZIC	350	B	AOP TO LGAC FEED TANK T-400 VALVE CLOSED	MI608	DI 120vac	R6	S6	CH3	5094-IA16	EI648			
YI-300A	YI	300	A	AOP SYSTEM RUNNING	MI607	DI 120vac	R6	S6	CH4	5094-IA16	EI648			
YI-300B	YI	300	B	AOP SYSTEM WARNING	MI607	DI 120vac	R6	S6	CH5	5094-IA16	EI648			
YI-300C	YI	300	C	AOP SYSTEM SHUTDOWN	MI607	DI 120vac	R6	S6	CH6	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH7	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH8	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH9	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH10	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH11	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH12	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH13	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH14	5094-IA16	EI648			
-				SPARE	-	DI 120vac	R6	S6	CH15	5094-IA16	EI648			
HS-610	HS	610		AIR COMPRESSOR AC-610 REMOTE START/STOP	MI618	DO 120vac	R6	S7	CH0	5094-IA16	EI648			
HS-620	HS	620		AIR COMPRESSOR AC-620 REMOTE START/STOP	MI618	DO 120vac	R6	S7	CH1	5094-IA16	EI648			
ZYO-350A	ZYO	350	A	AOP RECYCLE TO EQ. TANK VALVE OPEN COMMAND	MI608	DO 120vac	R6	S7	CH2	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-350A	ZYC	350	A	AOP RECYCLE TO EQ. TANK VALVE CLOSE COMMAND	MI608	DO 120vac	R6	S7	CH3	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
ZYO-350B	ZYO	350	B	AOP TO LGAC FEED TANK VALVE OPEN COMMAND	MI608	DO 120vac	R6	S7	CH4	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE OPEN CONFIRMATION
ZYC-350B	ZYC	350	B	AOP TO LGAC FEED TANK VALVE CLOSE COMMAND	MI608	DO 120vac	R6	S7	CH5	5094-IA16	EI648			TURN OUPUT OFF AFTER VALVE CLOSE CONFIRMATION
-				SPARE	-	DO 120vac	R6	S7	CH6	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH7	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH8	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH9	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH10	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH11	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH12	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH13	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH14	5094-IA16	EI648			
-				SPARE	-	DO 120vac	R6	S7	CH15	5094-IA16	EI648			
FQ-400	FQ	400		LGAC FEED FLOW TOTALIZATION	MI609	HMI	-	-	-	-	-	-	-	CALCULATED

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
HS-400	HS	400		P-400A/B SELECT	MI609	HMI	-	-	-	-	-	-	-	-
HI-400AA	HI	400A	A	LGAC FEED PUMP P-400A IN AUTO	MI609	NET-IN	-	-	-	-	-	-	-	-
HI-400AB	HI	400A	B	LGAC FEED PUMP P-400A IN HAND	MI609	NET-IN	-	-	-	-	-	-	-	-
II-400A	II	400A		P-400A PUMP CURRENT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SI-400A	SI	400A		P-400A PUMP SPEED INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SC-400A	SC	400A		P-400A PUMP SPEED CONTROL	MI609	NET-OUT	-	-	-	-	-	-	-	-
HS-400A	HS	400A		P-400A AUTO/MANUAL SELECT	MI609	HMI	-	-	-	-	-	-	-	-
YA-400A	YA	400A		P-400A FAULT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YI-400A	YI	400A		P-400A RUN INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YC-400A	YC	400A		P-400A RUN COMMAND	MI609	NET-OUT	-	-	-	-	-	-	-	-
HI-400BA	HI	400B	A	LGAC FEED PUMP P-400B IN AUTO	MI609	NET-IN	-	-	-	-	-	-	-	-
HI-400BB	HI	400B	B	LGAC FEED PUMP P-400B IN HAND	MI609	NET-IN	-	-	-	-	-	-	-	-
II-400B	II	400B		P-400B PUMP CURRENT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SI-400B	SI	400B		P-400B PUMP SPEED INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
SC-400B	SC	400B		P-400B PUMP SPEED CONTROL	MI609	NET-OUT	-	-	-	-	-	-	-	-
HS-400B	HS	400B		P-400B AUTO/MANUAL SELECT	MI609	HMI	-	-	-	-	-	-	-	-
YA-400B	YA	400B		P-400B FAULT INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YI-400B	YI	400B		P-400B RUN INDICATION	MI609	NET-IN	-	-	-	-	-	-	-	-
YC-400B	YC	400B		P-400B RUN COMMAND	MI609	NET-OUT	-	-	-	-	-	-	-	-
UI-610	UI	610		AIR COMPRESSOR C-610	MI618	ETHERNET	-	-	-	-	-	-	-	-
UI-620	UI	620		AIR COMPRESSOR C-620	MI618	ETHERNET	-	-	-	-	-	-	-	-
UI-300	UI	300		AOP/OZONE/REACTOR SYSTEM	MI607 MI608	ETHERNET	-	-	-	-	-	-	-	-
HS-200	HS	200		B-200A/B SELECT	MI617	HMI	-	-	-	-	-	-	-	-
HI-200AA	HI	200A	A	CARBON CANISTER BLOWER B-200A IN AUTO	MI617	NET-IN	-	-	-	-	-	-	-	-
HI-200AB	HI	200A	B	CARBON CANISTER BLOWER B-200A IN HAND	MI617	NET-IN	-	-	-	-	-	-	-	-
HS-200A	HS	200A		B-200A AUTO/MANUAL SELECT	MI617	HMI	-	-	-	-	-	-	-	-
II-200A	II	200A		B-200A CURRENT INDICATION	MI617	NET-IN								-
YA-200A	YA	200A		B-200A FAULT INDICATION	MI617	NET-IN								-
YI-200A	YI	200A		B-200A RUN INDICATION	MI617	NET-IN	-	-	-	-	-	-	-	-
YC-200A	YC	200A		B-200A RUN COMMAND	MI617	NET-OUT	-	-	-	-	-	-	-	-
HI-200BA	HI	200B	A	CARBON CANISTER BLOWER B-200B IN AUTO	MI617	NET-IN	-	-	-	-	-	-	-	-
HI-200BB	HI	200B	B	CARBON CANISTER BLOWER B-200B IN HAND	MI617	NET-IN	-	-	-	-	-	-	-	-
HS-200B	HS	200B		B-200B AUTO/MANUAL SELECT	MI617	HMI	-	-	-	-	-	-	-	-
II-200B	II	200B		B-200B CURRENT INDICATION	MI617	NET-IN								-
YA-200B	YA	200B		B-200B FAULT INDICATION	MI617	NET-IN								-
YI-200B	YI	200B		B-200B RUN INDICATION	MI617	NET-IN	-	-	-	-	-	-	-	-
YC-200B	YC	200B		B-200B RUN COMMAND	MI617	NET-OUT	-	-	-	-	-	-	-	-
-				-	-	-	-	-	-	-	-	-	-	-

IOP-5 (RW-9) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
LI-9	LI	9		RECOVERY WELL 9 LEVEL	MI602	AI 4-20mA	R7	S0	CH0	5094-IF8IH	EI655	LALL	LCH (Pump ON) LCL (Pump OFF)	
FI-9	FI	9		RECOVERY WELL 9 FLOW	MI602	AI 4-20mA	R7	S0	CH1	5094-IF8IH	EI655	FAL		MAGMETER W/120VAC POWER
PI-9	PI	9		RECOVERY WELL 9 DISCHARGE PRESSURE	MI602	AI 4-20mA	R7	S0	CH2	5094-IF8IH	EI655	PAL, PAH		
-				SPARE	-	AI 4-20mA	R7	S0	CH3	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH4	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH5	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH6	5094-IF8IH	EI655			
-				SPARE	-	AI 4-20mA	R7	S0	CH7	5094-IF8IH	EI655			
YA-IOP5A	YA	IOP5	A	IOP-5 UPS ON BATTERY	MI620	DI 24vdc	R7	S1	CH0	5094-IB16	EI655			0 = ALARM
YA-IOP5B	YA	IOP5	B	IOP-5 UPS LOW BATTERY	MI620	DI 24vdc	R7	S1	CH1	5094-IB16	EI655			0 = ALARM
JI-IOP5	JI	IOP5		IOP-5 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R7	S1	CH2	5094-IB16	EI655			
LAH-VV9	LAH	VV9		VALVE VAULT 9 HIGH LEVEL	MI602	DI 24vdc	R7	S1	CH3	5094-IB16	EI655			0 = ALARM
-				SPARE	-	DI 24vdc	R7	S1	CH4	5094-IB16	EI655			
TA-9	TA	9		RW-9 DISCHARGE PIPING HEAT TRACE ALARM	MI602	DI 24vdc	R7	S1	CH5	5094-IB16	EI655			1 = ALARM
-				SPARE	-	DI 24vdc	R7	S1	CH6	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH7	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH8	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH9	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH10	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH11	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH12	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH13	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH14	5094-IB16	EI655			
-				SPARE	-	DI 24vdc	R7	S1	CH15	5094-IB16	EI655			
FQ-9	FQ	9		RECOVERY WELL 9 FLOW TOTALIZATION	MI602	HMI	-	-	-	-	-	-	-	CALCULATED
HI-9A	HI	9	A	RW-9 IN AUTO	MI602	NET-IN	-	-	-	-	-	-	-	-
HI-9B	HI	9	B	RW-9 IN HAND	MI602	NET-IN	-	-	-	-	-	-	-	-
II-9	II	9		RW-9 PUMP CURRENT INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SI-9	SI	9		RW-9 PUMP SPEED INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
SC-9	SC	9		RW-9 PUMP SPEED CONTROL	MI602	NET-OUT	-	-	-	-	-	-	-	-
HS-9	HS	9		RW-9 AUTO/MANUAL SELECT	MI602	HMI	-	-	-	-	-	-	-	-
YA-9	YA	9		RW-9 FAULT INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
YI-9	YI	9		RW-9 RUN INDICATION	MI602	NET-IN	-	-	-	-	-	-	-	-
YC-9	YC	9		RW-9 RUN COMMAND	MI602	NET-OUT	-	-	-	-	-	-	-	-

IOP-6 (RW-10A) IO List

PLC Tag	Loop Function	Loop #	Loop Suffix	Description	P&ID	Signal Level	Rack	Slot	Chan	I/O Module	I/O Dwg #	Alarms	Control	Notes
LI-10A	LI	10A		RECOVERY WELL 10A LEVEL	MI603	AI 4-20mA	R8	S0	CH0	5094-IF8IH	EI665	LALL	LCH (Pump ON) LCL (Pump OFF)	
FI-10A	FI	10A		RECOVERY WELL 10A FLOW	MI603	AI 4-20mA	R8	S0	CH1	5094-IF8IH	EI665	FAL		MAGMETER W/120VAC POWER
PI-10A	PI	10A		RECOVERY WELL 10A DISCHARGE PRESSURE	MI603	AI 4-20mA	R8	S0	CH2	5094-IF8IH	EI665	PAL, PAH		
-				SPARE	-	AI 4-20mA	R8	S0	CH3	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH4	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH5	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH6	5094-IF8IH	EI665			
-				SPARE	-	AI 4-20mA	R8	S0	CH7	5094-IF8IH	EI665			
YA-IOP6A	YA	IOP6	A	IOP-6 UPS ON BATTERY	MI620	DI 24vdc	R8	S1	CH0	5094-IB16	EI665			0 = ALARM
YA-IOP6B	YA	IOP6	B	IOP-6 UPS LOW BATTERY	MI620	DI 24vdc	R8	S1	CH1	5094-IB16	EI665			0 = ALARM
JI-IOP6	JI	IOP6		IOP-6 PANEL POWER SUPPLY OK	MI620	DI 24vdc	R8	S1	CH2	5094-IB16	EI665			
LAH-VV10A	LAH	VV10A		VALVE VAULT 10A HIGH LEVEL	MI603	DI 24vdc	R8	S1	CH3	5094-IB16	EI665			0 = ALARM
-				SPARE	-	DI 24vdc	R8	S1	CH4	5094-IB16	EI665			
TA-10A	TA	10A		RW-10A DISCHARGE PIPING HEAT TRACE ALARM	MI603	DI 24vdc	R8	S1	CH5	5094-IB16	EI665			1 = ALARM
-				SPARE	-	DI 24vdc	R8	S1	CH6	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH7	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH8	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH9	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH10	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH11	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH12	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH13	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH14	5094-IB16	EI665			
-				SPARE	-	DI 24vdc	R8	S1	CH15	5094-IB16	EI665			
FQ-10A	FQ	10A		RECOVERY WELL 10A FLOW TOTALIZATION	MI603	HMI	-	-	-	-	-	-	-	CALCULATED
HI-10AA	HI	10A	A	RW-10A IN AUTO	MI603	NET-IN	-	-	-	-	-	-	-	
HI-10AB	HI	10A	B	RW-10A IN HAND	MI603	NET-IN	-	-	-	-	-	-	-	
II-10A	II	10A		RW-10A PUMP CURRENT INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
SI-10A	SI	10A		RW-10A PUMP SPEED INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
SC-10A	SC	10A		RW-10A PUMP SPEED CONTROL	MI603	NET-OUT	-	-	-	-	-	-	-	
HS-10A	HS	10A		RW-10A AUTO/MANUAL SELECT	MI603	HMI	-	-	-	-	-	-	-	
YA-10A	YA	10A		RW-10A FAULT INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
YI-10A	YI	10A		RW-10A RUN INDICATION	MI603	NET-IN	-	-	-	-	-	-	-	
YC-10A	YC	10A		RW-10A RUN COMMAND	MI603	NET-OUT	-	-	-	-	-	-	-	

SECTION 41 10 02

PROCESS PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials, equipment and incidentals required to install all Process Piping and Appurtenances as shown on the drawings and specified herein. This specification covers the requirements for above and below grade groundwater and process water pipe, pipe supports, valves, fittings, and accessories only. For other civil, mechanical and plumbing related piping specifications Contractor shall refer to other piping specifications. The Contractor shall procure, install, support and test all process piping shown on the Contract Drawings and described in these specifications.

1.1.2 All the process water piping as shown on drawings shall be PVC, except small bore piping (1” and below) for connecting to pressure gauges, instruments, sample ports, pipe drains, and pipe vents, which shall be as shown on drawings.

1.1.3 Piping shall include:

1.1.3.1 Water process piping from extraction vault and manholes to GWTP shall be PVC and HDPE piping as shown on contract drawings. HDPE piping shall be PE4710 SDR 11.

1.1.3.2 Water process piping from recovery well pumps to casing shall be stainless steel and piping inside extraction vaults shall be Schedule 80 PVC as shown on contract drawings.

1.1.3.3 Water process piping inside manholes shall be Schedule 80 PVC as shown on contract drawings.

1.2 RELATED SECTIONS

1.2.1 Sections Include:

1.2.1.1 Section 01 33 00 Submittals Procedures
1.2.1.2 Section 22 11 13 Facility Water Distribution Piping
1.2.1.3 Section 22 13 16 Sanitary Waste and Vent Piping
1.2.1.4 Section 22 42 13 Plumbing Fixtures
1.2.1.5 Section 31 00 00 Excavation, Backfill & Compaction
1.2.1.6 Section 46 30 00 Water and Wastewater Chemical Feed Systems

1.3 REFERENCES

1.3.1 The publications listed below form a part of this specification to the extent referenced.

1.3.1.1 American Society of Mechanical Engineers International (ASME)

1.3.1.1.1 B1.1: Unified Inch Screw Threads (UN and UNR Thread Form)
1.3.1.1.2 B1.20.1: Pipe Threads, General Purpose (Inch)
1.3.1.1.3 B1.20.7: Standard for Hose Coupling Screw Threads (Inch)
1.3.1.1.4 B16.11: Forged Fittings, Socket-Welding and Threaded
1.3.1.1.5 B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
1.3.1.1.6 B16.3: Malleable Iron Threaded Fittings, Classes 150 and 300
1.3.1.1.7 B16.39: Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
1.3.1.1.8 B16.5: Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
1.3.1.1.9 B16.9: Standard for Factory-Made Wrought Steel Butt-welding Fittings
1.3.1.1.10 B18.2.1: Square and Hex Bolts and Screws (Inch Series)
1.3.1.1.11 B18.2.2: Standard for Square and Hex Nuts
1.3.1.1.12 B31.3: Process Piping
1.3.1.1.13 B36.19M: Stainless Steel Pipe
1.3.1.1.14 BPVC SEC VIII D1: BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

1.3.1.2 American Society for Testing and Materials (ASTM)

1.3.1.2.1 A181/A181M: Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
1.3.1.2.2 D1784: Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds
1.3.1.2.3 D1785: Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
1.3.1.2.4 D2104: Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40
1.3.1.2.5 D2105: Standard Test for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube
1.3.1.2.6 D2122: Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
1.3.1.2.7 D 2241: Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
1.3.1.2.8 D2412: Standard Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
1.3.1.2.9 D2447: Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
1.3.1.2.10 D2464: Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
1.3.1.2.11 D2466: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
1.3.1.2.12 D2467: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
1.3.1.2.13 D2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
1.3.1.2.14 D2609: Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
1.3.1.2.15 D2737: Polyethylene (PE) Plastic Tubing ASTM D2774 (2012) Underground Installation of Thermoplastic Pressure Piping
1.3.1.2.16 D2855: Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

1.3.1.2.17 F2164: Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
1.3.1.2.18 F2620: Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
1.3.1.2.19 D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
1.3.1.2.20 F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
1.3.1.2.21 F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
1.3.1.2.22 F656: Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
1.3.1.2.23 F714: Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

1.3.1.3 American Welding Society (AWS):

1.3.1.3.1 B3.0: Welding Procedure and Performance Qualification
1.3.1.3.2 A5.11/A5.11M: Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding
1.3.1.3.3 A5.14/A5.14M: Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods
1.3.1.3.4 D1.1/D1.1M: Structural Welding Code – Steel

1.3.1.4 American Water Works Association (AWWA)

1.3.1.4.1 C901: Polyethylene (PE) Pressure Pipe, Tubing and Fittings, 1/2" through 3" for Water
1.3.1.4.2 C906: Polyethylene (PE) Pressure Pipe and Fittings, 4" through 63", For Water Distribution

1.3.1.5 Manufacturers Standardization Society (MSS)

1.3.1.5.1 SP-25: Standard Marking System for Valves, Fittings, Flanges and Unions
1.3.1.5.2 SP-58: Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
1.3.1.5.3 SP-69: Standard for Pipe Hangers and Supports - Selection and Application
1.3.1.5.4 SP-80: Bronze Gate, Globe, Angle, and Check Valves
1.3.1.5.5 SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices

1.3.1.6 Plastics Pipe Institute (PPI)

1.3.1.6.1 TR-21: Thermal Expansion and Contraction in Plastic Piping Systems

1.3.1.7 Rubber Manufacturers Association (RMA)

1.3.1.7.1 IP-2: Hose Handbook

1.4 SUBMITTALS

1.4.1 The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:

1.4.1.1 Shop Drawings: Shop drawings and support system detail drawings showing piping and appurtenances including mechanical joints, valves, hangers, and pipe supports. Include a complete list of equipment and materials on the drawings.

1.4.1.2 Product Data: Manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings and chemical resistance.

1.4.1.3 Material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) for each chemical (solvents, solvent cements, and glues) delivered for use in pipe installation.

1.4.1.4 Pipe Schedule: Provide a list of piping systems, pressure ratings and source of supply for each piping system broken out by material, size and application as indicated on the Contract Drawings. Provide a list of any special tools necessary for each piping system and appurtenance furnished for adjustment, operation, maintenance and disassembly of the system.

1.4.1.5 Valve and Valve Operator Schedule: Provide a list of valve materials, pressure ratings, and valve operator materials and reference identification as indicated in the Contract Drawings. Provide a list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly.

1.4.1.6 Test Reports: Submit Pipe Leakage Tests, Hydrostatic Tests, Valve Testing; copies of all field test reports including Pipe Leakage Tests and Hydrostatic Tests.

1.4.1.7 As-built drawings: Show pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. Submit as-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices. The P&IDs found in the Contract Drawings shall be revised by the Contractor to reflect the constructed process system.

1.4.1.8 Instruction Manuals: Submit sufficient detail in the Operation Manuals to demonstrate the step-by-step procedures required for startup, operation and shutdown of piping systems, and include the manufacturer's name, model number, parts list and brief description of piping components such as valves, fittings, and other appurtenances and their basic operating features. List in the Maintenance Manuals routine maintenance procedures and troubleshooting guides for the piping system and include piping layout and valve locations.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation

is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892. No piping shall be stored directly on bare ground. Valves and fittings shall be stored in their shipping crates or boxes until time of installation and be protected from the weather at all times.

1.6 BUILDING PIPING SYSTEMS

1.6.1 Buried piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure. Consideration shall be given to all operating and service conditions including forces both internal and external to the piping systems.

1.7 ABOVE GRADE PIPING SYSTEMS (WITHIN GWTP)

1.7.1 Above ground piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions including forces both internal and external to the piping systems.

1.8 SEQUENCING AND SCHEDULING

1.8.1 For slab, floor, wall, and roof penetrations, keep on site pertinent wall pipes and sleeves before they are required for placement in concrete forms. Verify and coordinate the size and location of building pipe penetrations before forming and placing concrete.

1.9 MAINTENANCE

1.9.1 Service

1.9.1.1A manufacturer’s representative who is experienced in the installation, adjustment and operation of the valves specified shall provide inspection services for automatic valve systems. The representative shall inspect the installation, and supervise the adjustment and testing of the valves.

1.9.2 Extra Materials

1.9.2.1 Contractor shall provide the manufacturer's recommended spare parts that are expected to be replaced within the first 3 years of service of the piping system.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Provide piping materials and appurtenances as specified and as shown on the Drawings. Piping materials, valves, and appurtenances supplied as part of this contract shall be of equal material and ratings as the connecting pipe, new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems shall be in accordance with the Contract Drawings. Pipe fittings shall be compatible with the applicable pipe materials.

2.1.2 Piping systems shall be rated for at least 1.5 times the deadhead pressure of the pump feeding the piping.

2.1.3 Standard Products: Provide material which are the standard products of a manufacturer regularly engaged in the manufacturing of the products and that essentially duplicate items that have been in satisfactory use for at least 10 years prior to bid opening. Nominal sizes for standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is within 50 miles of the site.

2.1.4 Identification and Tagging: Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. The service, valve identification number shown on the Contract Drawings, the manufacturer's name, and the valve model number shall be displayed. Valves shall be marked in accordance with MSS SP-25 and shall bear an identification tag securely attached using plastic straps designed for that purpose. Identification tags shall be 1.375-inch minimum diameter, made of engraved laminated plastic. Major process piping shall be labeled with the fluid service name and flow direction arrow (for example, Raw Groundwater, Treated Water, etc.). Letters for labeling pipes shall be easily readable from 10 feet away and shall be no smaller in height than 1 inch for pipes less than 2 inches in diameter and no smaller in height than 2 inches for all other size piping.

2.1.5 Pipe Supports: Pipe shall be provided with supports spaced not farther than the manufacturer's recommended spacing for 70°F service. For PVC pipe 2" or smaller, supports shall be every 5' or less; for 3" pipe every 6'; for 4" pipe every 8', and for pipe, 6" and larger supports shall be every 10' or less. Provide pipe flanges of the same material as shown on the drawings so as to be able to dismantle sections of PVC pipe for maintenance. Piping shall be pitched to

drain. Carbon steel pipe for air lines shall be supported every 7-ft maximum.

2.1.6 The Contractor shall provide slip-type PVC expansion joints with joint material as recommended by the manufacturer for the type of service. Joints shall be installed not more than 100 feet apart only on all straight runs of pipe that exceed 100 feet.

2.2 PLASTIC, DUCTILE IRON, AND CARBON STEEL PIPING AND FITTING FOR WATER PROCESS SERVICE

2.2.1 PVC Pipe: PVC pipe shall be Schedule 80, seamless, unplasticized polyvinyl chloride normal impact type, conforming to ASTM D-1784, Class 12454-B and D-1785, PVC 1120, for Type I, Grade 1. PVC pipe system shall be as manufactured by CertainTeed Corp, JM Eagle, North American Pipe, Harvel Pipe, or approved equal.

2.2.2 PVC Joints: The piping system shall be joined by flanged or mechanical connections except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly. Connections at those points shall be threaded.

2.2.3 PVC Fittings: The schedule rating for the fittings shall not be less than that for the associated pipe. All pipe and fittings shall conform to ASTM D2467 and joints shall be solvent socket welded where threaded or flanged fittings are not used.

2.2.4 Flanged Fittings: Flanges shall be used at all valves, pumps, equipment, tanks, and vessels. Flanges will be of the same material as the piping. Flanges shall be the Van-Stone type complete with gaskets, bolts, and nuts. Flanges will be flat face to match the flanges of the valves, pumps, equipment and vessels. Flanges will be drilled to ANSI B16.1, class 150 conforming to ASTM A182 and ANSI B16.5. Gaskets for flanged joints shall be Viton. Flange bolts shall be of the number and size in accordance with ANSI B16.1. All bolts, nuts and washers shall be Type 316 stainless steel.

2.2.5 PVC Solvent Cement: Joints shall be assembled using approved solvent cement in accordance with the manufacturer’s recommendations and ASTM D2564 and ASTM D2855. No cementing shall be done in the rain or when the air temperature is below 40°F or above 90°F.

2.2.6 The Contractor is cautioned to exercise care in handling, loading, unloading, and storing plastic pipe, valves, and fittings. All plastic pipe, valves, and fittings shall be stored under cover before using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged shall be discarded.

2.2.7 All PVC piping, fittings, and valves shall not be painted.

2.2.8 Ductile Iron Pipe for pump discharge: Ductile iron piping shall meet requirements of ANSI/AWWA C151/A21.51 and ANSI/AWWA C150/A21.50. The pipes shall be flanged of Pressure Class 350 with nominal pipe

thickness of 0.25 inches. Ductile iron pipe system shall be as manufactured by US Pipe, American Ductile Iron Pipe, or approved equal.

2.2.9 Condensate Pipe: Piping for condensate shall be 316L stainless steel pipe meeting ASTM A312/AS312M standards.

2.2.10 Carbon Steel Pipe for recovery well and extraction vaults: Carbon steel piping shall meet requirements of A252 Grade and A500 Grade Carbon Steel pipe, ASTM A181/A181M for forged fittings, general process piping application and ASTM/ASME A106/SA106. The pipe and fittings shall be suitable for meeting the design and test pressure. The pipe shall be flanged and Schedule 80. The minimum wall thickness at any point shall not be more than 12.5% under the nominal wall thickness. The pipe shall meet all the tensile, bending and flattening test requirements per standards based on NPS. The pipe grade and wall thickness shall be suitable for process pipe application. Carbon steel pipe shall be manufactured by Federal Steel Supply LLC, American Piping Products, Saginaw Pipe Co, Inc. or approved equal.

2.3 PLASTIC PIPING AND FITTINGS FOR TANK VENTS

2.3.1 Plastic vent piping shall be Schedule 40 PVC pipe, seamless, unplasticized polyvinyl chloride normal impact type, conforming to ASTM D-1784, Class 12454-B and D-1785, PVC 1120, for Type I, Grade 1. PVC vent pipe system shall be as manufactured by CertainTeed Corp., JM Eagle, North American Pipe, Harvel Pipe, or approved equal.

2.3.2 Vent piping shall be 8-inch diameter unless shown otherwise on the drawings. Standards: ASTM D 2665 and NSF approved for DWV; ASTM D 3034 for SDR.

2.3.3 Fittings: PVC material, solvent weld, Type 1, ASTM D 2466 for Schedule 40, and ASTM 2665 for DWV; ASTM D 3212 for SDR.

2.3.4 Joint material: Use solvent cement in accordance with industry standards and manufacturer's recommendations.

2.3.5 All vent pipe discharging outside shall have a rain guard and bird screen that is compatible.

2.4 VALVES AND SPECIALTIES (PVC PROCESS SERVICE)

2.4.1 General. The Contractor shall furnish and install all valves and specialties as specified herein and shown on the Drawings. In addition, valve-operator and other accessories shall be furnished and installed by the Contractor where specified for various system packages. All valves shall be new and of current manufacture. All valves, specialties, etc. shall be installed with sufficient unions and/or flange joints to permit replacement without the need to cut the pipes. Valves and fittings 2 inch and smaller shall have union joints. The valves shall be suitable for the intended service. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with the adjacent piping system. An operator shall be sized to operate the

associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Operators, actuators, and accessories shall be factory mounted. Check Valves. Check valves larger than 2 inches for liquid service shall be Schedule 80 PVC, wafer-type with spring-loaded flappers manufactured by Hayward, Asahi-America, George Fisher, or approved equal. Check valves shall be capable of operating in either the horizontal or the vertical position.

2.4.2 Check valves 2 inches and smaller for liquid service shall be Schedule 80 double-union ball check as manufactured by Nibco, Hayward, Chemline, or approved equal. Check valves shall be capable of operating in either the horizontal or the vertical position.

2.4.3 Ball Valves (General Purpose). Ball valves upto 4 inch, shall be Schedule 80 PVC double-union ball valves with handle as manufactured by Nibco, Hayward, Chemline, or approved equal.

2.4.3.1 All sampling valves and drain a valves shall be 316 SS, provided with a spring return handle with a locking device similar to manufactured J Flow Controls LLC or equal.

2.4.4 Butterfly Valves. Butterfly valves, 3 inch and larger, shall be Schedule 80 PVC with lugs for flanged service. Butterfly valves shall have hand wheel or chain wheel operators. Butterfly valves shall be as manufactured by Nibco, Hayward, Chemline, or approved equal. Where shown on drawings, provide electric actuated valves.

2.4.5 Pressure/Vacuum Relief Valve: Two pressure/vacuum pressure/vacuum breather valves shall be provided (one of which will be a backup). The valves shall be of stainless steel construction and shall be rated for atmospheric pressure (14.7 psi) and zero vacuum.

2.4.6 Air/Vacuum release valves(vent valves)

2.4.6.1 Air/Vacuum release valves up to 3 inches, shall be combination air/vacuum release automatic PVC valves and provided as shown on the drawings. The valves shall have flanged ends and manufactured by Nibco, Hayward, Chemline or approved equal. The valves shall have full port liquid capacities and high discharge capacities. The valves shall have excellent corrosion resistance material. The seal material of the valves shall be EPDM or Viton. The valves shall be rated for the maximum operating and test pressures of the system.

2.4.7 Solenoid Valves

Solenoid valves shall be ASCO General Service Solenoid Valves with brass bodies and manufactured by Emerson or Approved Equal. Provide and install solenoid valves where shown on drawings.

Valve Actuation: Solenoid
Body Material: Brass
Seals and Discs: PTFE
Core Tube: 305 Stainless Steel
Core and Plugnut: 430F Stainless Steel

Spring: 302 Stainless Steel
Shading Coil: Copper
Media: Air, Inert Gas, Water, Light Oil
Pipe Size: 2”
Orifice Size: 1 ¾”
Port Type: NPTF
Function: 2 way-2/2 Normally Closed
Flow: 43 Cv
Voltage: 24 AC, 110AC, 115 AC, 12 DC, 12 to 24 DC
Voltage Ranging, 120 AC, 120 DC
Max Differential / Max Operating Pressure: Up to 150 psi
Operating Environment: Indoor, Outdoor
UL listed and CSA certified

2.6.7 Electric Actuators

Electric Actuators: Series 70 manufactured by Bray International Inc. or approved equal
Motor Service: 120 VAC, 1 phase, 60 Hz
Enclosure: Designed to meet NEMA Type 4X and IP65 specification
Certification: UL, CSA and CE approved
Torque output range: For 6” to 12” Butterfly valves from 1200 lb-in to 5000 lb-in with a safety factor of 1.3
OPEN/CLOSED limit switches
Manual Override: The actuator shall be equipped with a manual override handwheel to rotate the valve without electrical power. The manual override system shall ensure efficient manual operation without the use of extra tools or levers. A motor power cutout switch shall be provided to cut power to the motor when the actuator manual override is engaged.

2.5 DRAINS AND VENT VALVES

2.5.1 All drain and vent valves may not be shown on the detailed drawings for individual pipelines; their absence will not relieve the Contractor of the responsibility for providing and installing them to complete the piping system for the use intended. Drain valve material shall match adjacent pipe.

2.5.1.1 Locations

2.5.1.1.1 All pipeline shall have a drain valve at low point.
2.5.1.1.2 All pressured pipeline shall have a vent valve at high point.

2.5.1.2 Sizes

2.5.1.2.1 For pipelines 2.5 inch and larger, drains shall be 0.75 inch and equipped with ball valves. For pipelines 2 inch and smaller, drains shall be 1/2 inch and equipped with ball valves.

2.6 SAMPLE PORTS

2.6.1 Sample ports, shown on the piping and instrument diagrams of the Contract Drawings, may not be shown on the detailed drawings of the individual pipelines; their absence shall not relieve the Contractor of the responsibility for providing them. Sample ports shall be provided as indicated in the piping and instrument diagrams to complete the piping systems for the use intended. The sample ports shall be located in easily accessible locations, no higher than five feet off the floor, and shall avoid potential stagnant points and/or areas where material could collect. Sample ports shall be ½" 316L SS ball valves with threaded ends and a PVC threaded barb.

2.7 STRAINERS

2.7.1 Strainers for recovery well and process piping service shall be Basket Strainers-Type, constructed of PVC Body and Basket material (Cell Class 12454 per ASTM D1784) of size specified in table below with flanged end connections. Basket strainers shall have a pressure rating of 150 psi at 70F temperature.

2.7.2 PVC strainers shall be located as per drawings and the following schedule. Strainers shall be Strainers shall be 6" and 8" SB Series Simplex Model as manufactured by Hayward Industrial Products or approved equal. Cast iron strainer shall be located as per drawings and the following schedule. Strainer shall be 12" Simplex Basket strainer 125# flange style. GFV cast iron as manufactured by Keckley or approved equal.

2.7.3 Strainer Schedule

Line #	Line Description	Flow (max); gpm	Location	No. of strainers	Strainer Size	Working Pressure (psi)	Connection	Material of Construction	Seal	Filter Basket Material of Construction	Mesh Size
GW-PVC-6"	GW from recovery wells	600	Valve Vaults	3	6-in	65	Flanged	PVC	EPDM O-ring seal	PVC	80 (5/32”)
GW-PVC-12"	MMF Feed pump suction	1800	EQ tank pump suction pipe	1	12-in	65	Flanged	PVC	EPDM O-ring seal	PVC	80 (5/32”)
BWW-PVC-8”	Dirty backwash water	550	MMF-back-wash dis-charge	1	8-in	30	Flanged	PVC	EPDM O-ring seal	PVC	325 (3/8”)
BWW-PVC-8”	Dirty backwash water	950	LGAC-back-wash dis-charge	1	8-in	30	Flanged	PVC	EPDM O-ring seal	PVC	325 (3/8”)

2.8 MISCELLANEOUS PIPING COMPONENTS

2.8.1 Air Release Valves

2.8.1.1 Air release vents shall be located, and vented, such that a hazardous atmosphere will not be created upon operation. Air release shall be located as indicated on the Contract Drawings and at all high points.

2.8.2 Expansion Joints

2.8.2.1 Provide all structural work and equipment required to control expansion and contraction of piping. Verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems. Provide rubber expansion joints for piping at connections to equipment as shown on the drawings. The expansion joints shall be flanged with a maximum working pressure range of 100 - 165 psi. The joints shall provide an axial movement from 1/2 to 3/4 inches, axial extension of 1/4 inches and transverse deflection of upto 1/2 inch. The materials shall meet requirements of ANSI/ASTM D1418-77 and the Elastomer type shall be EPDM or AFMU Elastomer (PTFE/TFE/FEP) with temperature rating

of greater than 250^{0}F. The expansion joints shall be manufactured by UIP International or approved equal.

2.8.3 Pipe Insulation Material

2.8.3.1 All exposed process piping shall have foam insulation and PVC jacketing as shown on the Drawings. Insulation shall be per Section 22 09 19.

2.8.4 Static Mixers and Injection Quill

2.8.4.1 All static mixers and injection quill shall be manufactured by Koflo Corporation or Approved equal.

The two (2) static mixers SM-200 and SM-300 as shown on drawings shall be:
12-80-4-3-9.I(.50)
12" Koflo Static Mixer
12" Schedule 80 (0.688" Wall) PVC Housing
Three (3) Fixed PVC Mixing Elements
12" PVC Class 150 Van-Stone Style Socket Flanged Ends
One (1) 0.5" PVC NPT Female Threaded Injection Port
Lifting Lug
Length: 60"
Net Weight: ~128.8 lb
Model Type: KD-1026
Pressure Loss: 4.46 psi @ 1,800 GPM

The injection quill for the above two (2) static mixers shall be:
QR-.5P-.5PV-7
PVC Retractable Injection Quill
PVC Ball Valve
0.5" Male NPT Process Connection
0.5" Female NPT Inlet Connection
7" Insertion Length with 45° Beveled Tip
Integrated check valve with Viton seal, corrosion-resistant Hastelloy® C-276 spring, ceramic ball, and 5 PSI cracking pressure

2.8.5 Equalization Tank Mixer

The equalization tank mixer shall be side mounted as shown on drawings and manufactured by Dynamix Agitators (Dynamix Model SMX1-5-3 (Premium), SPX Flow, or Approved equal).

This tank mixer shall meet the following requirements:

Drive: 3.0 HP 3/60/230-460V TEFC Severe Duty
Reducer Helical Gear 365 rpm
SF 1.5, Synthetic Lubricant

Mount: Pedestal Mount with 6in flange connection, Single Cartridge Mechanical Seal & Shut-off Valve.

Shaft: 1.5” Dia x 24” Length (316SS)

Bottom Impeller: 14.5” P3B Impeller / 3-Blades Welded with Keyed Hub (316SS)

Torque: 389 [lb inch]

Mixing cycle and class: Blending in Batch.

Min Level: Mixer must not be running when the liquid level is below 5ft.

Mixer mounting (inclination angle, angle facing away from the center & mounting height) shall be field determined. Mixer shall be provided with Pedestal, Mechanical seal and Shut-off valve for ease of maintenance and removing the drive without the need for draining the tank. Mixer shall be capable of being installed through the tank manway.

2.9 PIPE SUPPORTS AND PENETRATIONS

2.9.1 Provide auxiliary steel where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor has the option to use pre-engineered support systems of electrogalvanized steel products from one manufacturer such as Cooper B-line or approved equal. Where auxiliary steel is indicated as stainless steel, provide TP304 stainless steel conforming to ASTM A 167, No. 1 Finish.

2.9.1.1 Pipe Supports

2.9.1.1.1 Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69, and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material (or dielectric separation) so that neither shall have a deteriorating action on the other. Refer to the Drawings for pipe support details. The absence of pipe supports and details on the drawings does not relieve the Contractor of the responsibility for sizing and providing adequate supports throughout the facility.

2.9.1.1.1.1 Beam Clamps

2.9.1.1.1.1.1 For upper attachments on structural steel, provide beam clamps of stainless steel and MSS SP-58 Types 19 through 23, 25 or 27 through 30. Holes drilled in structural steel for hanger support rods shall not be permitted. Clamps shall be provided with hardened steel cup-point set screws and lock-nuts for anchoring in place. Clamp size selection shall only be based on the support of the required load.

2.9.1.1.1.2 Riser Clamps

2.9.1.1.1.2.1 Vertical runs of piping shall be supported on the floor, or closer where required, with stainless steel clamps bolted around pipes and attached to the building construction. Two bolt-type clamps designed for installation under insulation shall be used on insulated pipe runs.

2.9.1.1.1.3 Brackets

2.9.1.1.1.3.1 Where piping is run adjacent to walls or steel columns, provide welded stainless steel brackets, pre-punched with a minimum of two fastener holes.

2.9.1.1.1.4 Offset Pipe Clamp

2.9.1.1.1.4.1 Where pipes are indicated as offset from wall surfaces, supply a double-leg design two-piece stainless steel pipe clamp.

2.9.1.1.1.5 Racks

2.9.1.1.1.5.1 Multiple pipe racks or trapeze hangers shall be fabricated from stainless steel, and designed to suit the conditions at the points of installation. Pipes shall be kept in their relative positions to each other by the use of clamps or clips. Pipelines subject to thermal expansion must be free to slide or roll.

2.9.1.1.1.6 Hangers

2.9.1.1.1.6.1 Hangers shall be fabricated of stainless steel. All hangers shall be of a uniform type and material for a given pipe run and application. Coated or plated hangers shall be used to isolate steel hangers from dissimilar metal tube or pipe. Hangers for pipe sizes 2.5 inches or larger shall incorporate a means of vertical adjustment after erection while supporting the load.

2.9.1.1.1.7 Hanger Rods

2.9.1.1.1.7.1 Hanger rods shall be stainless steel. The diameter of the rods for the piping system support shall conform to ASME B31.1.

2.9.2 Wall Penetrations

2.9.2.1 Above Grade Wall Penetrations

2.9.2.1.1 Plastic pipe penetrations shall be fitted with galvanized steel collars that have intumescent inlays.

2.9.2.2 Below-Grade Wall Penetrations

2.9.2.2.1 Below-grade wall penetrations shall be provided with seals manufactured by Link Seal or approved equal. The locations where this will be used are:

2.9.2.2.1.1 Groundwater conveyance pipe entering the building.
2.9.2.2.1.2 Potable water line entering the building.
2.9.2.2.1.3 Electrical and instrumentation lines entering the building.

2.9.2.3 Galvanizing

2.9.2.3.1 Galvanizing shall be hot-dip applied and meet the requirements of ASTM A 153/A 153M. Stainless steel components may be substituted where galvanizing is specified.

PART 3 - EXECUTION

3.1 EXAMINATION

3.1.1 After becoming familiar with all details of the work, verify all dimensions in the field, and advise Owner’s Representative of any discrepancy before performing the work.

3.2 PREPARATION

3.2.1 Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. Pipe and fittings shall be inspected before piping is installed. Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.3 EXPOSED PIPING INSULATION

3.3.1 Exposed piping shall be run as straight as practical along the alignment shown on the Contract Drawings and with a minimum number of joints. Piping and appurtenances shall be installed in conformance with approved shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

3.3.1.1 FIELD Piping Flexibility Provisions

3.3.1.1.1 Thrust protection shall be provided as required. Additional pipe anchors and flexible couplings beyond those shown on the Contract Drawings shall be provided to facilitate piping installation, in accordance with approved shop drawings.

3.3.1.2 Couplings, Adapters and Service Saddles

3.3.1.2.1 Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

3.3.1.3 Piping Equipment/Component Installation

3.3.1.3.1 Piping components and instrumentation shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable and serviceable installation. The upstream and downstream lengths of undisturbed piping shall be in accordance with the flow element manufacturer's recommendations and at a minimum shall be at least 5 pipe diameters of straight run pipe upstream and at least 2 pipe diameters of straight run pipe downstream of the edge of the flow tube.

3.3.1.3.2 Local Instrumentation: All direct-reading instrumentation and pressure gauges shall be installed so that they can be easily read from floor level, and are readily accessible for maintenance and service. Pressure gauges shall be installed where indicated on the Contract Drawings. Differential pressure gauges shall be installed across the process equipment indicated on the Contract Drawings, in accordance with the manufacturer's recommendations, and arranged for easy observation at eye level.

3.3.1.4 Pipe Flanges

3.3.1.4.1 Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

3.3.1.5 Valve Locations

3.3.1.5.1 Valves shall be located in accordance with the Contract Drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences. Valves shall be installed so that they can be fully opened and closed without interferences.

3.3.1.6 PVC Pipe Installation

3.3.1.6.1 All PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Solvent-cemented joints shall be constructed in accordance with ASTM D 2855. Pipe shall not be laid in the rain and when the air temperature is below 40 deg F. All PVC piping installed above grade shall be ultraviolet (UV) resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during installation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cement. Provide and install supports and hangers in accordance with the manufacturer's recommendations. All non-gravity lines shall be hydrostatically tested to at least 1.5 times the upstream pump dead head pressure.

3.4 CONNECTING DISSIMLAR PIPE

3.4.1 Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.5 VALVE INSTALLATION

3.5.1 Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

3.5.1.1 Valve Orientation

3.5.1.1.1 The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on Contract Drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on the Contract Drawings. Automatic valves shall be installed in accordance with the manufacturer's instructions. Chain wheels and chains shall be provided if valves are located five feet above the floor.

3.6 PIPING SUPPORT SYSTEMS INSTALLATION

3.6.1 The absence of pipe supports and details on the Contract Drawings shall not relieve the Contractor of the responsibility for sizing and providing adequate supports throughout the plant.

3.6.1.1 General Support Requirements

3.6.1.1.1 Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes, equipment, or tanks. Pipes shall be supported by engineered supports independent of equipment and tanks. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the Contract Drawings. Pipe supports and hangers shall not be installed in equipment access areas. Hanging pipes shall be braced against horizontal movement by both longitudinal and lateral sway bracing. Installed support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration. All piping shall be supported by engineered supports and not by equipment or tanks.

3.6.1.2 Support Methods

3.6.1.3 Piping support and spacing shall be provided as specified and as shown in the Contract Drawings, in addition to supplemental support as needed in the field. Adjustable swivel-ring hangers shall support single horizontal suspended piping. Trapeze hangers shall support multiple horizontal suspended piping with channel type supports. Horizontal pedestal mounted piping shall have saddle type supports. Horizontal wall mounted piping shall have wall brackets. Vertical piping shall be supported by wall brackets, base elbows, or riser clamps on floor penetrations. All metal supports shall be stainless steel and all nuts, bolts and fasteners shall be 316 SS. Refer to the Drawings for pipe support details.

3.6.1.4 Pipe support locations shown on the drawings are the minimum requirements and does not relieve the Contractor from providing adequate support and meeting the intent of this specification.

3.7 FIELD QUALITY CONTROL

3.7.1 Exposed Piping

3.7.1.1 Hydrostatic testing shall be conducted in accordance with ASME B31.3. Piping systems shall be tested under normal service conditions to demonstrate compliance. Potable water shall be used as the hydrostatic test fluid. Provide clean test water of such quality to prevent corrosion of the piping system materials. Air release vents shall be opened at all high points of the piping system in order to purge air pockets while the piping system is filling. Contractor shall provide all test water and testing equipment.

3.7.1.2 Tests for above ground pressure piping shall be conducted after the piping has been completely installed, including all supports, hangers, and anchors, and inspected for proper installation but prior to installation of insulation.

3.7.1.3 Drain lines shall not be pressure tested.

3.7.2 Pipe Leakage Tests

3.7.2.1 Should leakage be observed during testing, the leaks should be located and repaired at no cost to the Owner.

3.7.3 Leak Testing Air Lines

3.7.3.1 Following installation of the air piping , the piping shall be checked for leaks at joints. At the design air flow rate the system shall be tested at a pressure of 5 psi. , The test pressure shall be applied within the pipe and soap water shall be applied to pipe joints. Any bubbling of the soapy water will indicate pipe leaks. All leaks shall be fixed by the Contractor at no cost to the Owner.

3.7.4 Leak Testing Vent Piping

3.7.4.1 PVC piping for tank atmospheric vents shall not be pressure tested.

3.7.5 Valve Testing

3.7.5.1 Valves may be tested while testing pipelines. It shall be demonstrated to the Owner's Representative that valves open and close smoothly and fully under operating pressure.

3.8 FINAL CLEANING

3.8.1 Following assembly and testing, and prior to final acceptance, liquid piping systems shall be flushed with water to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. Provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water. The minimum flushing velocity shall be 2.5 fps. Accumulated debris shall be removed through drains, or by removing spools or valves. Provide potable water for pipe flushing and cleaning.

3.8.2 Blow out all compressed air and vent vapor lines prior to connecting to equipment. Remove metal and plastic debris and other foreign matter from air and vapor lines before making final connections.

3.9 WASTE WATER DISPOSAL

3.9.1 All water generated during the flushing, and pressure testing of pipes shall be collected, stored temporarily onsite, tested, and disposed off-site in accordance with all Local, State, and Federal regulations and at a facility that appears on the Owner's list of approved disposal facilities.

END OF SECTION

SECTION 43 11 00.10

OFF-GAS FANS, BLOWERS AND PUMPS
05/20

PART 1 GENERAL

1.1 SCOPE OF WORK

The contractor shall provide two (2) blowers for the Carbon Cannister Vessel. The manufacturer shall provide materials and equipment which are as specified in this specification, as shown on the design drawings, and are suitable for the service intended. The manufacturer shall provide materials and equipment which are new and unused, except for tests.

Furnish all design, engineering, materials, equipment and incidentals required to supply complete and ready for operation the blower specified herein.

The blower shall include, but not be limited to, the blower, motor and drive guards and air inlet duct along with required duct connection transition fittings as specified herein and shown on design drawings. The entire system shall be supplied and guaranteed by one (1) supplier. The system supplier shall have a minimum of 10 years' experience for design and supply of blowers.

All of the equipment shall be furnished by a supplier/manufacturer that is fully experienced, reputable and qualified in the manufacture of the system components to be furnished. The equipment shall be designed, constructed and delivered in accordance with the best practices.

1.2 MEASUREMENT

Volume of air supplied will be determined by initial and final meter readings. A pitot tube shall be provided and installed as part of the equipment.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	(2003; R 2008) Mechanical Vibration -

	Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

WATER ENVIRONMENT FEDERATION (WEF)

WEF MOP 11	(2017) Operation of Water Resource Recovery Facilities

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for review and approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detailed Drawings; G

Detailed Process Flow Diagrams; G

Piping and Instrumentation Diagram; G

SD-03 Product Data

Instrumentation; G

Air Moving Equipment; G

Field Training

SD-06 Test Reports

Field Testing

SD-07 Certificates

Air Moving Equipment

Manufacturer's Representative

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

1.5 QUALITY ASSURANCE

1.5.1 Contractor

Contractor shall have a minimum of 10 years of experience in the construction of systems for handling sour gas, condensable gas, off-gas, vapor, or air.

1.5.2 Single Source Supplier

Assign to a single supplier full responsibility for the furnishing of the off-gas moving system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire system as specified herein.

1.5.3 Manufacturer's Representative

Provide the services of a manufacturer's field service representative who is experienced in the installation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system. Submit the names and qualifications of the manufacturer's representative and training engineers, and certification from the manufacturer that the representative and trainers are qualified in the appropriate technical areas.

1.5.4 Detailed Drawings

Submit detailed drawings including location of components, layout and anchorage of equipment and appurtenances, equipment relationship to other parts of the work, clearances for maintenance and operation of the off-gas system and subsystems. Drawings shall be to the approved scale.

1.5.5 Detailed Process Flow Diagrams

Submit detailed process flow diagrams and data including, but not limited to: air and off-gas stream flows, direction of flow, range of flow rate and range of composition, identified by lines and arrows denoting the direction and destination of the flow; material, mass and energy balances for the entire air and off-gas system; subsystem equipment, operating capacity and operating conditions; blowers and pumps, valves and other in-line devices; sizes of conveying devices (pipe, ducts, etc.); number of parallel components or lines.

1.5.6 Piping and Instrumentation Diagram

Submit a piping and instrumentation diagram indicating: process equipment; instrumentation; piping and valves; stacks, vents and dampers; control equipment (including sensors, process controllers, control operators, valves, interlocks, and alarms); labels and other necessary information to correlate to the process flow diagram. The P&ID shall include blowers and pumps, valves and other in-line devices.

1.6 DELIVERY, STORAGE, AND HANDLING

Store in a clean, dry location equipment delivered to the site and designated for storage; cover the equipment for protection against dust and moisture. Equipment stored longer than 60 days shall have silica bags suspended in the outlet and inlet of unit, bearings shall be filled full of grease, unit shall be filled with oil, machine surfaces shall be coated

with grease, and entire unit shall be enclosed with plastic or tarps. Shaft of rotating equipment including motors shall be turned every two weeks to prevent flat spots on bearings.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.2 MATERIALS AND EQUIPMENT

2.2.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has been in satisfactory operation at least 5 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Remedial Project Manager (RPM), FEAD CM or Engineer, reasonably convenient to the site. Pieces of equipment of the same types shall be products of the same manufacturer. Equipment shall be new and unused, except for test equipment. Materials may be reprocessed/recycled with equivalent durability and product warranty/guarantee.

2.2.2 Nameplates

Each piece of equipment shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each air moving unit shall show the capacity in standard cubic feet per minute (SCFM) at rated speed in rpm and head in inches of water. Nameplate for each electrical motor shall show, at least, the minimum information required by paragraph 10.38 of NEMA MG 1. Any other information that the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

2.3 PRESSURE BLOWERS

Blower shall be capable of delivering a design air flow rate of 600 scfm at 80 in wg with a maximum flow rate of 750 scfm.

2.3.1 Blower

Blowers shall be manufactured by Greenheck (Model: IP-7 Air Handling Wheel) or approved equal. The blower housing shall be heavy gauge, continuously welded steel housing constructed of welded formed steel parts to be rigid and prevent vibration. Steel components shall be coated with corrosion resistant fasteners. The bearings, shaft and wheel shall be heavy duty, self-aligning ball or roller pillow block bearings - Polished, solid steel shafts - Welded, heavy gauge dynamically balanced wheel. The isolation base shall be steel Channel - Welded construction - Pre-punched mounting holes for fan and isolator mounting - Integral lifting points.

Performance
Quantity: 2 Blowers (1+1 spare)
Design Flow (CFM) 600
Maximum Pressure (in. wg) 18
Operating Temp. (F) 50-70

Fan Configuration

Spark Resistance
Scroll Material Steel
Wheel Material Steel
Inlet Plate Material Steel
Pedestal Material Steel

Motor and Drives
NEMA premium efficient motor
Enclosure TEFC, V/C/P 460/60/3
Drives Standard
Drive Service Factor 1.5
Motor with Class B or Greater Insulation
Motor Slide Base
Access Door - Bolted
Drain Connection - Without Plug
Inlet Connection 8" - Slip Fit
Outlet Connection 6" - Punched
BeltGuard - TE, Steel
ShaftGuard - TE, Steel
Fasteners - Standard

Motor Starter shall be standard Control with smart start shall be manufactured by Greenheck (Model: MSSC-3R-9/J-G8-40) or approved equal. It shall have NEMA and IEC, dual-rated contractor - HOA keypad - Hand, off, auto, run and fault lights - Conduit plate knockouts - Solidstate, electronic overload - Stall protection - Locked rotor trip - Max start time monitoring - Overload miss calibration protection - 2 inputs for remote control; 12-250V direct voltage input and N.O. dry contact - Proof of flow output relay - UL and cUL.

2.4 ELECTRICAL EQUIPMENT

Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt.

2.4.1 Electric Motors

Each electric motor-driven unit shall be driven by a Type totally-enclosed fan cooled continuous-duty electric motor. Motor shall have a 1.15 service factor. Motors shall be inverter duty and having normal-starting-torque and low-starting-current characteristics, and shall be sized to avoid exceeding the nameplate power rating throughout the entire published characteristic curve. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of the rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during starting and under variable head conditions specified. Motors shall be rated 460 volts, 3 phase, 60 Hz and such rating shall be stamped on the nameplate. Motors shall conform to NEMA MG 1. The motor shall be compatiable with a variable speed control system.

2.5 ATTACHMENTS

Shafts, chains or gear driven equipment shall be provided with all-metal guards enclosing the drive mechanism. Guard shall be constructed of

galvanized sheet steel, or galvanized woven wire, or expanded metal set in galvanized steel frame. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment.

2.6 COATINGS OR FINISHES

Motors, casings and similar parts of equipment finished in the shop shall be cleaned, primed and given two finish coats with alkyd primer followed by two alkyd modified silicone final coats at the factory. Ferrous surfaces not painted at the factory shall be given a shop coat of grease or other suitable rust resistant coating.

2.7 FACTORY TESTS

Equipment shall be subject to in-plant shop and quality control inspections before approval for shipment from manufacturer's facilities. Rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration or noise.

2.7.1 Integrity

Each impeller assembly shall be tested by being operated at a speed to 20 percent above operating speed and checked for cracks using the dye penetrant method or similar method of equal accuracy.

2.7.2 Balance

Rotating parts shall be statically and dynamically balanced in accordance with ISO 1940-1. First critical speed shall be at least 150 percent of maximum operating speed. Rotating parts shall be statically and dynamically balanced. The shaft and impeller or blade assembly shall be statically and dynamically balanced as a unit. Removing of metal from the impeller or blades by boring is not an acceptable means of balancing the shaft and impeller unit. Impeller or blade assemblies shall be statically and dynamically balanced to within 0.5 percent of W times R squared, where W equals weight and R equals impeller radius.

2.7.3 Deflection

Total shaft peak-to-peak dynamic deflection measured by vibrometer at seal face shall not exceed 2 mils under the complete range of operating conditions.

2.7.4 Vibration

Vibration shall not exceed 1.0 mil at the bearing housing with the equipment operating. Peak vibration velocity shall be less than 0.30 inch per second.

2.7.5 Capacity

Volume and pressure characteristics of air moving equipment shall be determined by the manufacturer in accordance with AMCA 210. Certified test results and sample calculation from test readings shall be submitted to the Remedial Project Manager (RPM), FEAD CM or Engineer.

2.7.6 Noise

Air moving equipment shall be tested with sound attenuation devices installed by the manufacturer . Certified test results and sample calculation from test readings shall be submitted to the Remedial Project Manager (RPM), FEAD CM or Engineer. Where two or more identical units are specified, only one representative unit needs to be tested. Fans shall be tested in accordance with AMCA 300 with results interpreted in accordance with AMCA 301.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field and advise the Remedial Project Manager (RPM), FEAD CM or Engineer of any discrepancy before performing the work.

3.2 INSTALLATION

3.2.1 Concrete Foundations

Concrete for equipment foundations shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE . Concrete foundations shall be integral with and of the same class as that of the building floor . Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.3 FIELD PAINTING

Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted.

3.3.1 Touch-Up Painting

Factory painted items, requiring touching up in the field, shall be cleaned of foreign material and shall be primed top-coated with the manufacturer's standard factory finish, provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions.

3.4 FIELD TESTING

3.4.1 Testing and Inspection

Contractor shall be responsible for conducting all testing and inspections. Contractor shall engage the services of a qualified and certified testing agency that is approved to conduct tests and inspections of all equipment and materials installed prior to operation and putting in service. The testing and inspection shall be conducted under a certified PE in the state of New York where applicable. All testing and inspection reports shall be submitted to RPM, FEAD CM or Engineer for review and approval.

3.4.2 Field Service

Manufacturer's field service representative shall be engaged to verify the installation and connection requirements of all equipment and materials

for its complete operation.

The certified testing agency representative and manufacturer's field representative will work together to complete all testing and inspection requirements.

3.4.3 Noise Level

Sound level shall be less than 85 dB measured at 5 feet from the source.

3.4.4 Reporting

Submit test reports in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed equipment. Test methods used shall be identified and test results shall be recorded. Indicate in each test report the final position of controls.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Field Training

Conduct a field training course for designated operating, maintenance and supervisory staff members. Submit training course curriculum and training instructions 14 days prior to the start of training. Provide training after the system is functionally complete but prior to final acceptance tests, for a total period of 24 hours of normal working time. Field training shall cover the items contained in the operating and maintenance instructions.

3.5.2 Operating and Maintenance Instructions

3.5.2.1 Operating Instructions

Submit six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include in the operating instructions the following for system components: manufacturer's name, model number, service manual, parts list, and brief description of each piece of equipment and its basic operating features; flow diagrams; system layout showing piping, valves, and controls; as-built wiring and control diagrams; control sequence describing startup, operation, and shutdown; manufacturer's bulletins, cuts, and descriptive data.

3.5.2.2 Maintenance Instructions

Submit six complete copies of maintenance instructions for each piece of equipment including the following: manufacturer's complete list of parts, recommended spare parts and supplies, with current unit prices and source of supply; routine maintenance procedures, including the requirements of WEF MOP 11, as a minimum; possible breakdowns and repairs; a troubleshooting guide to help the operator determine what steps must be taken to correct any equipment problems.

-- End of Section --

SECTION 43 21 13

RECOVERY WELL PUMPS

PART 1. GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to install four Well Pumps as detailed in this section. Installation shall be complete and include, but not be limited to: pump controls, level switches, connectors, clamps, couplings, discharge hose, support cables, electrical cables, and appurtenances as shown on the Technical Drawings and referenced in the Technical Specifications.

1.2 RELATED SECTIONS

A. Section 01 01 00 Scope of Work

B. Section 01 33 00 Submittal Procedures

C. Section 01 78 00 Closeout Submittals

D. Section 01 78 23 Operation and Maintenance (O&M) Data

E. Section 41 10 02 Process Piping and Appurtenances

F. Section 26 00 00 Basic Electrical Materials and Methods

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced.

HYDRAULIC INSTITUTE STANDARDS FOR CENTRIFUGAL, ROTARY, AND RECIPROCATING PUMPS (HI)

ANSI/HI 1.1-1.6 Centrifugal Pumps

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 240 316/316L Stainless Steel

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

(ISO)

ISO 9001 Quality Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG1 Motors and Generators.

1.4 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 Submittals:

1. Shop Drawings: Submit shop drawings for pumps including, dimensions, materials of construction, bills of materials, motor data, certified performance curves, parts lists, pumps mounting arrangement, and tie in connections.

2. Product Data: Submit product data describing equipment features, materials of fabrication, general dimensions, pump curves, and general operating parameters.

3. Factory Tests: Test reports in booklet form showing the results of factory tests performed.

4. Field Tests and Inspections: Test reports in booklet form showing results of the field tests performed to adjust each component following the installation of the system and the field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

5. Submit the operation and maintenance (O&M) manual and required number of copies in accordance with Section 01 78 23.

1.5 DELIVERY AND STORAGE, AND HANDLING

A. All equipment shall be protected against damage during shipment.

B. All equipment shall be preassembled to the largest extent possible, compatible with transportation limitations and equipment protection considerations.

C. All equipment shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation. Exposed iron or steel surfaces shall be properly protected to prevent rust and corrosion.

1.6 QUALIFICATIONS AND WARRANTY

A. Manufacturer Qualification

1. The Pumps shall be supplied by a reputable Manufacturer having at least ten
(10) years' experience in the design and fabrication of pumps for the treatment of groundwater and water.

B. Warranty

1. Manufacturer shall provide warranty in accordance with Section 01 78 00 of the specifications.

1.7 TOOLS AND SPARE PARTS

A. All tools required for normal operation and maintenance of each piece of equipment shall be furnished. Special tools recommended by the Manufacturer shall also be furnished. The tools shall be stored in a dedicated cabinet or tool box and labeled "Groundwater Extraction Well Pumps". An inventory log shall be maintained and stored with the tools. All items shall be suitably packed and protected for long periods of storage.

1.8 EQUAL PRODUCTS

A. The Contract Drawings and Technical Specifications are based on using Grundfos pumps. Should the Contractor propose to furnish equal equipment of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed pumps into the design, and submit the necessary revised Contract Drawings and Technical Specifications for review and approval by the COR.

PART 2. PRODUCTS

2.1 PUMPS

A. Provide the pumps shown below in the pump list. The proposed equipment is subject to verification of capacity per the field pump test as performed by the Contractor.

1. Recovery pumps and motors shall be preassembled as a single unit, submersible, shrouded, centrifugal, and of "Grundfos" make, or approved equivalent.

2. Built-in check valve with spring.

3. Check Valve Housing, Check Valve, Diffuser Chamber, Impeller, Suction Interconnector, Inlet Screen, Pump Shaft, Straps, Cable Guard, Priming Inducer: 304 SS

4. Check valve seat: PTFE

5. Impeller Seal Ring: PTFE

6. Coupling: 316 SS

7. Intermediate Bearings: PTFE

8. Pumps shall fit inside the well casing diameter as specified in the Contract Drawings (6" nominal).

9. Motors for P-8 shall have a 1.60 service factor and Motor for P-9 and P-10A shall have 1.15 service factor.

10. Motor for P-8 shall be suitable for 460V, 3 phase, 60Hz whereas motors for P-9 and P-10A shall be suitable for 230V, 3 phase, 60Hz power source.

11. Motors shall be furnished with a lifting eye and a power cable from the pump motor to the terminal box.

PUMPING SYSTEM LIST:

Pump ID	Manufacturer / Model	Connection Size	Operating Flow (gpm)	TDH (ft)	Motor (HP)
P-8 (for RW-8)	GRUNDFOS (MODEL 625S300-2AA)	6 inch	Design=450 Maximum=600	107 111	30
P-9 (for RW-9)	GRUNDFOS (MODEL 625S300-2AA)	6 inch	Design=450 Maximum=600	115 126	30
P-10A (for RW-10A)	GRUNDFOS (MODEL 625S400-2)	6 inch	Design=600 Maximum=700	145 159	40

2.2 MATERIALS FABRICATION

A. Pumps shall be fabricated from Stainless Steel material and chemically compatible with the groundwater contaminants. Impeller Seal Ring, Intermediate Bearings and Valve seat shall be PTFE (Teflon®).

B. The pump and applicable connections shall be rated for a minimum of 175 psi.

C. Each pump shall be supported by one 316 stainless steel support cable. Support cable shall be sized and connected in accordance with the pump manufacturer’s recommendations.

PART 3. EXECUTION

3.1 EXAMINATON

A. After becoming familiar with all details of the work, verify dimensions in the field, and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

A. Installation of the pumps and all appurtenances shall be in accordance with the manufacturer’s recommendations.

B. The pump shall be inspected visually prior to installation.

C. Equipment installation shall be in accordance with the manufacturer's written instructions and in the presence of the Manufacturer’s representative.

D. Pumps discharge pipe, lifting cable and cables will extend thru a well cap located inside a valve pit. A level transducer will also be installed at each location and related control wire will be extended thru the well cap.

3.3 FIELD TESTS AND INSPECTIONS

A. Field tests shall not be conducted by the Contractor until such time that the entire installation is complete and ready for testing.

B. As part of the installation inspection, the Contractor shall operate the pumps and check for excessive noise, vibration or heating, and for discharge adequacy. The pumps shall be tested over the full range of flow conditions.

C. The pump and suction/discharge piping shall be inspected by the Contractor in the presence of the COR for leakage.

D. If the installation inspection reveals deficiencies, corrective measures shall be taken by the Contractor until the pumps satisfy the specified requirements.

3.4 MANUFACTURERS SERVICES

A. Installation, Adjustment, and Testing: Provide a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment to supervise the installation, adjustment and testing of the equipment for a period of 5 working days (8 hours a day).

B. Conduct a video recorded training course for designated operating, maintenance and support staff members. The training period shall be a total of 4 hours of normal working time. Field training shall cover each item contained in the operating and maintenance manual.

END OF SECTION

SECTION 43 31 13.13 10

ACTIVATED CARBON-GAS AND LIQUID PURIFICATION FILTERS

PART 1. GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install Gas and Liquid Phase Granular Activated Carbon (LGAC) units for the removal of organic compounds. The Contractor shall provide materials and equipment which are new and unused.

B. This section specifies the performance requirements for the design, fabrication, installation, and operation of the Liquid Phase Granular Activated Carbon (LGAC) system as shown on the Contract Drawings and as specified. The Contractor shall provide three (3) LGAC filters (LGAC-410, LGAC-420 and LGAC-430). The three units will be used to remove any organics that remains after Multimedia Filters and Advanced Oxidation Process (AOP). The contractor shall also provide and install one (1) carbon cannister vessel (C-100) as specified and shown on the contract drawings.

C. All piping shall be provided and installed in accordance with Section 41 10 02.

1.2 RELATED SECTIONS

A.	Section 01 01 00	Scope of Work
B.	Section 01 33 00	Submittals Procedures
C.	Section 01 78 00	Closeout Submittals
D.	Section 01 78 23	Operation and Maintenance (O&M) Data
E.	Section 41 10 02	Process Piping

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

<u>AMERICAN SOCIETY OF MECHANICAL ENGINEERS INTERNATIONAL</u>

ASME Section VIII, Division 1 - American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

ASME/ANSI B16.5 - American Society of Mechanical Engineers/American National Standard Institute.

ASME Section II, American Society of Mechanical Engineers - Materials, Parts A, B & C.

ASME B40.100(2005) Pressure Gauges and Gauge Attachments.

AMERICAN SOCIETY OF TESTING MATERIALS INTERNATIONAL (ASTM)

ASTM D 1784(2011) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2564(2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
American Water Works Association (AWWA) - B604, Standard for Granular Activated Carbon

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00

Submittals:

A. Pre-Construction Submittals:

1. Manufacturer's technical and engineering data sheets for the LGAC system including system features, materials of construction of the adsorber vessel, LGAC media, general dimensions, and operational parameters. Product data shall include selected model number, rated flow capacity, dimensions, weights (dry and operating), accessories, instrumentation list, and warranty coverage. List of all instrumentation shall include descriptive information for each component including, but not limited to, instrument number, manufacturer, and ranges measured.

2. Shop Drawings, including:

   a. General arrangement drawings with dimensions of adsorber vessel, skid, valve packs, clearance requirements, and Manufacturer's data covering installation instructions, weight, detailed specifications, materials of construction, parts, devices, and other information required to verify compliance with these specifications.

   b. Show on the Drawings proposed layout, location of valves and interface points, and anchorage requirements. Show location of piping, valves, pressure/vacuum relief devices, lifting lugs, anchor bolt locations. Indicate all sizes, capacities, and dimensions.

   c. Process flow diagrams and instrumentation diagrams(s) showing all major pieces of process equipment with valves. Show on the drawings complete piping, wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and shall properly function as a unit.

   d. Clearances for maintenance and operation.

   e. Details on vessel internals including underdrain and top distributor.

3. Empty bed contact time for each vessel, and pressure drop information across each carbon vessel for all plant flow conditions (min: 600 gpm, Average:1600 gpm, and Maximum: 1800 gpm).

4. Backwash requirements – flow and pressure drop.

5. Specification of each type of granular activated carbon to be utilized including iodine number, moisture content, effective size, uniformity coefficient, abrasion number, apparent density, and screen size. Projected granular activated carbon usage rates. Reports of testing granular activated carbon in accordance with AWWA B604. Material safety data sheets in conformance with 29 CFR 1910 Section 1200(g) for activated carbon.

6. Calculations:

a. Structural and anchorage calculations. Contractor shall submit detailed calculations illustrating the seismic characteristics and anchorage of the proposed skid. Calculations shall be signed and sealed by a professional engineer licensed to practice in the State of New York.

7. Manufacturer's certificates, including the name and address of the production facility, attesting that the activated carbon furnished meets the specified requirements.

8. Material specifications for pipe, valves, fittings and instrumentation, and specifications for vessel lining and painting (interior and exterior).

9. A comprehensive instrument, valve, and actuator list and associated datasheets. Contractor shall supply drawings detailing wiring between field instruments/valve actuators to Manufacturer supplied junction box. Manufacturer shall provide instrumentation per Contract Documents.

B. Informational Submittal, including:

1. Equipment delivery schedule.

2. Manufacturer’s hydrostatic test report at manufacturing facility.

3. Coating manufacturer certification of internal coating application.

4. Recommended spare parts list.

C. Contractor shall submit a Test Report describing the findings of the field inspection of the installed equipment and the results of the functional testing, hydrostatic testing, and performance testing – see paragraph 3.4 for details.

D. Operation and Maintenance Manual

1. Submit the operation and maintenance (O&M) manual and required number of copies in accordance with Section 01 78 23.

1.5 SEISMIC LOADS

The structural aspects of the LGAC shall be sufficient to meet the 2021 International Building Code requirements for Seismic Design Category = B. See structural sheet S-001 for additional Design Criteria information.

1.6 DELIVERY AND STORAGE

Protect all equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on a

conceptual arrangement of the three LGAC vessels and piping (TIGG Model CP-20K-10-GA system with 3 units). Should the Contractor propose to furnish an equivalent system of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed LGAC into the design and submit the necessary revised Contract Drawings and Technical Specifications for review and

approval.

1.8 QUALIFICATION AND WARRANTY

A. Manufacturer Qualification

1. The LGAC System shall be supplied by reputable Manufacturers having at least ten (10) years' experience in the design and fabrication of such systems for the treatment of groundwater and water.

B. Warranty

1. Manufacturer shall provide warranty in accordance with Section 01 77 00 of the specifications.

PART 2. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of LGAC systems and components, and that essentially duplicates items that have been in satisfactory use at other locations for at least 10 years.

B. GAC system shall be skid mounted, assembled, piped, and tested in the shop prior to shipment. Field assembly shall be minimized to the maximum extent possible. The Owner's Representative may desire to witness a factory acceptance test at the manufacturer's shop.

C. This equipment shall be manufactured/ supplied by: TIGG, Calgon, Carbonair, Evoqua, or approved equal.

2.2 GAC SYSTEM REQUIREMENTS

A. Service: The LGAC system (LGAC-410, LGAC-420 and LGAC-430) shall be designed to remove any residual hydrogen peroxide and organics.

B. Anticipated Influent Characteristics

Flow : 1800 gpm (max) and 1600 gpm (average)

Compound	Units	LGAC Influent Value (maximum)
Hydrogen Peroxide	ppm	3 maximum
Trichloroethene	ppb	5
Tetrachloroethene	ppb	1
Freon 113	ppb	1
1,1-Dichloroethene	ppb	1
cis-1,2-Dichloroethene	ppb	1
1,4-Dioxane	ppb	1.5

C. Performance Requirements

The LGAC System shall be designed to meet the discharge limits given below for
1800 gpm (max) and 1600 gpm (average) flow:

Compound	Units	Discharge Requirement
Hydrogen peroxide	ppm	ND*
Trichloroethene	ppb	ND
Tetrachloroethene	ppb	ND
Freon 113	ppb	ND
1,1-Dichloroethene	ppb	ND
cis-1,2-Dichloroethene	ppb	ND
1,4-Dioxane	ppb	<0.1

* ND – Non-Detect

D. Design Criteria

1. Number of LGAC Units: 3 (LGAC-410, LGAC-420 and LGAC-430) for Hydrogen Peroxide and Organics Removal

2. Headloss:8 psi during normal operation and maximum 15 psi

3. Maximum flow Rating: 785 gpm per unit

4. Flow direction: Three (3) units operating in parallel

5. Empty bed contact time: 12 minutes per vessel flow of 700 gpm per unit

6. Hydraulic loading rate: 8.9 gpm/ft^2 at flow of 700 gpm per unit

7. Backwash loading rate & water source: Atleast 12 gpm/ft^2

2.3 EQUIPMENT DESCRIPTION

A. GAC Vessel: The vessel shall have a diameter of 10 feet, a total height of 18 feet, and shall be oriented vertically. The vessels shall be of welded carbon steel construction and shall be tested to withstand a maximum allowable working pressure of 125 psi. Lifting lugs, supports, connections and appurtenances shall be provided as detailed on the drawings including pressure relief and vacuum relief valves for each vessel. The vessel shall be designed and fabricated in accordance with the ASME BPVC SEC VIII D1 and does not have to be stamped and certified.

B. Underdrain System: The underdrain shall be of the standard manufacturer's design particular to the supplied LGAC unit and furnished with the constructed package unit except that it shall not be of plastic material. The LGAC underdrain/ backwash distributor shall be slotted septa constructed of 316L stainless steel. The underdrain system shall be designed to withstand all loads due to design pressures, design loading rates, forces from backwash flows, and loads from the media to be installed in the tank. The slot size or perforations in the underdrain shall not permit media to pass through it.

C. Activated Carbon: Material shall be free from impurities that affect the serviceability and appearance of the finished product.

a. Twenty thousand (20,000) pounds of virgin LGAC shall be provided and installed within each vessel. The activated carbon shall be virgin liquid phase coconut based activated carbon.

b. The activated carbon shall be virgin liquid phase coconut-based activated carbon specifically designed to removal low concentration of weakly adsorbed organics from water. The media shall be produced in the United States. Granules shall be clean and hard. The LGAC shall conform to AWWA B604 (Potable Water Service) standard for LGAC and comply with ANSI/NSF Standard 61. The activated carbon which is manufactured to the following specification:

1. Manufacturer & Commercial Name: TIGG-5DC 0830

2. TIGG-5DC 0830 or Approved Equal

3. Iodine Number, mg/g (minimum) (ASTM D 4607): 1100

c. US Sieve, 90 wt% min: 8 x 30

d. Abrasion Number (minimum):85

e. Apparent Density, g/cc (ASTM D 2854): 0.42 - 0.47

2. An analysis sheet certifying compliance with the specifications and indicating point of manufacture shall accompany the delivered activated carbon.

D. Appurtenances and Instrumentation:

1. Pressure relief at each vessel shall be provided by a pressure/vacuum relief valve to relieve pressure at the Maximum Allowable Working Pressure (125 psi) of the vessel. One shall be provided for each liquid-phase LGAC vessel. Each of the vessels shall also be provided with a pressure relief/vacuum relief valve. The pressure/vacuum relief valve shall be mounted on the lines shown on the P&IDs.

2. Provide all skid-mounted interconnecting piping and valves between LGAC-410, LGAC-420 and LGAC-430. The process piping at each vessel shall be equipped with a differential pressure gauge to indicate the pressure drop across each adsorber and the system. The differential pressure gauge shall have a 4" face diameter with an encapsulated sensing element in a brass case housing (0 to 20 psig range). The differential pressure gauge shall have the ability to provide a field configurable, 120 VAC discrete input indicating a differential pressure of up to 10 psid.

3. The carbon fill and discharge shall be fitted with hose connections, such that carbon transfer to and from the adsorbers can be facilitated using carbon transfer hoses. These connectors shall be 3" Quick Disconnect Adaptors constructed of corrosion resistant materials (nylon) as manufactured by Dover Corp. as Kamlock connectors or approved equal.

4. Two (2) flush connections shall be provided on each LGAC fill line, one upstream and one downstream of the fill isolation valve. One (1) flush connection shall be provided on each LGAC discharge line, downstream of the fill isolation valve. The connections shall be welded into the steel or stainless steel pipe. Flush connections shall consist of a short section of ¾" pipe, a ¾" full port ball valve and a ¾" quick disconnect adaptor to match with water hose fittings.

E. Equipment Control: The LGAC system shall be provided with manual butterfly valves. The appropriate valves will be opened or closed to place LGAC in normal operation model or to initiate backwash.

1. Valves: Transfer of water to and from the LGAC unit shall be accomplished by a manual butterfly valve.

2. Control System Junction Box: Manufacturer shall provide a local, prewired, NEMA 4X junction box to terminate all skid mounted instrumentation and equipment wiring. Signals from the junction box shall be transmitted to the plant PLC to alarm, and notify when to initiate backwash due to high differential pressure, or place specific LGAC vessels back in service. Backwash initiation shall be by manual initiation. The valves shall be completely assembled, tested at the factory prior to shipment.

F. Carbon Cannister (vessel):

1. Furnish and install one (1) carbon cannister (vessel) from TIGG (Model: N-1200 PDB), Carbonair, Evoqua or approved equal.

2. The carbon cannister shall be rated for upto flow rate 1200 CFM with 1000 pounds of carbon capacity. Carbon media shall be 4mm pellet virgin carbon media.

   Bed Depth 36 inch
   Carbon Tetrachloride Number 60% (minimum)
   Apparent density (dense packing) 30 lbs/ft3
   Hardness Number 95 (minimum)
   Moisture Content (as packed) 2% (maximum)

2.4 PAINT

A. The interior and exterior of fabricated ferrous metal components shall be treated after fabrication to prevent corrosion. The surfaces of the vessels shall be sandblasted and completely factory finish painted prior to shipment. Insulating components such as gaskets, couplings, or bushing or dielectric-type which will prevent corrosion of bimetallic-type contacts, shall be used at connections between dissimilar metals.

B. Exterior Surfaces: All ferrous surfaces shall be coated or painted. Ferrous metal surfaces shall be prepared with two coats of epoxy paint.

C. Interior Surfaces: All interior surfaces shall be coated with Plasite 4110 applied at 40 mil dry film thickness (DFT).

2.5 ACCESSORIES

A. Supporting Skid: The LGAC system and all appurtenances shall be supported on a steel skid and legs.

B. Lifting Lugs: Individual equipment and or each field-assembled part over 100 pounds in weight shall be provided with lifting lugs for ease of handling.

C. Anchor Bolts: Contractor shall size and provide 316 SS anchor bolts, and shall provide installation template for positioning the bolts. The support system shall be designed to resist seismic forces. The seismic forces shall be based on the vessels and all appurtenances full of water.

D. Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the equipment (each LGAC vessel) in a location that is visible at eye level. The plate shall bear the Manufacturer’s name, address, phone number, equipment model number, serial number, and equipment ID number that matches the P&IDs.

2.6 SPARE PARTS & TOOLS

A. Contractor shall provide one set of recommended spare parts for LGAC and related accessories supplied.

B. Contractor shall supply one set of any special tools required for assembly, disassembly, or adjustment of the equipment supplied.

PART 3. EXECUTION

3.1 GENERAL

A. The LGAC System shall be manufactured in accordance with the best trade practices and in accordance with all applicable codes and regulations.

3.2 FABRICATION & SHIPMENT

A. The Contractor shall allow the Owner’s Representative access to the manufacturing facility should the Owner’s Representative decide to inspect the equipment during the manufacturing of the system or any part of the equipment. The Owner’s Representative may desire to witness a factory acceptance test at the manufacturer’s shop prior to shipping to demonstrate maximum processing flow rate and full functionality of all service/backwash modes of operation.

B. LGAC units shall be shipped dry without any media.

C. All open piping shall be fitted with blank flanges prior to shipment.

D. Work not required to be performed in the field shall be performed in the factory under controlled conditions. Field assembly of the equipment will be performed by the Contractor under the supervision of the Manufacturer.

E. The Contractor shall provide all installation documents and O&M Manuals in accordance with the Contract Documents.

3.3 INSTALLATION

A. Verify all dimensions in the field and advise the Owner’s Representative of any discrepancy before performing the work.

B. The LGAC system shall be installed in accordance with the Manufacturer's Instructions, as shown on the Contract Drawings, and in the presence of the Manufacturer’s representative.

C. The installed LGAC system shall be visually inspected for plumb and nozzle alignment, smoothness, and evenness.

D. Factory painted items shall be touched up as needed. Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material, wire brushed, sanded, primed and top-coated with the manufacturer's standard factory finish to match the desired color.

E. All valves and piping shown on the P&ID within the skid limits shall be factory installed.

F. After installation of the LGAC vessels, the Contractor shall load (fill/ transfer) each LGAC vessel with virgin LGAC. The Contractor shall provide all related equipment for the carbon fill to each LGAC unit including utilities such as air and potable water. Contractor shall assume that approximately 24,000 gallons of potable water will be required for two LGAC units for initially backwashing the carbon units for LGAC segregation prior to placing the units in service. Use care in loading carbon media and clean up all spills after they occur. Wear dust masks and/or other protective equipment to avoid breathing carbon dust.

G. Dispose of waste generated during the startup and placement of the units in service, including backwash waste generated during backwash of the units to segregate the carbon prior to startup, and all other related wastes.

3.4 TESTING

A. Functional Testing: Prior to startup, all equipment components shall be inspected by the Contractor for proper alignment, proper connections, and satisfactory installation. All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of valve openings and seats; all operating mechanisms shall be operated to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced. Proper installation and tightness of all underdrains and inlet distributors shall be checked. Photographs of each vessel internals shall be taken prior to loading LGAC.

B. Hydrostatic Tests: After installation, all LGAC pressure vessels/tanks shall be tested for water tightness. Testing shall be performed with potable water provided by the Contractor. Testing plugs or caps, all necessary pressure pumps, pipe connections, gauges, other equipment, potable water, and all labor required shall be included. The Contractor shall ensure all the air is removed from the system prior to pressure testing. Test pressures shall be 100 psi for 2 hours. No leaks are allowed; and a decrease in pressure of 0.5 psi is permissible. System shall be checked for leaks after one hour. Piping systems shall be isolated from the tanks for pressure testing at the specified test pressure.

C. Performance Tests: An Operating Performance Test shall be performed to demonstrate that the LGAC System conforms to the requirements of this specification. The performance test shall be performed for 3 days. Field tests shall not be conducted until such time that the entire treatment plant has been installed, and after startup and shakedown is complete, and the plant is ready for testing.

D. For the purpose of performance testing, system throughput will be continuously monitored on the plant flow meters. LGAC Influent and Effluent samples from all units will be collected, marked, preserved, and analyzed for any VOCs, SVOCs organics and residual hydrogen peroxide. The samples will be collected and analyzed once a day for three (3) days at the maximum design flow rate. The data will be compared to the influent characteristics and effluent requirements specified to verify that they are within the specified ranges. The system performance will be considered acceptable if the influent and effluent concentrations are per the concentrations specified in Paragraph 2.2 of this section.

E. Test Report: Contractor shall provide a test report that shall include as a minimum a description of the test, methodology used, data and time when test was performed, and the results of the testing. All testing results shall be reported, including test results that failed to meet the requirements. Should test runs fail to meet the requirements, an explanation shall be provided with the rational for failure of the test.

3.5 REMEDY

A. If the Installation, Inspection or Operating Performance Test reveals deficiencies, corrective measures shall be taken until the system satisfies all of the specified requirements. Remedies shall be at no additional cost to the Owner.

3.6 MANUFACTURER SERVICES

A. The Contractor shall provide the following personnel:

1. One (1) representatives of the Manufacturer who is experienced in the installation and adjustment of the equipment specified. The representative shall supervise the installation and adjustment of equipment - for up to 10 days (8 hours a day).

2. A representative of the Manufacturer for 15 days (3 trips) during Testing described in Paragraph 3.4.

B. Conduct a video recorded training course for designated operating, maintenance and support staff members. The training period shall be a total of 16 hours of normal working time. Field training shall cover each item contained in the operating and maintenance manual.

C. Application of the internal vessel coating shall be witnessed and certified by the coating manufacturer.

3.7 FIELD PAINTING

A. Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

B. Touch-Up Painting

1. Factory painted items requiring touching up in the field shall be thoroughly cleaned, and wire brushed of all foreign material, and shall be sanded, primed and top coated with the Manufacturer's standard factory finish.

3.8 SAFETY MESSAGE

A. Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable Federal and State requirements.

B. Contractor shall take all necessary health and safety precautions including the use of appropriate personal protective equipment (PPE) when unloading activated carbon.

END OF SECTION

SECTION 43 41 16.16 40

VERTICAL ATMOSPHERIC FIBERGLASS TANKS

PART 1. GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to procure and install single wall Fiber Reinforced Plastic (FRP) tanks. This section specifies the performance requirements for the design, fabrication, and installation of all process water FRP tanks. The manufacturer shall provide materials and equipment which are new and unused.

B. All fiberglass items shall be manufactured of material suitable for the service and shall be certified for such use on the shop drawings. Tanks shall be designed and checked for all loads to be incurred during shipment, service, including, but not limited to, seismic and temperature stress. The items indicated under this specification shall be furnished by manufacturers having experience in the manufacture of similar products and having a record of successful installations.

1.2 RELATED SECTIONS

A. Section 01 33 00 Submittals and Substitutions

B. Section 01 77 00 Project Closeout Procedures

C. Section 42 32 70 Chemical Storage Tanks

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

<u>AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM) INTERNATIONAL</u>

ASTM D3299-10 (2010) Standard Specification for Filament-Wound Glass-Fiber- Reinforced Thermoset Resin Corrosion-Resistant Tanks.

ASTM F4097-01 (2010) Standard Specification for Contact-Molded Glass-Fiber- Reinforced Thermose Resin Corrosion-Resistant Tanks.

ASTM D2563-08 (2008) Standard Practice for Classifying Visual Defects in Glass- Reinforced Plastic Laminate Parts.

ASTM D2583-13a Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 Submittals:

A. Shop Drawings: Shop Drawings shall include:

1. Detailed and certified design calculations. The laminate sequence used for all tanks must either be attached to or included on drawings used by the fabricator's shop personnel.

2. Tank layout drawings showing dimensions, wall thickness, anchor layout, knuckle radii, nozzle location and orientation, and nozzle construction.

3. Laminate sequence of construction and all materials of construction listed.

B. Installation Instructions: Submit installation instructions including:

1. Installing tank on a concrete slab.

2. Tank manufacturer's recommended bolt torque for flanges.

C. Resin Type Certification: Submit a certificate listing:

1. The type of resin to be used, describing the manufacturer's brand name.

2. Manufacturer's certification that tank construction complies with ASTM D-3299 or D-4097, D-2563.

D. Structural Design Calculations: Submit design calculations for information purposes:

1. Structural design of walls and design of tie-down lugs.

2. Details of all clips and lugs for hold down lugs, pipe brackets, and anchor bolts, as integral parts of the tank.

E. Nozzle Schedule: Include the following in the nozzle schedule:

1. Size and orientation

2. Mark, thickness and rating

3. Connection type

F. Contractor shall submit a Test Report describing the test results – see paragraph 3.5 for details.

G. Vendor Furnished Record Drawings & Information

1. Approved Drawings: Two (2) copies of the drawings listed below shall be submitted for record purposes. Any subsequent revisions to the drawings or procedures must be approved by the Owner's

Representative. Drawings must be checked and signed by the Manufacturer as checked before they will be reviewed by the Owner's Representative. Approved drawings shall present the following information as a minimum:

a. Certified dimensions of the tank, thickness, and attachments.

b. Construction specifications.

c. Shop testing procedures.

d. Nozzle schedule, including size, mark, thickness and rating.

e. Details of all nozzles, joints and reinforcements.

f. Details of all ladders, lifting, hold-down or support lugs.

g. Specifications for all supplied bolting and gaskets and accessory items.

h. Tank weight, empty.

i. Tank capacity (gallons).

j. UV absorbers or other pigments, if applicable.

k. Customer purchase order number, project and equipment number.

l. All materials of construction and laminate sequence of construction.

m. Method used for post-heat curing, if applicable.

1.5 SEISMIC LOAD

A. The structural aspects of the tanks and anchorage shall be sufficient to meet the 2021 International Building Code requirements for Seismic Design Category = B. See structural sheet S-001 for additional Design Criteria information. Tank Supplier shall submit detailed calculations illustrating the seismic characteristics and anchorage of the proposed tanks. Calculations shall be signed and sealed by a professional engineer licensed to practice in the State of New York.

1.6 QUALIFICATION AND WARRANTY

A. Manufacturer Qualification

1. The FRP Tanks shall be supplied by a reputable Manufacturer having at least ten (10) years' experience in the design and fabrication of such systems for the treatment of groundwater and water.

B. Warranty

1. Manufacturer shall provide warranty in accordance with Section 01 77 00 of the specifications.

PART 2. PRODUCTS

2.1 MATERIALS

A. Provide materials which are the standard products of a manufacturer regularly engaged in the manufacture of these types of tanks for a minimum of 10 years.

B. All tanks shall be fabricated in the shop, field assembly shall be minimized.

C. Tanks shall be manufactured by Augusta Fiberglass, Belding, or approved equal.

D. Resin:

1. The resins shall meet ASTM D-3299 for filament wound tanks greater than 8 feet in diameter.

2. The resins shall meet ASTM D-4097 for tanks less than 8 feet in diameter.

3. The same resin shall be used throughout the laminate. The resin used shall not contain fillers. No dyes or pigments will be used unless authorized by the Engineer. The cure system used for the resin shall be in accordance with the resin manufacturer's current recommendations. Proper curing of the resin is the fabricator's responsibility. All products fabricated to this specification shall be cured to at least 90% of the minimum Barcol hardness specified by the resin manufacturer. This requirement applies to both interior and exterior surfaces. No chemical-resistant surface shall be acetone sensitive. Acetone sensitivity is defined as tackiness of the laminate surface when rubbed with acetone.

E. Reinforcement: The reinforcing material shall be commercial grade type E glass fiber having a coupling chemically compatible with the resin used. Alternatively the glass fiber shall be as recommended by the tank manufacturer to meet the requirements of this application.

2.2 TANK REQUIREMENTS

A. See table below and tank schedule for tank sizes. Tank schedule also presents tank size, dimensions, ladder, type of top, and railing requirements.

Tank Description*	**Tank #**	**Bottom**	**Top**	**Nominal Volume (gal)**	**Diameter (ft)**	**Height (ft)**
Equalization Tank	T-100	Flat	Dome with slip resistant grit	15,000	12	18
LGAC Pumping Tank	T-410	Flat	Dome with slip resistant grit	15,000	12	18

Backwash Supply Tank	T-500	Flat	Dome with slip resistant grit	14,000	12	16

*Contents: Groundwater between pH 5 and 10.5; Density of water: 8.34 lb/gal.
** The tanks shall be provided with bottom that is sloped towards the pump suction nozzle.

B. Shell & Head Requirements: Shell & head requirements shall be as follows:

1. The minimum wall thickness shall be ¼" regardless of operating conditions.

2. Unless otherwise specified all vertical FRP tanks listed in tank schedule above shall be single wall tanks.

3. Unless otherwise specified, all vertical tanks shall be of flat-bottomed construction, continuously supported on a flat concrete pad, or equivalent.

4. The knuckle radius of all flat-bottomed tanks shall be 1 ½" minimum.

5. The shell shall be made of one manufactured section. No body joints will be allowed. If body joints are required, they shall be in the upper 1/3 of the shell.

C. Laminate Requirements: The following are the laminate requirements:

1. The outer surface of the fabricated product shall be relatively smooth and no glass fibers shall be exposed. On custom contact molded equipment, the final ply shall be mat or spray-up. The addition of reinforcement over this finish surface is optional and, if required, will be specified in the FRP Data Sheet.

2. An ultraviolet stabilizer shall be incorporated in the final coat of resin. The amount of stabilizer shall be per the resin manufacturer's recommendation.

3. All edges of reinforcement material shall be lapped: 1" minimum format, and 2" minimum for woven roving. Lapped edges of adjacent layers shall be staggered.

4. On laminates containing woven roving, cut edges exposed to the chemical environment shall be coated with resin and surfacing mat, and all other cut edges may be coated with resin only. The resin used shall be designated in the purchase specification and must contain paraffin to assure adequate surface cure.

5. Mold release agents such as MELINEX polyester film or PVA must be removed prior to inspection and shipment.

D. Equipment and Tank Connections:

1. Unless otherwise specified, all connections on tanks shall be flanged and provided as per the Tank Nozzle Layout Drawings.

2. All flanges shall be made by the hand lay-up construction. Press molded flanges are not acceptable. Flanges shall be manufactured of one-piece construction with integral stub.

3. The machine facing of the back of hand lay-up flanges is not permitted. All bolt holes shall be spot faced for SAE size washers, if required.

4. Flange drilling on pipe connections shall be in accordance with ANSI B-16.5 for 150-psi pressure class.

5. All nozzles 4” diameter or less shall be reinforced with plate gussets. Conical gussets having comparable strength may be substituted for the plate gussets.

6. Bolt holes in flanged nozzles are to straddle the vertical centerline.

7. On all flanged joints, use 1/8” thick full-faced neoprene gaskets having a specified Shore A Durometer hardness.

8. Reinforcement of nozzle and manhole openings in vessel walls shall be in accordance with the requirements of ASTM D 3299. The reinforcement pad shall consist of alternate piles of mat and woven roving. The edges of all reinforcing overlays shall be tapered to avoid abrupt change in overall thickness of vessel laminates.

9. No field fabrication shall be permitted.

2.3 ACCESSORIES

A. Tank Vent: Vent size shall equal size of largest fill or discharge fitting. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other standard. All tanks must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Tank manufacturer shall recommend necessary venting and placement information.

B. External fill pipes shall be provided per the approved drawings. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All external fill pipes shall be constructed of PVC or other specified material.

C. Internal down pipes shall be provided per approved drawings. All internal down pipes and dip tubes shall be supported at 5 ft. maximum intervals with a support structure welded to the inside of the primary tank. The support design may utilize a PVC clamp or other manufacturer-recommended materials for support. All internal fill pipes shall be constructed of PVC or other specified material. Interior piping (piping inside tanks such as drop piping) shall be installed at the shop as per drawings.

D. Sealed manways (24 in. I.D. minimum) with gaskets shall be provided on the sidewalls per the tank drawings. The manway shall be constructed of the same material as the tank. The bolts and nuts shall be 316 stainless steel and provided with washers and gaskets. .

E. All tanks shall be provided with a top manway with hinged lid that rests by its own weight on top of the lid opening (not bolted or latched shut or sealed air tight). The manway shall have a 24-inch I.D.

F. Ladder: All tanks taller than 5 feet shall be provided with OSHA-compliant ladders.

G. Handrails: All tanks taller than 5 feet shall be provided with FRP handrails on top, that are in accordance with OSHA requirements.

H. All tanks shall be provided with lifting lugs and seismic tie-down lugs. All anchor bolts shall be 316 SS.

I. All tank nozzles shall be provided with flanges at locations (orientation and elevation) shown on the Contract Drawings.

J. Tank Identification Plates: A stainless steel identification plate shall be securely mounted on the tank in a location that is visible at eye level. The plate shall bear the following information:

1. Manufacturer’s name, address, phone number, equipment model number, and serial number.

2. Capacity in Gallons

3. Manufacturer Serial Number

4. Year Built

5. Tank Name and ID Number (per P&ID); for example “T-8 BACKWASH SUPPLY TANK”.

6. Maximum Specific Gravity

7. Design Pressure and Temperature

8. Resin

PART 3. EXECUTION

3.1 GENERAL

A. The FRP storage tanks shall be manufactured in accordance with the best trade practices and in accordance with all applicable codes and regulations.

3.2 FABRICATION REQUIREMENTS

A. The fabricator shall not sublet any FRP component assembly without obtaining the Owner’s approval in writing. When pigmentation is specified, the pigment shall be dispersed in the resin used for the finish coat of the laminate. UV protection shall be provided for the exterior layer for improved resistance to degradation by UV radiation.

3.3 SHIPPING

A. All tank shipments shall be made by truck.

B. Tanks which are shipped in a horizontal position shall be mounted on padded cradles. All tank end blocking used to prevent shifting of tanks must be padded and bare only upon the knuckle radius of the tank bottom.

C. Tanks shall be secured to the cradles or skids to prevent rotation or other movement. In turn, the cradles or skids shall be fastened securely to the truck bed.

D. All tie-down straps shall give provision for thermal expansion and shall be padded where in contact with the tanks.

E. Flange faces shall be protected from damage by covering with suitable plywood, blank flanges, or hardboard, and securely fastened. Tanks shall be positively vented at all times. Tanks shall be shipped dry and free of any debris and FRP shavings.

3.4 INSTALLATION

Transportation, handling, storage of the tanks, and installation shall be in accordance with the manufacturer's printed instructions.

A. Contractor shall utilize the services of a tank manufacturer’s representative when installing the tanks.

B. The installer is to certify in writing that the tank system has been installed according to the tank manufacturer’s guidelines for use & installation.

3.5 TESTING

A. Visual inspection in the field after installation: The Contractor and Owner's Representative shall inspect the tank in the field after installation to ensure the tank is free of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delamination that will impair the serviceability of the vessel. If such visual defects are identified in the field after installation, the tank manufacturer shall field repair to the satisfaction of the Owner or if required replace such tanks at no cost to the Owner. All field repairs shall be conducted in accordance with industry standards and ASTM means and methods.

B. Cleaning following installation: Tanks shall be cleaned of loose debris, dirt and extraneous materials, washed with water and dried prior to testing. Any detergent or soap used for cleaning shall be compatible with the FRP material and shall be approved by the FRP tank manufacturer. Tanks shall be field tested for leaks or damage. Damage or leaks in tanks shall be repaired to the satisfaction of the Owner or tanks shall be replaced at no cost to the Owner. The fabricator shall remove all surface markings, coatings, or contaminants prior to inspection.

C. Hydrostatic Water Test (both at the factory and after installation in the field after all connections are made): The hydrostatic water test shall consist of filling the tank to brim full capacity and let it sit for a minimum of 24 hours then conducting a visual inspection for leaks around the perimeter (exterior) of the tank and checking for loss of water level. Contractor shall provide clean potable water, temporary pipes, hoses, pumps, and/or other equipment for onsite hydrostatic testing of each tank.

D. Test Report: Contractor shall provide a test report for each of the tanks that shall include as a minimum a description of the test, methodology used, data and time when test was performed and the results of the testing. Should test runs fail to meet the requirements, an explanation shall be provided with the rationale for failure of the test.

3.5 REMEDY

A. If the testing reveals deficiencies, corrective measures shall be taken until the tank satisfies all of the specified requirements. Remedies shall be completed at no additional cost to the Owner.

3.6 MANUFACTURER SERVICES

A. The Contractor shall provide the following personnel:

1. One (1) representative of the manufacturer who is experienced in the installation, adjustment, and testing of the tank. The representative shall supervise the installing, adjusting, and testing of tanks - for 20 days (8 hours a day).

END OF SECTION

SECTION 46 30 00

HYDROGEN PEROXIDE CHEMICAL FEED SYSTEMS
08/17

PART 1 GENERAL

1.1 SCOPE OF WORK

Provide the following chemical feed system consisting of chemical feed pumps on containment skid and chemical dosing control:

1. Two (2) peristaltic metering pumps with the entire pump containment skid assembly including the flow meters, inlet and outlet connections, panel and electrical enclosure, calibration cylinder and tubing, valves, pressure gauges and steel enclosure. All fittings and connections shall be stainless steel and the tubing shall be welded.
2. One (1) Chemical dosing control system capable of delivery in real time. The dosing system shall be capable of interacting with the AOP reactor to collect data on flow rate, chemical dosing concentration, contaminant concentration and other data.

Pump shall be mounted inside the steel enclosure. Capacity and design of the chemical feed systems and accessories shall be suitable for full load service in ambient, nonfreezing conditions. All feed pumps shall be consistent and work in the chemical dosing control system.

Contractor shall supply and install all materials, equipment, appurtenances, specialty items, and services required to provide an upright, double wall, flat bottom, closed top, one (1) 3000-gallon polyethylene storage tank for storage of the chemical application described in Table I. Thank will be capable of storing the chemical application at atmospheric pressure.

The supplier work shall include the supply and installation of a double wall, flat bottom storage tank with all assemblies. The assembly shall consist of one cylindrical inner primary tank and one blended form octagonal outer secondary tank. The tank will be designed for above ground, vertical installation and capable of containing chemicals at atmospheric pressure. The assembly shall be designed to prevent rainwater from entering the containment tank. The design shall allow direct primary tank base retention for up to seismic conditions per IBC code requirements.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2015) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe,

	Schedules 40, 80, and 120

HYDRAULIC INSTITUTE (HI)

HI 9.1-9.5	(2000) Pumps - General Guidelines for Types, Applications, Definitions, Sound Measurements and Documentation
HI ANSI/HI 7.1-7.5	(2017) Controlled-Volume Metering Pumps American National Standard for Nomenclature, Definitions, Application, and Operation - B115

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for review and approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Chemical Feed System; G

Safety Data Sheets

Framed Instructions

Auxiliary Equipment and Spare Parts

Factory Test Report

SD-06 Test Reports

Operating Tests

Tank Testing

System Pressure Tests

Flow Tests

SD-07 Certificates

Supplied Chemical

Service Organization

Certificates; G

SD-10 Operation and Maintenance Data

Operating Instructions; G

Maintenance Instructions; G

SD-11 Closeout Submittals

Extended Warranty; G

1.4 DELIVERY, STORAGE, AND HANDLING

Protect material and equipment delivered and placed in storage from the weather, excessive humidity and excessive temperature variation, dirt, dust, or other contaminants.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a chemical feed system consisting of a chemical supply storage tank from which the chemical solution is pumped through piping or tubing, as appropriate, to the point of application. Include with each chemical feed system controlled volume pumps, tanks, mixers, gauges, back pressure regulators, strainers, pressure relief valves, sight glasses and flow metering devices, check valves, and hand valves.

2.1.1 System Requirements

Select and fabricatee the pumps in accordance with HI ANSI/HI 7.1-7.5 and HI 9.1-9.5 except as modified herein. Provide pump stands and platforms adequate to support the pumping system.

2.1.2 Performance Requirements

Capacity and features of the chemical feed systems and accessories must be suitable for 24-hour full load service in ambient, non-freezing conditions.

2.1.3 Submittal Data for Chemical Feed System

Submit manufacturer's performance charts, and pump curves. List of materials, list of equipment, including a complete list of parts and supplies with current unit prices and source of supply. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.

2.1.4 Extended Warranty

provide Manufacturer's Extended Warranty to cover system components for 5 years.

2.2 EQUIPMENT

2.2.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening. Equipment must be supported by a service organization that is, in the opinion of the Remedial Project Manager (RPM), FEAD CM or Engineer, reasonably convenient to the site.

Submit Service Organization Certificates outlining their location and qualifications to the Remedial Project Manager (RPM), FEAD CM or Engineer.

2.2.2 Nameplates

Secure a plate to each major item of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.2.3 Controlled Volume Pumps

Provide controlled volume pumps as defined by HI ANSI/HI 7.1-7.5. Each pump must be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and be capable of continuous operation at rated capacity. Accuracy must be plus or minus 2 percent over a 100 to 1 range from the required maximum capacity to the minimum pumping rate. Net positive suction head required cannot exceed 90 percent of the net positive suction head available, as installed. Provide in a configuration as simple as practicable to provide equipment isolation, bypass and reliable service and to be readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

2.2.3.1 Oxidant Feed System

Provide the following for hydrogen peroxide solution delivery.

Concentration of material on suction side of pump:	Minimum 25 percent; maximum 27 percent.
Number of pumps:	2
Type of pump:	Peristaltic pump
Configuration:	Duplex.
Controls:	Automatic rate adjustment.
Feed or flow rate:	Minimum 0.6 gph; maximum 4.0 gph.
Back pressure at point of injection:	100 psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at 10 psig. Regulators must be of polyvinyl chloride construction with fluorocarbon resin diaphragms.
Suction valve cartridge:	Single ball check.
Discharge valve cartridge:	Single ball check.

Materials of construction allowed for wetted parts:	Type 304L stainless steel,.

2.2.3.2 Oxidant Feed Pump Requirements

2.2.3.2.1 Manufacturer

Pumps shall be manufactured by BlueWhite Ind. (FLEXFLO), Watson Marlow Pumps (Qdos Peristaltic Metering) or Approved Equal.

2.2.3.2.2 Materials and Equipment

Standard Products: Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products.

Nameplates: Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.2.3.2.3 Chemical Feed Pumps

Each Metering pump shall be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and shall be capable of continuous operation at rated capacity. Accuracy shall be plus or minus 3 percent of maximum capacity. Construction shall be as simple as practicable to provide equipment isolation, bypass and reliable service and to be readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

Chemical metering pumps and entire containment skid assembly shall be provided by USP Technologies or Approved Equal.

The following shall be provided for agent solution delivery.
1. Pump Drive: IP66 (NEMA 4X) for industrial environment.
2. Display: 3.5" TFT color display.
3. Pump Head: Sealed pump head with integral leak detection.
4. Pump Mounting: Pumps shall be mounted inside a steel enclosure having a pump skid and pump mount at the location shown on contract drawings.
5. Valves: Valve shall be constructed from 316 SS. The pressure range on the valve shall be with a design pressure range of 0-50 PSI.

2.2.3.2.4 Chemical Dosing Control System

The dosing control system shall be monitoring system that provides accurate readings for proper dose for water quality changes. The system shall integrate easily with the plant SCADA system using 4-20 Ma output.

2.2.3.2.5 Calibration Standpipes

Chemical metering equipment shall be provided with a calibration cylinder 1000 ml with 1/2" FNPT connection for measuring pump output. The calibration cylinder shall allow convenient observation of the change of fluid level for at least 1/2 minute at maximum speed settings, and shall be Schedule 80, clear PVC pipe conforming to ASTM D 1785. The standpipe

shall have a clear, observable length of at least 12 inches and shall be permanently calibrated in gallons and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.2.3.2.6 Pressure Gauges

Gauges shall be diaphragm type with Bourdon tube and diaphragm compartments filled completely with oil and shall be made of materials suitable for the application. Diaphragm seals shall be installed at each gauge connection to isolate gauges from corrosion, sludge or other hazards of the process fluid. Seal material shall be compatible with the oil in the gauge and the process fluid.

2.2.3.2.7 Injectors

Injectors for chemical solution shall be provided on process piping by means of a plastic injection nozzle, or by means of a suitable diffuser tube inserted through a corporation cock. The device for introducing the solution into a pressure main shall be constructed in such a way that accidental breakage of discharge hose or tubing will not cause water to escape from the pipeline and will allow disassembling of the unit without leakage.

2.2.3.2.8 Piping

Chemical Solution Piping: Chemical solution piping shall be 1/2" ID tubing housed in 2" CPVC pipe conforming to ASTM F441. The CPVC piping will act as secondary containment and shall be compatible with the chemical conveyed within the tubing. Provisions shall be incorporated to allow solution piping to be conveniently and safely bled of trapped air and minimize infiltration of air bubbles

2.2.3.2.9 Equipment Appurtenances

Bolts, nuts, anchors, washers and all other types of supports necessary for the installation of the equipment shall be Type 316 stainless steel.

2.2.4 Controls

Provide the chemical metering equipment with the appurtenances and accessories, as required, for flow capacity adjustment. Provide manual range adjustment on all systems.

2.2.4.1 Automatic Control

Provide automatic control with the capability to vary feed rate based on signals from a flow meter or controller.

2.2.4.1.1 Flow meter and Controller

Provide flow meter and controller capable of varying the chemical dosage in proportion to the measured flow with the dosage per flow unit manually adjustable. The chemical metering pumps shall be flow controlled. The chemical dosing shall be based on flow meter upstream of AOP. The dosing skid shall be controlled by AOP control panel. The control panel shall control the dose based on signal from flow meter.

2.2.5 Drives for Controlled Volume Pumps

Provide with and drive the metering pumps by alternating current electric motor drives.

2.2.6 Calibration Standpipes

Provide chemical metering equipment with a calibration standpipe for measuring pump output. The standpipe must allow convenient observation of the change of fluid level for at least 1/2 minute at full stroke and maximum speed settings, and of Schedule 80, clear PVC pipe conforming to ASTM D1785 with Schedule 80 fittings equipped with a flanged connection to the pump manifold and an end cap fitted with a PVC vacuum breaker and ball valve for air venting. The standpipe must have a clear, observable length of at least 12 inches and be permanently calibrated ingallons and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.2.7 Valves

2.2.7.1 Metering Pump Valves

Equip the metering pump with adjustable internal vacuum and pressure relief valve, hydraulic oil refill valve, and automatic air bleed valve. The relief valve must be adjustable over the full pressure range of the pump and preset at the factory.

2.2.7.2 Suction and Discharge Valves

Fit suction and discharge valve cartridges with ball checks that open to full pipe diameter.

2.2.7.3 Back Pressure Valve

Install back pressure regulating valve on the pump discharge and factory adjust to crack open at the indicated pressure. Provide spring opposed diaphragms with loading pressures adjustable by means of a screw in the top works.

2.2.7.4 Pulsation Dampeners

Size pulsation dampeners for the displacement of each pump. Pulsation dampeners must have a diaphragm separating the upper chamber from the lower chamber. Charge the upper chamber with compressed air to 50 percent of the expected line pressure. Provide the diaphragm of molded construction and prevent the air charge from being dissolved in the process fluid. The lower chamber must be plastic to prevent corrosion by the process fluid. Equip the upper chamber with a tire valve type charging valve and air pressure gauge. Provide an air line and air hose with pressure regulator and hand-operated, lever-type valve suitable for charging the pulsation dampers.

2.2.8 Solution Tanks

2.2.8.1 Oxidant Tank

Provide hydrogen peroxide solution resistant tank and comply with the

following:

Number of tanks:	1.
Minimum tank nominal capacity:	3000 gal.
Minimum tank operating capacity:	2000 gal.
Sign reading:	"DANGER - STRONG OXIDIZER" .
Containment:	Double wall and secondary containment.

2.2.8.2 Tank Requirements

2.2.8.2.1 Manufacturer

Tank shall be manufactured by USP Technologies or Approved Equal.

2.2.8.2.2 Design Requirements

The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 in. thick.
T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
T = wall thickness
SD = hydrostatic design stress, PSI
P = pressure (.433 x S.G. x H), PSI
H = fluid head, ft.
S.G.= specific gravity, g/cm^3
O.D.= outside diameter, in.

1. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, with a service factor selected for the application. The hydrostatic design stress would be 660 PSI at 73 degrees Fahrenheit. In accordance with the formula in 2.2 A., the tank shall have a stratiform (tapered wall thickness) wall. In no case shall the wall thickness be less than the minimum allowed per calculation of ASTM D1998.
2. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
3. The standard design specific gravity shall be 1.9.

The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Secondary containment tank shall be designed per the manufacturer's standard containment thickness requirements. The secondary containment shall be configured to allow shipment of the primary tank inside of the secondary tank. The shipment shall be done without the aid of additional spacer blocks which can be lost during shipment causing tank damage.

The top cover of the tank shall be a cylinder shell. The primary tank top shall be configured to prevent rain water from entering the secondary containment tank. The primary tank shall be keyed to the secondary tank

preventing primary tank rotation. The secondary containment shall have 115% of the normal fill capacity of the primary tank

Tank shall have lifting lugs into the top shell. The lifting lugs shall be designed to allow erection of empty primary and secondary tank. Tank shall be capable of being lifted into posi-tion as a unit (primary and secondary tank).

Tank Schedule	
Tank Reference #	1
Quantity/Capacity	One (1)/3000 gallons
Outside Diameter (Nominal)	102 inches
Inside Diameter (Nominal)	95 inches
Height maximum	108 inches
Maximum Usable Volume Height	94 inches
Secondary Tank Height	90 inches
Color	White
Manway Type	18" PE Threaded/Vented Manway w/15" Access
Fitting Material	PVC
Gasket Material	Viton
Bolt Material	316 SS

2.2.8.2.3 Service Conditions

Table I - Service Conditions							
Tank #	Chemical Stored	Concentrati Density	Tank Location Inside/ Outside	Operating Temp Range	Fitting Material	Gasket Material	Bolt Material
1	Hydrogen Peroxide	27% by weight/ 9.18 lbs/gal	Inside	-4deg F to 110deg F	PVC	Viton	316 SS

2.2.8.2.4 Chemical Compatibility

Chemical compatibility shall be according to the following chemical resistance guides:
Compass Publications -
Pruett, Kenneth M., "Chemical Resistance Guide for Plastics"

Pruett, Kenneth M., "Chemical Resistance Guide for Metals and Alloys"
Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers III"
These references shall be considered as general guidelines only.

Chemical	Concentration	Tank Resin	Tank Design Info	Fitting Material	Gasket Material	Bolt Material
Hydrogen Peroxide	27%	HDLPE	1.9/ASTM	PVC	Viton	316 SS

2.2.8.2.5 Tank Fittings and Accessories

Fittings - Threaded Bulkhead

1. Threaded bulkhead fittings are available for above liquid installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. The maximum allowable size for bulkhead fittings placed on a curved cylindrical section of tank 48 in. to 142 in. in diameter is 2 inch. Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness for each fitting size is shown below.

Fitting Size	Maximum Wall Thickness
1/2 in.	2 in.
3/4 in.	2 in.
1 in.	2 in.
1 1/4 in.	2 in.
1 1/2 in.	2 in.
2 in.	2 in.
3 in.	2.125 in. (Flat Surface Only)

2. The bulkhead fittings shall be constructed of PVC. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM.

Fittings - Bolted Stainless Steel Fittings

1. Bolted stainless steel fittings are available for below liquid level installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult SII for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in.	3 in.
64 in. - 142 in.	4 in.

The bolted stainless-steel fittings shall allow tank wall thickness up to 2 1/2 in.

2. The bolted stainless-steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have two gaskets and two flanges. One gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The other gasket shall be compressed be-tween the outside tank wall surface and the outside flange of the fitting. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of 1/4" thickness and constructed of 4050 du-rometer EPDM, 60-70 durometer Viton or other specified material.

Vents

1. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other accepted standard. All tank must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Some applications may require a sealed tank with a vent line going to a scrubber system for proper chemical safety. Venting equipment should be sized to limit pressure or vacuum in the tank to a maximum of 1/2" of water column (0.02 psi). U-Vents are offered in sizes from 1 in. to 6 in. with or without mesh insect screening. U-Vents with mesh screening may require additional sizing due to reduced airflow rates. Consult the manufacturer for necessary venting and placement information.

2. All u-vents shall be constructed of PVC or other specified materials.

3. When a tank is being filled from a pressurized tanker truck or rail car steps need to be taken to avoid pressurizing the tank. The tank may require a secondary surge protection lid to avoid any pressure build up. The surge protection lid is to be a 14" or 18" hinged and be design that it is self-closing.

4. To avoid the air surge and over-pressurization from a tank being filled from a pressurized tanker truck or rail car, the 18" (26" x 11.7") polyethylene mushroom vent could be used. The vent is to be attached to the tank with (8) screws and a bead of silicone sealant. The underside of the vent has 1/8" poly mesh insect screen. The mushroom vent requires a 19" diameter flat surface on the tank for installation.

Flexible Connections

1. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4% tank design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

2. The flexible connection is to be manufactured of the same material as the tank or a compatible material approved by the project engineer. If an elastomer flexible connection is used control bolts are required if recommended by the manufacturer. The flexible connection is to be designed for a minimum of 4% tank movement. The flexible connection is to be designed with 150# flange connections to allow for attachment to the tank and the piping system. The flexible connection is to be attached as close as possible to the tank to reduce stress.

2.2.8.2.6 Tank Attachments

Level Indication

1. Sight Level Gage

   a. The sight level gage shall be constructed of flexible PVC tubing to allow for tank contraction and expan-sion due to loading and temperature changes. The level gage shall be connected to the tank at the top of the tank with 1ea. appropriate 3/4" fitting and to a tee off of the drain / transition fitting. Each fitting can have valves installed for isolation or drainage purposes.

2. Reverse Float Level Gage

   a. The float level gage shall be constructed of a guided float on the inside of the tank connected to a weight indicator on the exterior of the tank with a 1/4" rope. The weighted indicator shall move along inside a clear guide pipe and may be equipped with an optional gallonage indicator board. The gallonage indicator board shall be made of PVC material and may be attached to the clear guide pipe. The board shall be stenciled with one hundred-gallon marks and labeled every five hundred gallons. The level gage shall be connected to the tank at an appropriate tank flat on the tank dome with 3" threaded bulkhead fittings and held along the tank sidewall with appropriate 1" fittings and stand-off connections.

   b. The float level gage rigid components shall be constructed of PVC. The rope shall be constructed of polypropylene or other specified material. Gaskets shall be constructed of EPDM or Viton.

3. Ultrasonic Level Indicator

   a. The ultrasonic enclosure is to be an all plastic design with a NEMA 4X rating. The ul-trasonic transducer is to have a 12" dead band and beam with a 20 ft range. The sup-ply voltage can be 110, 220 VAC or 24 VDC. The connection to the tank is to be 2" NPT.

   b. The ultrasonic level indicator shall provide a visual display of liquid level in the tank showing gallonage in measurement of hundreds of gallons along with 4-20 mA output for other alarm or control systems as well as four independent contacts capable of handling 10 amps each. Each contact can be programmed to operate in different opening and closing methods (7 modes). Contacts can be used to control pumps, valves, alarms.

Leak Detector Unit

1. The leak detector unit shall consist of a proximity sensor, a welded 2 in. FPT connection, a 2 in. bung plug with 3/4 inch strain relief, and

an indicator box. The sensor is placed in the interstitial space between the primary and secondary tank approximately 1 in. above the tank bottom. The indicator box shall be NEMA 4 rated and factory pre-wired for 110 VAC power. All connections shall be labeled to prevent errors in field installation. The indicator box will show a green light when power is on and the sensor is not detect-ing a liquid. The light is a push to test light allowing the operator to test for power outage or malfunction. If the green light goes out there are two possibilities. The green light does not come on when the button is pushed. This would indicate a lack of power to the unit or the light bulb is burned out. If the green light comes on when pushed, then a possible leak condition is indicated.

Threaded Manways and Fill Caps

1. Manways shall be 18 in. vented or non-vented threaded design or hinged style (minimum opening diameter of 15 in.) and a 24 in. vented or non-vented threaded or hinged style (minimum opening diameter of 22 in.)

2. All caps and manways shall be constructed of polyethylene material.

Down Pipes and Fill Pipes

1. External Fill / Down Pipe

    a. External fill pipes shall be approved drawings and specifications. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported).

    b. All external fill pipes shall be constructed of PVC or other specified materials.

Ladders

1. Ladders shall be constructed of galvanized mild steel or FRP.

2. Safety cages shall be provided with ladders per OSHA standards.

3. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.

4. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded-in attachment lugs that allow for tank movement due to temperature and loading changes.

5. Mild steel parts shall be deburred and galvanized.

Base Angles

1. The tie down system shall consist of built in base angles around the perimeter of the tank base. Expansion or chemical anchors shall be used to connect to base slab through holes in these angles. The base angles shall be designed to withstand wind loads. The base angles must meet seismic requirements per IBC 2015 / CBC 2016 code (Seismic Design Category "D" - Fa=1.0, Fv=1.5, Ss=1.4, S1=0.5). The contractor shall provide the calculations that meet these requirements. A registered

engineer's wet stamped calculations and or drawings shall be submitted for review and approval prior to installation.

2. The base angle system shall be offered in either galvanized steel, 304 or 316 stainless steel.

2.2.8.2.7 Marking and Packaging

The tank shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a 3 of 9, HRI bar code label containing tank de-scription, manufacturing order number, part number, serial number, manufacturer, and date.

The proper caution or warning signs as prescribed by OSHA standard 29 CFR 1910.106 shall be customer determined and supplied.

All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.

All fittings that do not interfere with tank shipment shall be installed unless otherwise specified. Fittings and accessories that interfere with tank shipment or could be broken during shipment are shipped separately

Permanent Labels:

1. Engraved stainless steel identification plate.

2. National Fire Protection Association label specifically coded for the tank contents in accordance with NFPA 30. to be supplied by the contractor.

3. Stencil the chemical label on to the tank wall to be clearly visible from outside the tank enclosure. Must be ordered by customer. (remove if not required).

2.2.8.2.8 Tank Fitting Accessories Requirements

Fitting and Accessory Schedule

Tank Number	Tank-1
Quantity/Capacity	One (1)/3000 gallon
Inlet/Fill	2-inch, 316 SS
Outlet	1 inch threaded
Drain	2 inches threaded
Overflow Pipe	2 inches
Vent	One(1) - 6 inches
Surge Protection Lid	

Manway	18" PE Threaded/Vented Manway w/15" Access
Access Ladder	FRP
Lifting Lugs	68" lifting lug assembly, U-Bolt, 6" x 5/8" threads, SS

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Remedial Project Manager (RPM), FEAD CM or Engineer of any discrepancy before performing the work.

3.2 INSTALLATION

Submit detail drawings containing complete piping, wiring, schematic, flow diagrams, and any other details required to demonstrate that the system has been coordinated and properly functions as a unit. On the drawings show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for installation, maintenance and operation.

3.2.1 Chemical Feeding Equipment

Install controlled volume pumps, equipment, and appurtenances to provide a complete and integrated system in accordance with the instruction of the manufacturer and under the direct supervision of the manufacturer's representative.

3.2.2 Pipe, Tubing, Hangers and Supports

Install pipes and tubes in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.3 Field Painting

Thoroughly clean, prime and top-coat factory painted items requiring touching up in the field with the manufacturer's standard factory finish provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Paint the equipment which did not receive a factory finish as specified in Section 09 90 00 PAINTS AND COATINGS. Coating must be at least 1.75 mils thick. Provide piping identification as specified in Section 09 90 00 PAINTS AND COATINGS. Mark pipe carrying materials not listed in Section 09 90 00 PAINTS AND COATINGS in accordance with ASME A13.1.

3.2.4 Framed Instructions

Submit framed instructions for approval prior to postings. Final size must be easy to read by operators 5 feet from instructions. Limit frame size to 11" x 17" size provide multiple frames if needed. Post framed instructions, containing wiring and control diagrams, where directed. Post condensed operating instructions as outlined in paragraph 3.4.2 Operating Instructions. Post the framed instructions before acceptance testing of the systems.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

After installation of each controlled volume pump, carry out operating testsas specified below to assure that the chemical metering installation operates properly. If any deficiencies are revealed during any tests, correct such deficiencies and reconduct the tests. Submit reports of all tests in booklet form prior to final acceptance of the installation. Show all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

3.3.1.1 Testing and Inspection

Contractor shall be responsible for conducting all testing and inspections. Contractor shall engage the services of a qualified and certified testing agency that is approved to conduct tests and inspections of all equipment and materials installed prior to operation and putting in service. The testing and inspection shall be conducted under a certified PE in the state of New York where applicable. All testing and inspection reports shall be submitted to EOR for review and approval.

3.3.1.2 Field Service

Manufacturer's field service representative shall be engaged to verify the installation and connection requirements of all equipment and materials for its complete operation.

The certified testing agency representative and manufacturer's field representative will work together to complete all testing and inspection requirements.

3.3.1.3 Tank Testing

Clean tanks of loose debris and dry prior to testing. Field test tanks for leaks or damage in shipment. Hydrostatically test tanks to 1.5 times the system operating pressure, whichever is greater, to detect large leaks and then with the specified chemical to detect small leaks. Test each tank with its solution for a period of 24 hours at which time no visible leakage is evident. Supply all pipes, hoses, pumps, water, power and other equipment required to convey the test liquids and to carry out the tests. Repair damage or leaks in tanks or replace tanks. Replace damaged ceramic tanks.

3.3.1.4 Flow Tests

Test pumps to demonstrate zero gpm flow at a zero stroke or speed setting. Failure to meet this test is cause for rejection. Test pumps through full range of performance: min. flow 0.6 GPH. Submit test results to prove pump functions within specified system parameters.

3.3.2 Chemical Waste

Neutralize chemicals wasted during testing procedures to achieve a pH value between 6.5 and 9.5 and a chlorine concentration of not more than 1 percent (10,000 mg/L). Route all chemicals wasted during testing

procedures as directed by the Remedial Project Manager (RPM), FEAD CM or Engineer at a rate that the process can assimilate without upset.

3.3.3 Manufacturer Field Service

Provide the services of a manufacturer's representative who is certified by manufacturer in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, and testing of the equipment. Submit certificates to Remedial Project Manager (RPM), FEAD CM or Engineer for approval.

3.4 CLOSEOUT ACTIVITIES

3.4.1 FIELD TRAINING

Conduct a field training course for designated operating, maintenance and supervisory staff members. Provide training for a total period of 24 hours of normal working time and start after the system is functionally complete but prior to final acceptance tests. Cover all of the items contained in the Operating and Maintenance Instructions during field training.

3.4.2 Operating Instructions

Submit complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include in the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Also include in the instructions as-built drawings of the piping layout, equipment layout, simplified wiring and control diagrams of the system as installed, and flow diagrams.

3.4.3 Maintenance Instructions

Submit complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble-shooting guides.

-- End of Section --

SECTION 46 30 01

WATER AND WASTEWATER CHEMICAL FEED SYSTEMS
08/17

PART 1 GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment, and incidentals required for the following chemical feed systems:

1. Sodium Hydroxide (Caustic Soda (25%)

2. Sodium Hypochlorite (12%)

Each chemical system shall include a double wall chemical storage tank, metering pump(s), containment skid, related piping, valves, and controls as shown on the drawings and specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2015) Scheme for the Identification of Piping Systems
ASME B16.1	(2015) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded

ASTM INTERNATIONAL (ASTM)

ASTM D1785	(2015; E 2018) Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM F441/F441M	(2015) Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

HYDRAULIC INSTITUTE (HI)

HI 9.1-9.5	(2000) Pumps - General Guidelines for Types, Applications, Definitions, Sound Measurements and Documentation

HI ANSI/HI 7.1-7.5	(2017) Controlled-Volume Metering Pumps American National Standard for Nomenclature, Definitions, Application, and Operation - B115

PLUMBING-HEATING-COOLING CONTRACTORS ASSOCIATION (PHCC)

NAPHCC NSPC	(2015) National Standard Plumbing Code Illustrated

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G [, [_____]]

SD-03 Product Data

Chemical Feed System; G [, [_____]]

Safety Data Sheets

Framed Instructions

Auxiliary Equipment and Spare Parts

Factory Test Report

SD-06 Test Reports

Operating Tests

Tank Testing

System Pressure Tests

Flow Tests

SD-07 Certificates

Supplied Chemical

Service Organization

Certificates; G

SD-10 Operation and Maintenance Data

Operating Instructions; G [, [_____]]

Maintenance Instructions; G [, [_____]]

SD-11 Closeout Submittals

Extended Warranty; G

1.4 DELIVERY, STORAGE, AND HANDLING

Protect material and equipment delivered and placed in storage from the weather, excessive humidity and excessive temperature variation, dirt, dust, or other contaminants.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide each chemical feed system complete with a storage tank from which the chemical solution is pumped through piping or tubing, as appropriate, to the point of application. Include with each chemical feed system metering pumps, tanks, mixers, gauges, back pressure regulators, strainers, pressure relief valves, sight glasses and flow metering devices, check valves, and hand valves.

2.1.1 System Requirements

Select and fabricate the pumps in accordance with HI ANSI/HI 7.1-7.5 and HI 9.1-9.5 except as modified herein. Provide pump stands and platforms adequate to support the pumping system.

2.1.2 Performance Requirements

Capacity and features of the chemical feed systems and accessories must be suitable for 24-hour full load service in ambient, non-freezing conditions.

2.1.3 Submittal Data for Chemical Feed System

Submit manufacturer's performance charts, and pump curves. List of materials, list of equipment, including a complete list of parts and supplies with current unit prices and source of supply. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.

2.1.4 Extended Warranty

provide Manufacturer's Extended Warranty to cover system components for 5 years.

2.2 EQUIPMENT

2.2.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 5 years prior to request for proposal. Equipment must be supported by a

service organization that is, in the opinion of the Owner's representative, reasonably convenient to the site. Submit Service Organization Certificates outlining their location and qualifications to the Contracting Office.

2.2.2 Nameplates

Secure a plate to each major item of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.2.3 Controlled Volume Pumps

Provide controlled volume pumps as defined by HI ANSI/HI 7.1-7.5. Each pump must be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and be capable of continuous operation at rated capacity. Accuracy must be plus or minus 2 percent over a 100 to 1 range from the required maximum capacity to the minimum pumping rate. Net positive suction head required cannot exceed 90 percent of the net positive suction head available, as installed. Provide in a configuration as simple as practicable to provide equipment isolation, bypass, and reliable service and to be readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

2.2.3.1 Metering (Chemical Feed) Pump Requirements

2.2.3.1.1 Manufacturer

Pumps shall be manufactured by Blue White Ind., Pulsafeeder, Prominent metering pumps, or Approved Equal.

2.2.3.1.2 Materials and Equipment

Standard Products: Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products.

Nameplates: Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.2.3.1.3 Chemical Metering Pump Requirements

Include with each chemical metering pump system: controlled volume pump, pressure gauge, diaphragm seals, back pressure valve, strainer, pressure relief valves, pulsation damper, sight glass (calibration column), check valve, hand valves, stand, and any other items as shown on the P&IDs as being within the limits of the chemical metering system manufacturer's responsibility. Injection assembly shall be provided separately for field installation. Containment skid shall be adequate to contain minor leaks, and strong enough to support metering pump(s) and related piping and valves system. Capacity and design of the chemical metering systems and accessories shall be suitable for 24-hour full load service in ambient, non-freezing conditions.

Each chemical pumping system shall be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and shall be capable of continuous operation at rated capacity. Accuracy shall

be plus or minus 2 percent over a 100 to 1 range from the required maximum capacity to the minimum pumping rate.

Chemical	Number of Pumps	Pump Flow Rate and Pump Description
Caustic (25%)	Two pumps (pre-piped with all valves and installed on a secondary containment skid)	Peristaltic Metering Pump rated for 8 gph @ 110 psi. Pump equipped with brushed DC, 1/8 hp motor, 115 v / 60 Hz / 1 phase operating voltage. 1/2" Male NPT fitting, natural PVDF connectors and .187” ID Flex-A-Prene tube. **Mode of Operation** · Manual (local) speed adjustment · Ethernet/IP · Remote Input: 4-20mA analog · Remote Input: Pulse Input · Remote Input: Pulse triggered batch dispensing **Inputs** · 4-20 mA, 0-10VDC, pulsed, contact closure (remote start/stop) **Outputs** · 4-20 mA, 1-amp contact closure **Displays** · Motor speed, input signal, tube life timer, TFD alarm status **Features** · Patented Tube Failure Detection (TFD) System · Prime Button · Heavy duty rotor with bi-directional injection · Tube Life Timer · Backlit LCD Display · Output adjustment: 200:1 (0.65 to 130 RPM)

Chemical	Number of Pumps	Pump Flow Rate and Pump Description
Sodium Hypochlorite (12%)	Two pumps (pre-piped with all valves and installed on a secondary containment skid)	Peristaltic Metering Pump rated for 2 gph @ 110 psi. Pump equipped with brushed DC, 1/8 hp motor, 115 v / 60 Hz / 1 phase operating voltage. 1/2" Male NPT fitting, natural PVDF connectors and .187” ID Flex-A-Prene tube. **Mode of Operation** · Manual (local) speed adjustment · Ethernet/IP · Remote Input: 4-20mA analog · Remote Input: Pulse Input · Remote Input: Pulse triggered batch dispensing **Inputs** · 4-20 mA, 0-10VDC, pulsed, contact closure (remote start/stop) **Outputs** · 4-20 mA, 1-amp contact closure **Displays** · Motor speed, input signal, tube life timer, TFD alarm status **Features** · Patented Tube Failure Detection (TFD) System · Prime Button · Heavy duty rotor with bi-directional injection · Tube Life Timer · Backlit LCD Display · Output adjustment: 200:1 (0.65 to 130 RPM)

2.2.5 Chemical Feed System Controls

The chemical metering equipment shall be provided with the appurtenances and accessories, as required, for flow capacity adjustment. Manual range adjustment shall be provided on all systems. Provide a color coordinated, 115 V AC, 1 PH plug and outlet for each feed pump.

Chemical metering pumps shall be controlled by the Plant PLC through the Ethernet/IP connection on the pump. Available controls and monitoring shall include at a minimum:

a. Pump Start/Stop
b. Pump Speed Setpoint
c. Pump Run Status
d. Pump Available
e. Pump Speed Feedback
f. Tube Failure Detected (TFD)

Manual Control: Provide the capability for starting or stopping the chemical metering equipment and adjustment of the solution feed rate manually by the operator.

2.2.6 Chemical Storage Tanks

2.2.6.1 Tank Size and Capacity

Tanks sizes capacity is specified below.

2.2.6.2 Chemical Tank Requirements

2.2.6.2.1 Manufacturer

Tank shall be manufactured by Assmann Tanks, Snyder Tanks, Chemtainer, Poly Processing or Approved Equal.

2.2.6.2.2 Mechanical Properties of Tank

Mechanical properties of tank material HDLPE shall be as follows:

PROPERTY	ASTM	VALUE
Density (Resin	D1505	0.941-0.948 g/cc
Tensile (Yield Stress 2"/min)	D638	3000 PSI
Elongation at Break (2"/min)	D638	>1000%
ESCR (100% lgepal, Cond. A, F50)	D1693	550 hours
ESCR (10% lgepal, Cond. A, F50)	D1693	50 hours
Vicat Softening Degrees F. Temperature	D1525	235
Flexural Modulus	D790	130,000PSI
Rated for Product Temperature		120 F

2.2.6.2.3 Chemical Tanks Design Details

A. **Sodium Hydroxide (25%) -** Stored inside at ambient temperature

CONFIGURATION: Double-wall, vertical, cylindrical, flat bottom, domed top head

CAPACITY: 4400 US Gallons (nominal)

DIMENSIONS: 10’ OUTER DIAMETER, 10.5’ OVERALL HEIGHT

CONSTRUCTION: Rotationally molded for a seamless, one-piece tank

MATERIAL: Linear Polyethylene

DESIGN: Tank rated for up to 1.9 specific gravity product
No internal pressure or vacuum
No wind load or seismic calculations
Temperatures to 130°F sustained, 140°F upset MAX
Tanks designed and fabricated in accordance with ASTM D1997-98 standards

SUPPORT: Tank to rest flat on floor or pad
Tank bottom must be fully supported

MANWAY: (1) 16” DIA top access manway with lever lock cover

FITTINGS: (1) 3” CPVC bulkhead fitting with EPDM gasket – VENT (TOP)
(1) 2” CPVC bulkhead fitting with EPDM gasket, fill pipe assembly and a CPVC internal anti-foam elbow – FILL CONN (TOP)
(3) 3” CPVC bulkhead fitting with EPDM gasket – LT, LSH AND A SPARE (TOP)
(2) 2” CPVC bulkhead fitting with EPDM gasket – PRV RETURN AND A SPARE (TOP)
(1) 3” CPVC bulkhead fitting with EPDM gasket – OVERFLOW (TOP SIDE)
(2) 2” 316SS/EPDM Thru-Wall fitting with EPDM gasket with CPVC Siphon Drain –BOTTOM SIDE for Suction and Drain

ACCESSORIES: (1) Name Plate, White phenolic plastic engraved
(1) Heat Tracing and Insulation, 50 deg. Delta T

INSULATION USE: Nominal 2” of urethane spray foam insulation

MASTIC USE: Two coats of mastic coating (grey standard)
Silcopad adhesive backed heating elements
NEMA 4 Control Box with dual control thermostats high limit/maintenance temperature

B. **Sodium Hypochlorite (12%)** -Stored inside at ambient temperature

CONFIGURATION: Double-wall, vertical, cylindrical, flat bottom, domed top head

CAPACITY: 1000 US Gallons (nominal)

DIMENSIONS: 6.5’ OUTER DIAMETER, 5.5’ OVERALL HEIGHT

CONSTRUCTION: Rotationally molded for a seamless, one-piece tank

MATERIAL: Linear Polyethylene

DESIGN: Tank rated for up to 1.9 specific gravity product
No internal pressure or vacuum
No wind load or seismic calculations
Temperatures to 130°F sustained, 140°F upset MAX
Tanks designed and fabricated in accordance with ASTM D1997-98 standards

SUPPORT: Tank to rest flat on floor or pad
Tank bottom must be fully supported

MANWAY: (1) 16" DIA top access manway with lever lock cover

FITTINGS: (1) 2" CPVC bulkhead fitting with Viton gasket, fill pipe assembly and a CPVC internal anti-foam elbow - FILL CONN (TOP)
(4) 3" CPVC bulkhead fitting with EPDM gasket - LT, LSH, VENT AND A SPARE (TOP)
(2) 2" CPVC bulkhead fitting with Viton gasket - PRV RETURN AND A SPARE (TOP)
(1) 3" CPVC bulkhead fitting with Viton gasket - OVERFLOW (TOP SIDE)
(2) 2" 316SS/EPDM Thru-Wall fitting with Viton gasket with CPVC Siphon Drain - BOTTOM SIDE for Suction and drain (SIDE)

ACCESSORIES: (1) Name Plate, White phenolic plastic engraved

2.2.6.2.3 Chemical Tanks - Additional Design Requirements

The minimum required wall thickness for the cylinder straight shell shall be sufficient to support its own weight in an upright position without any external support. Secondary containment tanks shall be designed per the manufacturer's standard containment thickness requirements.

The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 550 or more gallons of capacity shall be designed to provide a minimum of 1300 square inches of flat area for fitting locations. The primary tank shall be keyed to the secondary tank preventing primary tank rotation. The secondary containment shall have at least 115% of the maximum fill capacity of the primary tank.

Tanks with 550 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of empty primary and secondary tanks. Tanks shall be capable of being lifted into position as a unit (primary and secondary tanks). Contractor shall follow tank manufacturer's guidelines for lifting, placing, and securing tanks.

The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in seismic loading situations without tank damage. The primary/secondary tank unit shall be configured to allow direct primary tank base retention for seismic load conditions. The base retention unit shall be anchor bolted to an appropriate structure and not require additional spacer blocks

1. The tie down system shall be designed to withstand seismic loads per paragraph 1.5 of this section. Anchor bolts shall be provided by the Contractor per the calculations and the base plates for the system. A Professional Engineer registered in the state of PA shall stamp the calculations and anchorage drawings. The tie down system shall be manufactured in the same materials as the anchor bolts as specified in the above table.

2.2.6.2.4 Chemical Tank Appurtenances

Tank appurtenances shall be as follows:

Tank Number	T-910 (Caustic)	T-920 (Sodium Hypochlorite)
Description	Quantity/Size	Quantity/Size
External fill pipe	CPVC	CPVC
Internal fill pipe	CPVC	CPVC
Manway; Bolted/Sealed	Yes	Yes
Ladder with safety cage/FRP	Yes	Yes
Handrails on top of tank	Yes	Yes
Lifting Lugs	Yes	Yes
Tie-down Lugs	Yes	Yes
Seismic Tie-down	Yes	Yes
Anchor bolts	Yes- 316 SS	Yes - Titanium
Visual Level Indicator; Mechanical Reverse Float	Yes	Yes
Leak Detection System	Yes	Yes
Heat System, ambient temp., maintenance temp., 2” insulation w/mastic coating	Yes	No

2.2.6.2.5 Chemical Tanks - Additional Accessories

1. Tank Vent: Vent size shall one size larger than the largest fill or discharge fitting. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106

(f) (2) (iii) or other accepted standard. All tanks shall be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Tank manufacturer shall recommend necessary venting and placement information. Tanks shall be vented outside the building as shown on the drawings. A rain guard and ¼" CPVC mesh screen for caustic, sodium hypochlorite.

2. All chemical storage tank shall have a leak detector unit consisting of an optic sensor with SPST switch (NO or NC states). The probe shall be compatible with the chemical stored. The sensor shall be placed in the interstitial space between the primary and secondary tanks approximately 1 in. above the tank bottom. Vendor shall provide a 4-conductor shielded cable, 25-foot minimum for ease of field wiring. The leak detector shall have dry contact relay for sending leak signal back to the Treatement Plant PLC. Vendor shall provide connection to tank containment, sized to allow vendor provided leak detector to be inserted into the interstitial space.

3. External fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All external fill pipes shall be constructed of CPVC for caustic and sodium hypochlorite tanks.

4. Internal down pipes shall be supported at 5 ft. maximum intervals with a support structure welded to the inside of the primary tank. The support design may utilize a PVC clamp or other specified materials for support. All internal fill pipes shall be constructed of the same materials as that of their respective fill pipes.

5. For tanks larger than 550 gallons, a sealed top manway (24 in. in size) shall be provided. The manway shall be constructed of the same material as the tank. The bolts shall be the same material as the anchor bolts specified above. The gaskets shall be closed cell, crosslinked polyethylene foam and Viton O-rings to seal the bolts. For small er tanks, provide a 12” diameter threaded manway.

6. The float level gauge shall be constructed of a guided float on the inside of the tank connected to a weight indicator on the exterior of the tank with a 1/4" rope. The weighted indicator shall move along inside a clear guide pipe and may be equipped with a gallonage indicator board. The gallonage indicator board made of CPVC material and may be attached to the clear guide pipe. The board shall be stenciled with fifty-gallon marks and labeled every hundred gallons. The level gauge shall be connected to the tank at an appropriate tank flat on the tank dome with 3” threaded bulkhead fittings and held along the tank sidewall with appropriate 1" fittings and stand-off connections. The float level gauge rigid components shall be constructed of CPVC material. The rope shall be constructed of EPDM.

7. Precautions need to be taken to avoid pressurizing the tanks. The tanks require a secondary surge protection lid to avoid any pressure build up. The hinged lid is to be manufactured of polyethylene. The lid will be a 14 in. size with 11 in. access opening or 18 in. size with 15 in. access opening. The opening of the lid is to be restricted by a tether. The lid is to be designed so that is will close when the pressure has been released.

8. All tank nozzles shall be provided with flanges at locations (orientation and elevation) shown on the Contract Drawings.

9. Ladders and Handrailing (for tanks greater that 96” tall)

   a. Ladders shall be constructed of FRP.

   b. Safety cages shall be provided with ladders per OSHA standards.

   c. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.

   d. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded-in attachment lugs that allow for tank movement due to temperature and loading changes.

   e. Provide FRP handrailing at the top of each tank to access manway for periodic inspection and instruments calibration.

9. Base Angles

   a. The tie down system shall consist of built-in base angles around the perimeter of the tank base. Expansion or chemical anchors shall be used to connect to base slab through holes in these angles. The base angles shall be designed to withstand wind loads. The base angles must meet seismic requirements per IBC 2021 / NYBC 2020 code with seismic loads. (Seismic Design Category "D" - Fa=1.6, Fv=2.4, Ss=0.24, S1=0.05). The contractor shall provide the calcula-tions that meet these requirements. A registered engineer's wet stamped calculations and or drawings shall be submitted for review and approval prior to installation.

   b. The base angle system shall be offered in either galvanized steel, 304 or 316 stainless steel.

10 Nameplates: Provide the following information printed on its nameplate:

   1. Name of Manufacturer

   2. Capacity in Gallons

   3. Chemical Stored

   4. OSHA Safety Placard

   5. Year Built

   6. Tank/equipment Number

   7. Maximum Specific Gravity

   8. Design Pressure, Temperature and Resin

2.2.7 Chemical Feed Piping, Tubing, Valves and Accessories

2.2.7.1 Piping and Tubing

All chemical feed system shall be ½" Teflon tubing housed in 2" CPVC pipe conforming to ASTM D 1785. The CPVC piping will act as secondary containment and shall be compatible with the chemical conveyed within the tubing. Provisions shall be incorporated to allow solution piping to be conveniently and safely bled of trapped air and minimize infiltration of air bubbles. The tubing shall be continuous and without any joints from the pump to the injection/discharge location.

Provide Teflon tubing that is suitable for suction and discharge application for use at caustic, and hypochlorite chemical feed systems. Tubing shall be constructed of Teflon resin - fluorinated ethylene propylene (FEP), 55 durometer, 3500-psi tensile strength, suitable for 80-psi working pressure and a test pressure of 150% working pressure. Tubing shall be capable of withstanding repeated flexing and crimping. Tubing shall be translucent in color. In addition, caustic conveyance tubing shall be in an insulated and heat traced jacked as described below.

Tube fittings shall be flareless compression type, constructed of Teflon® resin. Fitting system shall meet a 150-psi working pressure.

CPVC Solvent Cement: Joints shall be assembled using an approved solvent cement in accordance with the manufacturer's recommendations and ASTM D2564 and ASTM D2855. No cementing shall be done in the rain or when the air temperature is below 40°F or above 90°F.

Containment Pipe Supports: Pipe shall be provided with supports spaced not farther than the manufacturer's recommended spacing for 100°F service. For piping 2" or smaller, supports shall be every 5'. Pipes shall be pitched to drain towards the storage tank as much as possible.

2.2.7.2 Injectors

Injector for caustic, hypo system shall be provided with a check valve and shall be CPVC. The device shall introduce the solution that it will allow disassembling of the unit without leakage/spillage of the chemical solution. The injector shall be manufactured by SAF T SEAL or approved equal provided with a ½" male inlet connection, spring loaded ball check valve, CPVC compression gland, CPVC Ball valve, CPVC quick release coupling, 1" male main connection, and the tip shall be provided with a Viton® GLT SAF-T-SEAL. The injector shall be connected to the Teflon tubing and the secondary containment dip-tube in such a way that it shall allow for ease of maintenance.

2.2.7.3 Secondary Containment Skid (Hypo and caustic pumping Systems)

The duplex chemical metering pumps, suction and discharge piping, valves and appurtenances (as identified on PIDs) shall be factory installed inside a secondary containment skid system, Model BCPS-Chem Feed System as manufactured by Burt Process Equipment or approved equal. The containment skid shall have a leak detection sensor with dry contacts for sending leak signal back to Treatment Plant PLC. Containment shell material shall be compatible with the chemical. Each skid mounted pumping system shall be factory tested at 100 psi.

Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the skid in a location that is at eye level. The plate shall bear the system supplier's name, address, phone number, equipment model number, and serial number. Contractor shall confirm material and contents on equipment ID plate.

2.2.7.4 Calibration Standpipes

Provide chemical metering equipment with a calibration standpipe for measuring pump output. The standpipe must allow convenient observation of the change of fluid level for at least 1/2 minute at full stroke and maximum speed settings, and of Schedule 80, clear PVC pipe conforming to ASTM D1785 with Schedule 80 fittings equipped with a flanged connection to the pump manifold and an end cap fitted with a PVC vacuum breaker and ball valve for air venting. The standpipe must have a clear, observable length of at least 12 inches and be permanently calibrated in gallons and fractions thereof, to allow reading of the fluid contents with an accuracy of 1 percent.

2.2.7.5 Valves

2.2.7.5.1 Suction and Discharge Valves

Fit suction and discharge valve cartridges with ball checks that open to full pipe diameter.

2.2.7.5.2 Back Pressure Valve

Install back pressure regulating valve on the pump discharge and factory adjust to crack open at the indicated pressure. Provide spring opposed diaphragms with loading pressures adjustable by means of a screw in the top works.

2.2.7.6 Pulsation Dampeners

Size pulsation dampeners for the displacement of each pump. Pulsation dampeners must have a diaphragm separating the upper chamber from the lower chamber. Charge the upper chamber with compressed air to 50 percent of the expected line pressure. Provide the diaphragm of molded construction and prevent the air charge from being dissolved in the process fluid. The lower chamber must be plastic to prevent corrosion by the process fluid. Equip the upper chamber with a tire valve type charging valve and air pressure gauge. Provide an airline and air hose with pressure regulator and hand-operated, lever-type valve suitable for charging the pulsation dampers.

2.2.7.7 Pressure Gauges

Provide diaphragm type gauges with Bourdon tube and diaphragm compartments filled completely with oil and made of materials suitable for the application. Install diaphragm seals at each gauge connection to isolate gauges from corrosion, sludge, or other hazards of the process fluid. Provide seal material that is compatible with the oil in the gauge and the process fluid.

2.2.8 Spare Parts and Tools

System supplier shall provide following recommended replacement parts for all chemical metering system fittings and related accessories:

1. Four (4) 3" EPDM gaskets
2. Four (4) 2" EPDM gaskets
3. Four (4) 2" Viton gaskets
4. Two (2) CPVC 2" check valves with 1/2" NPT
5. Two (2) CPVC 2" ball valves with Viton seals
6. Two (2) CPVC Back pressure valves with 1/2" union connection
7. Two (2) CPVC Pressure relief valves with 1/2" union connection
8. One (1) calibration column
9 Two (2) Float level gauge
10. 100 feet of 1/2" Teflon tubing
11. Two (2) 316 stainless steel pressure gauges
12. One (1) pulsation dampener
13. One (1) ½" CPVC injection quill

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Owner's representative of any discrepancy before performing the work.

3.2 INSTALLATION

Submit detail drawings containing complete piping, wiring, schematic, flow diagrams, and any other details required to demonstrate that the system has been coordinated and properly functions as a unit. On the drawings show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for installation, maintenance, and operation.

3.2.1 Chemical Feeding Equipment

Install controlled volume pumps, equipment, and appurtenances to provide a complete and integrated system in accordance with the instruction of the manufacturer and under the direct supervision of the manufacturer's representative.

3.2.2 Pipe, Tubing, Hangers and Supports

Install pipes and tubes in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.3 Field Painting

Thoroughly clean, prime, and top-coat factory painted items requiring touching up in the field with the manufacturer's standard factory finish provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Paint the equipment which did not receive a factory finish as specified in Section 09 90 00 PAINTS AND COATINGS. Coating must be at least 1.75 mils thick. Provide piping identification as specified in [ASME A13.1] [Section 09 90 00 PAINTS AND COATINGS. Mark pipe carrying materials not listed in Section 09 90 00 PAINTS AND COATINGS in accordance with ASME A13.1.]

3.2.4 Framed Instructions

Submit framed instructions for approval prior to postings. Final size must be easy to read by operators 5 feet from instructions. Limit frame size to 11" x 17" size provide multiple frames if needed. Post framed instructions, containing wiring and control diagrams, where directed. Post condensed operating instructions as outlined in paragraph 3.4.2 Operating Instructions. Post the framed instructions before acceptance testing of the systems.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

After installation of each controlled volume pump, carry out operating tests as specified below to assure that the chemical metering installation operates properly. If any deficiencies are revealed during any tests, correct such deficiencies and reconduct the tests. Submit reports of all tests in booklet form prior to final acceptance of the installation. Show all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

3.3.1.1 Testing and Inspection

Contractor shall be responsible for conducting all testing and inspections. Contractor shall engage the services of a qualified and certified testing agency that is approved to conduct tests and inspections of all equipment and materials installed prior to operation and putting in service. The testing and inspection shall be conducted under a certified PE in the state of Pennsylvania where applicable. All testing and inspection reports shall be submitted to the Owner’s representative for review and approval.

3.3.1.2 Field Service

Manufacturer's field service representative shall be engaged to verify the installation and connection requirements of all equipment and materials for its complete operation.

The certified testing agency representative and manufacturer's field representative will work together to complete all testing and inspection requirements.

3.3.1.3 Tank Testing

Clean tanks of loose debris and dry prior to testing. Field test tanks for leaks or damage in shipment. Test all tanks with potable water for 24 hours to detect large leaks and then with the chemicals (designed to store) to detect small leaks. Test each tank with the chemical for a period of 24 hours at which time no visible leakage is evident. Supply all pipes, hoses, pumps, water, power, and other equipment required to convey the test liquids and to carry out the tests. Repair damage or leaks in tanks to the satisfaction of the Owner’s representative.

3.3.1.4 Flow Tests

Test all chemical metering pumps to demonstrate zero gpm flow at a zero stroke or speed setting. Failure to meet this test is cause for rejection. Test pumps through full range of performance. Submit test results to prove pump functions within specified system parameters.

3.3.2 Chemical Waste

Neutralize chemicals wasted during testing procedures to achieve a pH value between 6.5 and 9.0 and a chlorine concentration of not more than 0.01 percent (100 mg/L). Route all chemicals wasted during testing procedures as directed by the Owner’s representative at a rate that the process can assimilate without upset.

3.3.3 Manufacturer Field Service

Provide the services of a manufacturer's representative who is certified by manufacturer in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, and testing of the equipment. Submit certificates to the Owner’s representative for approval.

3.4 CLOSEOUT ACTIVITIES

3.4.1 FIELD TRAINING

Conduct a field training course for designated operating, maintenance, and supervisory staff members. Provide training for a total period of 8 hours of normal working time and start after the system is functionally complete but prior to final acceptance tests. Cover all of the items contained in the Operating and Maintenance Instructions during field training.

3.4.2 Operating Instructions

Submit complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation, and shutdown. Include in the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Also include in the instructions as-built drawings of the piping layout, equipment layout, simplified wiring and control diagrams of the system as installed, and flow diagrams.

3.4.3 Maintenance Instructions

Submit complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble-shooting guides.

-- End of Section --

SECTION 46 30 13

ADVANCED OXIDATION PROCESSES (AOP)
02/11

PART 1 GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and appurtenances required to provide a Hydrogen Peroxide-Ozone Advance Oxidation System (AOP) complete with all required operating components. The system shall be complete and operational with all control equipment and accessories as shown on the contract drawings. The system shall be installed by the Contractor and tested and commissioned by the manufacturer.

This specification covers the equipment and installation requirements for one (1) AOP system. In addition to this the scope of work can include supply of oxygen and ozone generation system components per specification 50 05 01. This includes self cooled air compressor, air dryer, oxygen generator, ozone generator and distribution system, air receiving and oxygen buffer tanks, AOP reactors, catalytic ozone destructor skid, and chiller. This systems components shall also include hydrogen peroxide feed system including chemical storage tank and metering pumps per specification 46 30 00.

The units shall be furnished and installed with all necessary equipment including control and power panel and simple PLC control, chemical dosing/injection system and any other auxiliaries for a complete and operable system.

The hydrogen-peroxide AOP system shall be designed to provide treatment of 1,4-Dioxane in the groundwater stream. Table-1 shows the AOP system treatment requirements. Table-2 shows the Phase III Area Hotspot Treatment System Plume Characterization and Treatment Goals.

All process piping on the skid shall be 316L stainless steel along with all 316L stainless steel valves as shown on the P&IDs and contract drawings. All ozone feed tubing shall be double wall (dual containment). The size of the process piping and fittings will be as shown the P&IDs and contract drawings. Butterfly valves shall be supplied by the Contractor.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM F593	(2017) Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-4.1	(2009) Cleaning Equipment for Oxygen

Service; 6th Edition

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ANSI/ISA 5.1	(2009) Instrumentation Symbols and Identification

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for review and approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

AOP System; G

Reactor Vessel; G

Metering Pump; G

Local Controls and Panels; G

Liquid Process Tank; G

Maintenance; G

Drawings showing shop and erection details and chemical application locations; including cuts, codes, connections, holes, bolts, welds, anchorage, installation details, wiring diagrams, schematic diagrams, component identification tables and directory, and clearances for maintenance and operations.

SD-03 Product Data

AOP System; G

Calculations; G

Commissioning/Demonstration Plan; G

Manufactured Units

Performance Requirements; G

Qualifications; G

SD-06 Test Reports

Performance Requirements; G

SD-07 Certificates

AOP System

Field Training

SD-10 Operation and Maintenance Data

AOP System; G

Maintenance; G

1.4 QUALIFICATIONS

1.4.1 Contractor

Provide documentation of a minimum of 10 years of experience in the construction of water, wastewater, industrial wastewater, or hazardous and toxic waste water treatment facilities. The Contractor is responsible for installation and start-up of the AOP equipment supplied, as well as operator training.

1.4.2 Equipment Manufacturer

Submit a statement by the equipment manufacturer listing any exception to or deviations from the contract drawings and specifications. Written evidence that equipment and accessories are a product of a qualified and experienced manufacturer. Statement indicating the system is capable of treating the wastes to the levels identified.

1.4.3 Hydrogen Peroxide - Ozone AOP System Supplier

Equipment provided shall duplicate equipment that has been in satisfactory service for a minimum of 10 years prior to bid opening. The system supplier shall be responsible for furnishing a complete prepackaged system. The supplier need not manufacture the entire system, but shall coordinate the selection, assembly, installation, and testing of the entire system as specified.

1.4.4 Manufacturer's Representative

Provide services, as specified, of a qualified manufacturer's field representative experienced in the installation, adjustment, and operation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system. Include a statement indicating the operators designated to train the on site operators have been trained to operate the installed equipment.

1.4.5 Welding

Perform welding following qualified procedures, using performance qualified welders and welding operators. Furnish a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators to the Remedial Project Manager (RPM), FEAD CM or Engineer prior to beginning any work on the AOP equipment.

1.5 REGULATORY REQUIREMENTS

The AOP system shall conform to all federal, state, regional, and local regulations concerning chemical storage, air, noise and water pollution control requirements.

1.6 PRE-SUBMITTAL CONFERENCE

Assemble the primary process designer, AOP equipment and major component suppliers, electrical and mechanical subcontractors, and major component manufacturer's representatives at the construction site prior to preparation of the Contractor's AOP submittal for government approval. This meeting is intended to ensure that facility construction is properly scheduled; power, control, plumbing, space interfaces are verified; and responsibilities coordinated among subcontractor's and suppliers and reflected on the Contractor's AOP submittals.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver equipment free of structural or other damage and place in storage, in accordance with the manufacturer's requirements, protected from structural damage, the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants that could otherwise damage its components.

1.8 SEISMIC LOADS

The structural aspects of the AOP system shall be sufficient to meet the current editions of the NYC Construction Code and the International Building Code requirements for Seismic Design Category = B.

1.9 WARRANTY

Manufacturer shall provide warranty in accordance with Section 01 77 00 of the specifications.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the AOP including all items necessary as a complete system for removal of those chemicals identified below to the levels indicated. The AOP reactor shall be manufactured by APT Water LLC, DE NORA Water Technologies (Spratan Environmental Technologies) or approved equal. Equipment includes, but is not limited to, self cooled air compressor, air dryer, oxygen generator, ozone generator system, air receiving and oxygen buffer tanks, AOP reactors, gas separator tank, ozone destructor skid, and chiller. This system components shall also include the ozone feed and hydrogen peroxide feed system including chemical storage tank and metering pumps and equipment to provide complete and functional system within the limits identified. Analytical and sampling protocols shall be as specified in Section 01 91 00.15.10 and Section 01 91 13.

2.1.1 Design Requirements

Minimum equipment life	20 years
Max. equipment dimensions	As indicated
Maximum AOP reactor operating pressure	30 psi
Reactor inlet pipe diam.	12 inch
Reactor outlet pipe diam.	12 inch
Max. AOP influent flow rate	1800 gpm
Max. liquid temperature rise across AOP reactor	104 degrees F

2.1.2 Performance Requirements

Submit performance tests results indicating temperature rise through the reactor, dosage, detention time, gas monitoring results, and treatment system off gas monitoring and destruction results, equipment and analytical testing methods used, and removal of constituents identified below stated in mass/unit volume treated relative to the influent concentration.

Report in booklet form, upon completion of the installed system. Test report shall include field tests performed to adjust each component and field tests conducted to prove compliance with the specified performance criteria. Test report shall indicate the recommended position of the controls.

a. Influent characteristics: See TABLE-2 for Influent characteristics

b. Effluent requirements: See TABLE-1 and TABLE-2 for desired AOP treatment and influent characteristics. The AOP shall be able to meet the Effluent requirements provided.

c. Efficiency factors:

Ozone usage	6 mg/L
Hydrogen peroxide usage	6 mg/L

2.1.3 AOP System Requirements

One (1) Hydrogen Peroxide-Ozone advanced oxidation process (AOP) system.

The Contractor shall provide a guarantee that the installed system shall continuously meet the specified performance requirements under the following conditions:

1. Design Maximum Flow rate (gpm) 1800
2. Minimum Flow Rate (gpm) 900
3. Design Flow rate (gpm) 1600

4. Maximum Process Water Temperature (deg F/C) 104/40
5. Maximum Operating Pressure (psig) 30

2.1.4 Equipment Appurtenances

Supporting Skid: The AOP system and all appurtenances shall be supported on a structural frame and painted to prevent corrosion.

Lifting Lugs: Individual equipment and or each field assembled part over 100 pounds in weight shall be provided with lifting lugs for ease of handling.

Anchor Bolts: All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts, nuts, and washers shall be Type 316 stainless steel.

Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the equipment in a location that is visible at eye level. The plate shall bear the Manufacturer's name, address, phone number, equipment model number, serial number, and equipment ID number (to match the P&IDs).

Static Mixer: Contractor shall provide hydrogen peroxide injector and static mixer.

2.1.5 Spare Parts & Tools

Contractor shall provide one set of recommended spare parts for AOP and related accessories supplied.

Contractor shall supply one set of any special tools required for assembly, disassembly, or adjustment of the equipment supplied.

2.2 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and which essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Remedial Project Manager (RPM), FEAD CM or Engineer, reasonably convenient to the site.

2.3 NAMEPLATES

Provide each major item of equipment with the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Nameplates shall be provided for, but not limited to, each contact vessel, pumps, motors, oxidant equipment and accessories, and electrical components.

2.4 MATERIALS

2.4.1 In Pipeline Static Mixers

In pipeline static mixers shall be installed at the locations indicated . Mixers shall be installed in a flanged section of piping , have a pressure rating equal to that of the piping installed, have a maximum headloss of 85 inch of water, at 1800 gpm while inducing completely turbulent mixing

conditions in the pipeline installed. Mixers and housing shall be constructed of Grade 316 stainless steel and be compatible with hydrogen peroxide .

2.4.2 Bolts, Nuts, Anchors and Fasteners

Bolts, nuts, anchors and fasteners shall be stainless steel in conformance with ASTM F593.

2.5 ELECTRICAL

Electrical products shall be in accordance with electrical specifications. Reactor vessels shall be independently grounded.

2.5.1 Local Controls and Panels

Manual or automatic controls, protective or signal devices required for the operation specified, and any control wiring required for controls and devices, shall be provided. Enclosures for local power and control panels shall conform to NEMA ICS 6.

2.6 AOP CONTROL SYSTEM

Equipment shall be locally controlled and shall be capable of receiving standard digital or analog control signals from the plant central control system. Status and adjustments to the equipment shall be provided from the central control system. Instruments shall be provided with mounting hardware as appropriate. All equipment shall be designed for operation on a 120 volts 60 hertz electrical input. Controls shall be provided to remotely monitor and adjust hydrogen peroxide delivery rate.

2.6.1 Hydrogen Peroxide Feed

Hydrogen peroxide feed pump and control shall conform to the requirements of Section 46 30 00 WATER AND WASTEWATER CHEMICAL FEED SYSTEMS.

2.6.2 Alarms and Interlocks

Alarms and interlocks shall be provided to ensure proper operation of the advanced oxidation equipment, and its sequenced shutdown based on potentially unsafe or improper conditions that may exist. The following paragraphs list alarms that (as a minimum) shall be monitored at the central control point, or that will initiate shutdown of the appropriate advanced oxidation equipment components.

2.6.2.1 AOP System

Failure of major equipment components or safety interlocks shall initiate system, followed by plant shutdown, if not acknowledged.

a. AOP system alarms and control interlocks shall be provided for the following items:

   (1) Safety interlocks for open door on reactor vessel or panel
   (2) High water temperature in AOP reactor vessel
   (3) Low water flow to the reactor vessel
   (4) High pressure in reactor vessel headspace

b. Submit the following data for the AOP System

(1) Manufacturer's descriptive and technical literature; performance charts and curves, catalog cuts for specified equipment including: instrumentation and controls; capacities and pressure drop; model number; and installation instructions.

(2) Materials of construction; inlet and outlet pipe sizes; power demand requirements; and ozone generator cooling water flow rate.

(3) Spare parts data for each piece of equipment, current unit prices and source of supply.

(4) Manufacturer's descriptive and technical literature; performance charts and curves, catalog cuts for specified equipment including: instrumentation and controls; capacities and pressure drop; model number; and installation instructions.

(5) Materials of construction; inlet and outlet pipe sizes; power demand requirements; and ozone generator cooling water flow rate.

(6) Spare parts data for each piece of equipment, current unit prices and source of supply.

(7) Manufacturer's certificates stating that the equipment meets the specified requirements, and has been installed in accordance with the equipment manufacturer's requirements.

2.6.2.2 Metering Pump

Pump failure shall initiate system, followed by plant shutdown, if not acknowledged. Metering Pump alarms and control interlocks shall be provided for the following items:

a. Hydrogen peroxide feed
b. Pump failure

2.6.2.3 Hydrogen Peroxide Tank

Hydrogen peroxide tank alarms and control interlocks shall be provided for the following items:

a. High liquid level
b. Low liquid level
c. Low low liquid level

2.6.2.4 Ground Fault

A ground fault protection alarm shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Remedial Project Manager (RPM), FEAD CM or Engineer of any discrepancy before performing the work. Compare the limits of work for the equipment supplied to field conditions

to ensure the limits previously identified for piping, electrical and control interfaces meet the actual physical requirements at the facility. Bring any discrepancies to the attention of the Remedial Project Manager (RPM), FEAD CM or Engineer for correction.

3.2 PREPARATION

Provide the reactor vessel, hydrogen peroxide storage and feed system, with an equipment pad isolated from the floor slab as detailed on the drawings . Reinforced concrete shall be designed and installed in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. Prior to placing ozone piping, or other equipment, into service it shall be cleaned by one of the methods specified in CGA G-4.1. Piping and equipment used to store or feed hydrogen peroxide shall be passivated in accordance with the hydrogen peroxide supplier's requirements.

3.3 EQUIPMENT INSTALLATION

Perform the equipment installation as indicated on the drawings, shop drawings, manufacturer's instructions and recommendations. Piping, valves, fittings, and appurtenances shall be installed in accordance with the manufacturers recommendations, as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE, or as otherwise indicated. All valves, fittings, meters and other appurtenances shall be given unique identification numbers corresponding to those used in operation and maintenance manuals, and in AOP submittals prepared. Identification numbers shall be placed on brass identification tags and securely fastened to all valves, fittings, meters and other appurtenances. Tags shall not be less than 1-1/2 inches in diameter with depressed black figures 1/2 inch high. Piping for wet ozone service shall be PVDF, stainless steel, or PTFE. Piping for dry ozone service shall be PVDF, stainless steel, or PTFE. Oxygen Piping shall be copper or stainless steel. Hydrogen peroxide piping shall be stainless steel, PTFE or PVDF.

3.4 ELECTRICAL WORK

Perform electrical work in accordance with the drawings and applicable requirements of electrical specifications. Equipment shall be appropriate for continuous duty, and installation in a dusty, humid and corrosive environment. Electrical equipment and wiring shall comply with NFPA 70.

3.5 TOOLS

Provide tools to the Remedial Project Manager (RPM), FEAD CM or Engineer prior to the onsite training identified in paragraph FIELD TRAINING.

3.6 PAINTING/CORROSION PROTECTION

All ferrous surfaces shall be coated or painted. Color shall be as indicated on the paint schedule or as otherwise approved. Factory painted items shall be touched up as needed. Factory painted items requiring touch up in the field shall be thoroughly cleaned of all foreign material, primed and top coated with the manufacturer's standard factory finish in accordance with the manufacturer's recommendations, including dry finish thickness. Equipment which did not receive a factory finish shall be painted in accordance with the requirements indicated in Section 09 90 00 PAINTS AND COATINGS. Painting corrosion resistant metals such as brass, bronze, aluminum, copper, galvanized steel and stainless steel is not required unless otherwise specified.

3.7 CHEMICALS

Provide the chemicals needed to do all the operational and start up testing, and completely refill the hydrogen peroxide tanks at the time of contract completion.

3.8 SAMPLING AND ANALYSIS

3.8.1 Plan Details

The plan shall include a detailed description of proposed sampling and analysis required to document system performance. A plan detailing the sampling locations, frequency, analytical protocols, and duration which will ensure the equipment complies with the standards indicated. Submit the plan to the Remedial Project Manager (RPM), FEAD CM or Engineer 30 days prior to equipment start up. Coordinate work within this section with other sections to ensure upstream and downstream unit processes are complete and operational prior to startup/commissioning the AOP unit.

3.8.2 Plan Calculations

Include the following calculations in the commissioning/demonstration plan.

a. Headloss calculations through the process units at the design flow rate, including headloss calculations for associated compressed air and pumping systems.

b. Oxidant demand and subsequent AOP unit sizing.

c. Electrical usage rate.

d. Removal performance and material mass balance.

e. Chemical feed requirements and equipment sizing.

3.8.3 Chemical Sampling

The chemical parameters identified in Influent Characteristics and Effluent requirements Tables under PERFORMANCE REQUIREMENTS shall be sampled daily , monitored at the locations specified in Section 01 91 13, using analyses with detection limits one order of magnitude lower then the levels indicated in paragraph PERFORMANCE REQUIREMENTS.

3.9 POSTING FRAMED INSTRUCTIONS

Post framed instructions containing wiring and control diagrams, under glass or in laminated plastic, adjacent to the equipment or where otherwise directed before acceptance testing of the system. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.10 FIELD TESTS AND INSPECTIONS

All accessories shall be factory tested prior to shipment to the job site.

3.10.1 Testing and Inspection

Contractor shall be responsible for conducting all testing and inspections. Contractor shall engage the services of a qualified and certified testing agency that is approved to conduct tests and inspections of all equipment and materials installed prior to operation and putting in service. The testing and inspection shall be conducted under a certified PE in the state of New York where applicable. All testing and inspection reports shall be submitted to Remedial Project Manager (RPM), FEEAD CM, or Engineer for review and approval.

3.10.2 Field Service

Manufacturer's field service representative shall be engaged to verify the installation and connection requirements of all equipment and materials for its complete operation.

The certified testing agency representative and manufacturer's field representative will work together to complete all testing and inspection requirements.

3.11 MANUFACTURER'S SERVICES

Provide a manufacturer qualified service representative, experienced in the installation, adjustment, operation and maintenance of the equipment specified, for a minimum of 3 days to supervise the installation, adjustment, testing, and to provide instruction in the operation, and maintenance of the equipment. During the startup and one years operating period, the major equipment suppliers shall be required to be onsite 2 times to verify that the equipment is installed and operates properly, and to provide trouble shooting and technical assistance.

3.12 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members. The training shall include operation of individual components as well as the integrated system, maintenance needs and procedures, instrument calibration, safety issues and emergency procedures, control and alarm features, troubleshooting equipment and control problems, and laboratory analytical procedures. Training shall be provided during normal working time and shall start after the system is functionally complete but prior to performance testing. Field training shall cover all of the items contained in the operating and maintenance manuals. The first period shall be at system startup and the second as defined by the Remedial Project Manager (RPM), FEAD CM or Engineer. Upon completion, submit certificates indicating the designated personnel have received training specified and have successfully operated the installed AOP equipment.

3.13 MAINTENANCE

3.13.1 Extra Materials

Furnish the initial supplies to fill the vessels, as well as all consumables during the startup, prove out, and initial operation period. At the time the Contractor turns the plant over to the long term Operation and Maintenance Contractor, the vessels storing consumables such as hydrogen peroxide shall be refilled within two days prior to the plant turn over.

3.13.1.1 Spare Parts

The supplier shall provide a minimum of the following spare parts:

3.13.2 Maintenance Service

The ozone generator dielectrics shall be cleaned in accordance with the manufacturer's recommendations immediately prior to the conclusion of the Contractor's operating period; or after one year, if greater than one year after startup, and at the conclusion of the Contractor's operating period.

3.13.3 Operating Instructions

Submit six complete copies of operating instructions outlining the step-by-step procedures required for system start-up, operation and shutdown, routine maintenance, potential breakdowns and repairs, and troubleshooting. The instructions shall include drawings and schematics of the system as installed. The instructions shall include the manufacturer's name, model number, service manual parts list and brief description of all equipment and their basic operating features. The instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves and controls, process flow diagrams, piping and instrumentation diagrams with all valves, meters, and similar units identified.

b. Approved wiring and control diagrams prepared in accordance with ANSI/ISA 5.1 including a drawing index, legend and symbols list, and abbreviations and identifiers.

c. A control sequence describing startup, how to make adjustments to the equipment during operation, standard and emergency shutdown procedures.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and other periodic maintenance and inspection information as well as trouble shooting guides.

e. Manufacturer's bulletins, cut sheets and descriptive data, parts lists, and recommended spare parts, and sources of supply for all major pieces of equipment.

-- End of Section --

TABLE 1
TREATMENT PLANT UNIT PROCESS GOALS

Parameters	Units	Equalization Tank with Neutralization, Iron Oxidation, and Aeration		Multi Media Filtration		Advanced Oxidation Process Technology		Liquid Granular Activated Carbon	
		Influent [(a)]	Effluent	Influent	Effluent	Influent	Target Effluent	Influent	Target Effluent
Organics									
Trichloroethene	ug/L	1.8/5	<5	<5	<5	<5	<1	<1	<1
Tetrachloroethene	ug/L	ND/1	<1	<1	<1	<1	<1	<1	<1
Freon 113	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
1,4-Dioxane	ug/L	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.1 to 0.3	0.1 to 0.3	0.1 to 0.3
Inorganics									
Iron - dissolved	mg/L	1.5/2.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Iron - total	mg/L	1.5/2.5	1.5/2.5	1.5/2.5	<0.3	<0.3	<0.3	<0.3	<0.3
Suspended Solids	mg/L	<1	3 to 5	3 to 5	<1	<1	<1	<1	<1
Ozone	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	6	2	<0.1
Hydrogen Peroxide	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	6	2	<0.1
Sodium Hypochorite	mg/L	<0.1	<0.1	1 to 2	<1	<1	<1	<1	<0.1
pH	Standard Unit	4.5 to 5.5	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2

(a) Average/maximum.

< - Less than.

µg/L - Microgram per liter.

mg/L - Milligram per liter.

TABLE 2
RECOVERY WELL WATER QUALITY AND TRETAMENT GOALS

Parameter	Unit	RW8 (Avg/Max)	RW9 (Avg/Max)	RW10A (Avg/Max)	Combined (Avg/Max)	Treatment Goal[1]
Organics						
Trichloroethene	µg/L	1/5	5/25	0.2/1	1.8/10	5
Tetrachloroethene	µg/L	ND	ND	0.2/5	ND/1	5
Freon 113	µg/L	ND	0.2/0.5	ND	ND/0.5	5
1,1-Dichloroethene	µg/L	ND	0.2/0.5	ND	ND/0.5	5
cis-1,2-Dichloroethene	µg/L	ND	0.2/0.5	0.5/2	ND/0.5	5
1,4-Dioxane	µg/L	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.35 to 1
Inorganics						
pH (Range)	Standard Unit	4.8 to 5.5	4.6 to 5.4	4.5 to 5.5	4.5 to 5.5	6.5 to 8.0
Sodium	mg/L	NA	NA	NA	3/10	NA
Calcium	mg/L	NA	NA	NA	3/6	NA
Iron	mg/L	NA	NA	NA	1.5/2.5	0.3
Manganese	mg/L	NA	NA	NA	0.02/0.03	NA
Alkalinity	mg/L	NA	NA	NA	4/15	NA
Chloride	mg/L	NA	NA	NA	5/12	NA
Ammonia	mg/L	NA	NA	NA	ND/0.2	NA
Nitrate/Nitrite	mg/L	NA	NA	NA	0.2/0.5	NA
Sulfate	mg/L	NA	NA	NA	7/15	NA
Total Dissolved Solids	mg/L	NA	NA	NA	25/60	NA
Total Organic Carbon	mg/L	NA	NA	NA	0.6/1.5	NA
Total Suspended Solids	mg/L	NA	NA	NA	1/2	NA
Phosphorus	mg/L	NA	NA	NA	0.04/0.06	NA

1. The treatment goals presented are based on New York State Department of Health drinking water standards and New York State Department of Environmental Conservation Class GA groundwater standards. Practical target treatment levels for VOCs will be 1 µg/L and for 1,4-dioxane 0.1 to 0.3 µg/L.

µg/L - Microgram per liter. mg/L - Milligrams per liter.
RW - Recovery Well. GPM - Gallon per minute.
NA - Not applicable. ND - Not detected.

TABLE-1
RECOVERY WELL WATER QUALITY AND TREATMENT GOALS

Parameter	Unit	RW8 (Avg/Max)	RW9 (Avg/Max)	RW10A (Avg/Max)	Combined (Avg/Max)	Treatment Goal[1]
Organics						
Trichloroethene	µg/L	1/5	5/25	0.2/1	1.8/10	5
Tetrachloroethene	µg/L	ND	ND	0.2/5	ND/1	5
Freon 113	µg/L	ND	0.2/0.5	ND	ND/0.5	5
1,1-Dichloroethene	µg/L	ND	0.2/0.5	ND	ND/0.5	5
cis-1,2-Dichloroethene	µg/L	ND	0.2/0.5	0.5/2	ND/0.5	5
1,4-Dioxane	µg/L	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.35 to 1
Inorganics						
pH (Range)	Standard Unit	4.8 to 5.5	4.6 to 5.4	4.5 to 5.5	4.5 to 5.5	6.5 to 8.0
Sodium	mg/L	NA	NA	NA	3/10	NA
Calcium	mg/L	NA	NA	NA	3/6	NA
Iron	mg/L	NA	NA	NA	1.5/2.5	0.3
Manganese	mg/L	NA	NA	NA	0.02/0.03	NA
Alkalinity	mg/L	NA	NA	NA	4/15	NA
Chloride	mg/L	NA	NA	NA	5/12	NA
Ammonia	mg/L	NA	NA	NA	ND/0.2	NA
Nitrate/Nitrite	mg/L	NA	NA	NA	0.2/0.5	NA
Sulfate	mg/L	NA	NA	NA	7/15	NA
Total Dissolved Solids	mg/L	NA	NA	NA	25/60	NA
Total Organic Carbon	mg/L	NA	NA	NA	0.6/1.5	NA
Total Suspended Solids	mg/L	NA	NA	NA	1/2	NA
Phosphorus	mg/L	NA	NA	NA	0.04/0.06	NA

1. The treatment goals presented are based on New York State Department of Health drinking water standards and New York State Department of Environmental Conservation Class GA groundwater standards. Practical target treatment levels for VOCs will be 1 µg/L and for 1,4-dioxane 0.1 to 0.3 µg/L.

µg/L - Microgram per liter. mg/L - Milligrams per liter.
RW - Recovery Well. GPM - Gallon per minute.
NA - Not applicable. ND - Not detected.

TABLE-2
TREATMENT PLANT UNIT PROCESS GOALS

Parameters	Units	Equalization Tank with Neutralization, Iron Oxidation, and Aeration		Multi Media Filtration		Advanced Oxidation Process Technology		Liquid Granular Activated Carbon	
		Influent [(a)]	Effluent	Influent	Effluent	Influent	Target Effluent	Influent	Target Effluent
Organics									
Trichloroethene	ug/L	1.8/5	<5	<5	<5	<5	<1	<1	<1
Tetrachloroethene	ug/L	ND/1	<1	<1	<1	<1	<1	<1	<1
Freon 113	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
1,4-Dioxane	ug/L	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.1 to 0.3	0.1 to 0.3	0.1 to 0.3
Inorganics									
Iron - dissolved	mg/L	1.5/2.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Iron - total	mg/L	1.5/2.5	1.5/2.5	1.5/2.5	<0.3	<0.3	<0.3	<0.3	<0.3
Suspended Solids	mg/L	<1	3 to 5	3 to 5	<1	<1	<1	<1	<1
Ozone	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	6	2	<0.1
Hydrogen Peroxide	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	6	2	<0.1
Sodium Hypochorite	mg/L	<0.1	<0.1	1 to 2	<1	<1	<1	<1	<0.1
pH	Standard Unit	4.5 to 5.5	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2

(a) Average/maximum.

< - Less than.

µg/L - Microgram per liter.

mg/L - Milligram per liter.

SECTION 46 61 00

FILTRATION EQUIPMENT

02/11

This equipment/system will be supplied by Owner as specified under Section 01 01 00. For General Contractor's scope related to this system, refer to Section 46 61 00 A.

PART 1 GENERAL

1.1 SCOPE OF WORK

The Equipment Manufacturer (VenCOR) shall furnish all labor, materials, equipment and incidentals required to install a Multimedia Pressure Filter (MMF) System and Horizontal Cartridge Filters. This Section specifies the requirements for the design, fabrication, installation, performance, and operation of the MMF system and Horizontal Cartridge Filters as shown on the Contract Drawings and as specified herein. The manufacturer shall provide materials and equipment which are new and unused.

All piping and valves on the skid shall be provided in accordance with specification and as shown on contract drawings. Installation of all equipment will be by the Contractor.

1.2 RELATED SECTIONS

Section 01 33 00 Submittal Procedures

Section 26 05 00 Common Work Results for Electrical

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B100	(2016; Errata 2017; Addenda 2018) Granular Filter Material

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ANSI/ISA 5.1	(2009) Instrumentation Symbols and Identification

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Filtration System; G

Include complete wiring and schematic diagrams; equipment layout and anchorage; and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

SD-03 Product Data

Posting Framed Instructions

Qualifications

Media

Materials and Equipment

Control System

Spare Parts

SD-06 Test Reports

Acceptance Testing

Factory Tests

SD-07 Certificates

Materials and Equipment

SD-10 Operation and Maintenance Data

Field Training

Operating and Maintenance Instructions; G

1.5 QUALIFICATIONS

Submit qualifications of the installer, and the manufacturer's and media supplier's representatives.

1.5.1 Installer

The installer shall have a minimum of 10 years experience in the installation of a minimum of 5 similar filtration systems and shall show evidence of satisfactory operation for each installation.

1.5.2 Manufacturer's Representative

A representative of the filtration system manufacturer, who is familiar with the design and experienced in the installation, adjustment, and operation of the Cartridge Filters specified shall be present at the jobsite during installation of the filtration system.

1.5.3 Media Supplier Representative

A representative of the media supplier who is experienced in the installation of the specified filtration media shall be present at the jobsite during media installation.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect from the weather, excessive humidity, excessive temperature variation, and dirt, dust, or other contaminants equipment delivered and placed in storage.

1.7 EXTRA MATERIALS

Standard spare parts shall be provided as recommended in the manufacturer's instruction manuals for each component of the equipment. Submit spare parts data for each different item of material and equipment specified. Include in the data a complete list of parts and supplies, with current unit prices and source of supply.

1.8 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on a conceptual arrangement of the MMF filters and piping (Westech's - Triplex Vertical Pressure Filter System, Model FPV22C) and Horizontal Cartridge filters and piping (Rosedale Model 36 Horizontal Cartridge Filter). Should the VenCOR propose to furnish an equivalent system of a different configuration or manufacturer, the VenCOR shall be responsible for all modifications necessary to incorporate the proposed MMF and Cartridge Filters into the design and submit the necessary revised Contract Drawings and Technical Specifications for review and approval.

PART 2 PRODUCTS

2.1 MULTIMEDIA FILTRATION SYSTEM DESCRIPTION

Provide multi media filtration system from Westech, H2K Technologies Inc., Evoqua, Klenn Industries or approved equal. Provide horizontal cartridge filtration system from Rosedale, American Melt Blown & Filtration, Filtra Systems or approved equal. The filtration system shall be designed, constructed, and installed to comply with the following design

conditions. Supply auxiliary systems and equipment required to maintain complete and workable filter systems including, but not limited to, required piping between units, auxiliary equipment for plumbing and power, and controls and interfaces between auxiliary equipment and the filter. Chemical additives will not be allowed to enhance the filtration system.

2.1.1 MMF System Requirements

Service: The MMF system shall be designed to meet the effluent requirements as shown in attached TABLE-2. The filtration system shall be designed, constructed, and installed to comply with the following design conditions. Supply auxiliary systems and equipment required to maintain complete and workable filter systems including, but not limited to, required piping between units, auxiliary equipment for plumbing and power, and controls and interfaces between auxiliary equipment and the filter.

Influent Flow Characteristics

1. Maximum Flow Rate: 1800 gpm Design Flow Rate: 1600 gpm
2. Design Influent Temperature: 55 def F
3. Flow Conditions: Continuous

Design Criteria

1. Number of Filters: 3 piped in parallel Each filter dimension: 10' diameter x 11.5' high (side wall height 6' high)
2. Maximum Effluent, Suspended Solids: 0.1 mg/L
3. Maximum Effluent, Particle Size: 5 microns
4. Maximum Effluent Turbidity: 1 NTU
5. Hydraulic Loading Ratio (HRL): 6.79 gpm/ft2 of Filter Surface at 1600 gpm flow.
6. Headloss To Initiate Backwash: 12 psi (at design flow and temperature):
7. Required Run Time at 24 hours Design Conditions:
8. Backwash Water Source: Plant effluent (treated water)
9. Backwash loading rate 12 gpm/ft2
10. Design Influent, Suspended Solids: 2 mg/L
11. Source of water: Groundwater
12. Maximum Filtration Rate: 0.12 gal/second/ft2
13. Maximum pipe velocity: 9ft/s

2.1.2 MMF Equipment Description

Provide a multimedia filter (MMF) using high performance sand filter media with supporting garnet and quartz configured per AWWA B100 specifications. The filter shall be suitable for effluent polishing or for primary water filtration. The filter will remove particulate >15 microns in size. The filter will be an automatic backwash filter using either fresh water or captured filtered water for backwash. The filter cells shall be capable of monitoring Differential Pressure and each cell shall get a backwash as demanded by either DP, Timer, or by operator indicated Push Button. The filter shall be capable of being expanded by adding additional filter modules.

The MMF filter shall consist of the following:

1. Filters shall be Triplex vertical pressure filter vessels, 10' in diameter providing 78.5 ft2 of filter loading surface per cell.

2. The filter vessels shall be designed for 100 psi working pressure and 130 psi test pressure and ASME Certified.
3. The internal coatings shall be Carbon steel NSF61 rated and external coatings shall be industrial coatings. Internal coating will be Bar-Rust 233H type multipurpose epoxy coating or equal.
4. Filter shall include 316 stainless steel internal distribution wheel and spoke type collection, and distribution manifolds, and 316 stainless steel underdrain.
5. The piping shal be PVC schedule 80 external piping with electric valves. Provide bypass piping with valves around the MMF filters as shown on contract drawings and PID.
6. The MMF system shall include Electric Actuated distribution valves, Bray Series 31 BFV with Series 70 electric actuators with XO/XC limit feedback switches. Valve shall be a butterfly full lug style. The MMF system shall also include manual butterfly valves as part of the skid as shown on contract drawings and PID.
7. The filter should be provided as modular skids that easily bolt together in the field.
8. MMF system shall include fully automatic backwash by either timed, operator initiated, or pressure differential as operator selected.
9. Each filter cell will require 550 gpm for low rate, air purge, and high rate re-stratification backwash rate based on their surface area. Backwash shall be adjustable from 3-15 minutes with 8-10 minutes being typical.
10. System shall have AWWA B100 certified media arranged in five distributed layers.
11. Dimensions: Triplex filter skid,33' wide x 15' deep x 11.5' tall. Top vessel access will be required for media loading/change out.

Appurtenances and Instrumentation:

1. Pressure relief at each vessel shall be provided by a pressure relief valve and designed to relieve pressure at the Maximum Allowable Working Pressure (100 psi) of the vessel. One shall be provided for each MMF filter. Each of the vessels shall also be provided with a pressure relief/vacuum relief valve. The pressure/vacuum relief valve shall be mounted on the lines shown on the P&IDs.

2. Provide all skid-mounted interconnecting piping and valves between MMF units. The process piping at each vessel shall be equipped with a differential pressure gauge to indicate the pressure drop across each vessel. The differential pressure gauge shall have a 4" face diameter with an encapsulated sensing element in a brass case housing (0 to 20 psig range). The differential pressure gauge shall have the ability to provide a field configurable, 120 VAC discrete input indicating a differential pressure of up to 10 psid.

3. Provide inlet and outlet pressure transmitters for the multi media filtration system.

5. MMF Control Panel: Provide an assembled, wired and tested control panel for control and monitoring of the MMF System. The system shall be controlled by a Programmable Logic Controller (PLC) and the preferred PLC manufacture for the project is Allen-Bradley. The MMF Control Panel shall interface with the Ground Water Treatment Plant (GWTP) Control System using Ethernet I/P communications protocol. The MMF Control Panel shall control, monitor and display all functions

associated with the operation and backwash of the filtration units, including but not limited to:

a. System Inlet and Outlet Pressure.
b. Differential Pressure across each vessel.
c. All filter valve positions (inlet, outlet, backwash supply, backwash waste, air wash).
d. The Active, Requires Backwash, In Backwash, Settling, and Ready for Service status for each vessel.
e. Backwash Timers.
f. Backwash Request to GWTP Control System (to be maintained until backwash is complete).
g. Air Wash Blower run request to GWTP Control System.
h. Backwash Flow Rate to GWTP Control System.
i. Backwash Enabled status from the GWTP Control System. Note: The GWTP provides a "Backwash Enable" when there is sufficient clean water level in the Backwash Supply Tank, sufficient Backwash Waste storage is available, a Backwash Supply Pump is available, and the Air Wash Blower is available.

The MMF Control Panel shall consist of the following at a minimum:

a. NEMA 4X Enclosure.
b. Minimum 12" Operator Interface Terminal (OIT) color touch screen.
c. Ethernet Switch, size as required.
d. Uninterruptible Power Supply (UPS), minimum 5 minutes of backup time.
e. Circuit breakers, fuses, terminals, wire-way, etc. as required to facilitate the internal wiring of the control panel.
f. Field wiring terminals with labels for landing of all skid-mounted filtration system instruments and devices.
g. Panel interface connector with RJ45 Ethernet port and simplex receptacle on the door of the enclosure.
h. Single power feed. Note: 120VAC, 1-phase, 60Hz is available from the GWTP.
i. UL508A label.
j. Minimum 20% spare I/O, terminals, circuit breakers and fuses.

6. A drain line and valve shall be located to facilitate the removal of water from the filter tank. The drain line shall be readily accessible and shall be of the manufacturer's standard design and placement.

2.1.3 Paint

The interior and exterior of fabricated ferrous metal components shall be treated after fabrication to prevent corrosion. The surfaces of the filter tanks shall be sandblasted and completely factory finish painted prior to shipment. Insulating components such as gaskets, couplings, or bushing or dielectric-type which will prevent corrosion of bimetallic- type contacts, shall be used at connections between dissimilar metals.

Exterior Surfaces: All ferrous surfaces shall be coated or painted. Ferrous metal surfaces shall be prepared with two coats of epoxy paint.

Interior Surfaces: All interior surfaces shall be coated with Plasite 4110 applied at 40 mil DFT.

2.1.4 Accessories

Supporting Skid: The MMF system and all appurtenances shall be supported on a steel skid and legs.

Lifting Lugs: Individual equipment and or each field assembled part over 100 pounds in weight shall be provided with lifting lugs for ease of handling.

Anchor Bolts: Manufacturer shall size and provide 316 SS anchor bolts, and shall provide installation template for positioning the bolts. The support system shall be designed to resist seismic forces. The seismic forces are to be based on the vessels and all appurtenances full of water.

Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the equipment (each MMF vessel) in a location that is visible at eye level. The plate shall bear the equipment ID number (that matches the P&ID), Manufacturer's name, address, phone number, equipment model number, and serial number.

2.1.5 Spare Parts & Tools

Provide 15% additional media to account for potential media loss during initial backwash. Spare media shall be in 50-pound bags stored inside in dry conditions.

VenCOR shall provide one set of recommended spare parts for MMF and related accessories supplied.

VenCOR shall supply one set of any special tools required for assembly, disassembly, or adjustment of the equipment supplied.

2.2 Horizontal Cartridge Filter Influent

2.2.1 Influent Flow Characteristics

Design Flow	1600 gpm/unit
Maximum Flow Rate	1800 gpm/unit
Design Pressure	150 psi
Design Influent Temperature	54 degrees F
Maximum Influent Temperature	60 degrees F
Minimum Influent Temperature	40 degrees F
Flow Conditions	continuous

Design Influent, Suspended Solids	2 mg/L
Design Influent, Particle Size	25 micron
Source of Process Water	groundwater

2.2.2 Horizontal Cartridge Filter Criteria

Total Number Operating Units	2
Number of On-line Units	1
Number of Stand-by Units	1
Number of Elements per Unit	13
Length of each Element	60" long
Diameter of each Element	7.2 inches
Design Effluent, Suspended Solids	<0.1 mg/L
Design Effluent, Particle Size	5 micron
Maximum Differential Pressure (Clean elements)	1 psi at design temperature
	3 psi at maximum temperature
Maximum Differential Pressure (Dirty elements)	12-15 psi

2.2.3 SYSTEM DESCRIPTION

Service: The Horizontal Cartridge Filters shall be designed for liquid to enter the housing and flow through. Solids shall be contained inside the cartridge elements where they can be easily removed when unit is serviced. The filtration system shall be designed, constructed, and installed to comply with the following design conditions. Supply auxiliary systems and equipment required to maintain complete and workable filter systems including, but not limited to, required piping between units, auxiliary equipment for plumbing and power, and controls and interfaces between auxiliary equipment and the filter.

Influent Flow Characteristics

1. Maximum Flow Rate: 1800 gpm Design Flow Rate: 1600 gpm
2. Design Influent Temperature: 54 def F
3. Flow Conditions: Continuous

Performance Requirements

1. The Horizontal Cartridge filter shall fit in the area shown on the plans.
2. Filter Run Time: Minimum 24 hour
3. Differential pressure for filter change: 12 PSID
4. Pressure Differential at startup: <1-2 PSID

Design Criteria

1. Model: Rosedale Model 36 DH361360-10F-1-150-S-B-R-C W/SKID)
2. Pipe size: 10 inch
3. Cartridge Element Type Type: 60 inch length, 13 elements, 7.2 inch diameter, Polypropylene
4. Number of Filters: 2 piped in parallel (1 operating plus 1 standby)
5. Micron rating: 5 micron
6. Cover style: Cover shall be O-ring sealed
7. Construction: Stainless Steel (304) housing, skid painted Carbon Steel
8. O-ring seals: Buna N
9. Gasket Material: Buna N
10. Pressure Rating: 150 psi
11. Cartridge Elements: Model DP-603-P601B
12. Inlet/Outlet orientation: Side Inlet, Side Outlet
13. Flanged connection: 150 class Flanged
14. Drain: 1" NPT

2.3 MATERIALS AND EQUIPMENT

2.3.1 Nameplates

Provide each major item of equipment with the manufacturer's name, address, type of style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.3.2 Protection of Moving Parts

Completely enclose by guards belts, chains, couplings, and other moving parts to prevent accidental personal injury. Guards shall be removable or arranged to allow access to the equipment for maintenance. If equipment is housed in a lockable housing, this shall be sufficient protection and no additional guards are necessary.

2.3.3 Special Tools

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

2.3.4 Steel Plates, Shapes and Bars

ASTM A36/A36M.

2.3.5 Plastic Piping

PVC Pipe: PVC pipe shall be Schedule 80, seamless, unplasticized polyvinyl chloride normal impact type, conforming to ASTM D-1784, Class 12454-B and D-1785, PVC 1120, for Type I, Grade 1. PVC pipe system shall be as manufactured by CertainTeed Corp, JM Eagle, North American Pipe, Harvel

Pipe, or approved equal.

PVC Fittings: The schedule rating for the fittings shall not be less than that for the associated pipe. All pipe and fittings shall conform to ASTM D2467 and joints shall be solvent socket welded where threaded or flanged fittings are not used.

PVC Joints: The piping system shall be joined by flanged or mechanical connections except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly. Connections at those points shall be threaded.

Flanged Fittings: Flanges shall be used at all valves, pumps, equipment, tanks, and vessels. Flanges will be of the same material as the piping. Flanges shall be the Van-Stone type complete with gaskets, bolts, and nuts. Flanges will be flat face to match the flanges of the valves, pumps, equipment and vessels. Flanges will be drilled to ANSI B16.1, class 150 conforming to ASTM A182 and ANSI B16.5. Gaskets for flanged joints shall be Viton. Flange bolts shall be of the number and size in accordance with ANSI B16.1. All bolts, nuts and washers shall be Type 316 stainless steel.

PVC Solvent Cement: Joints shall be assembled using approved solvent cement in accordance with the manufacturer's recommendations and ASTM D2564 and ASTM D2855. No cementing shall be done in the rain or when the air temperature is below 40°F or above 90°F.

All PVC piping, fittings, and valves shall not be painted.

2.3.6 Valves

General. The VenCOR shall supply all valves and specialties as specified herein and shown on the Drawings and PID. In addition, valve-operator and other accessories shall be supplied by VenCOR. All valves shall be new and of current manufacture. All valves, specialties, etc. shall be installed with sufficient unions and/or flange joints to permit replacement without the need to cut the pipes. Valves and fittings 2 inch and smaller shall have union joints. The valves shall be suitable for the intended service. Valves shall be the same size as adjoining pipe. Valve ends shall be compatible with the adjacent piping system. An operator shall be sized to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Operators, actuators, and accessories shall be factory mounted.

Ball Valves (General Purpose). Ball valves upto 4 inch, shall be Schedule 80 PVC double-union ball valves with handle as manufactured by Nibco, Hayward, Chemline, or approved equal.

All sampling valves and drain a valves shall be 316 SS, provided with a spring return handle with a locking device similar to manufactured J Flow .Controls LLC or equal.

Butterfly Valves. Butterfly valves, 3 inch and larger, shall be Schedule 80 PVC with lugs for flanged service. Butterfly valves shall have hand wheel or chain wheel operators (when higher than 7 feet). Butterfly valves shall be as manufactured by Nibco, Hayward, Chemline, or approved equal. Where shown on drawings, provide electric actuated valves.

Air/Vacuum release valves (vent valves)

Air/Vacuum release valves up to 3 inches, shall be combination air/vacuum release automatic PVC valves and provided as shown on the drawings. The valves shall have flanged ends and manufactured by Nibco, Hayward, Chemline or approved equal. The valves shall have full port liquid capacities and high discharge capacities. The valves shall have excellent corrosion resistance material. The seal material of the valves shall be EPDM or Viton. The valves shall be rated for the maximum operating and test pressures of the system.

2.3.7 Site Glasses

A 12 inch diameter observation port shall be provided in the tank wall. The observation port shall be located at the surface of the filter media.

2.4 MEDIA

Filter materials shall conform to the requirements of AWWA B100. Sieve analysis shall be performed in accordance with ASTM C136/C136M and AWWA B100. Specific gravity shall be determined in accordance with ASTM C127 for support media and ASTM C128 for silica sand and high-density media. Submit characteristics of each filter media material.

2.4.1 Silica Sand

The silica sand shall have an effective size between 0.45mm and 0.55 mm, uniformity coefficient less than or equal to 1.7, and a specific gravity of 2.65 . Ninety-five percent shall be larger than or equal to 0.50 mm. The media shall have a density of 100 lbs/cubic foot.

2.4.2 Support Media

1/4 X 1/8 Quartz Gravel Under Bedding
The primary support media shall be a gravel or quartz consisting of 1/4" x 1/8" hard, rounded stones with an average density of 100 lbs/cubic foot. The gravel shall contain not more than 5 percent by weight of thin, flat, or elongated pieces (elongated pieces are those that in the largest dimension exceeds three times the smallest dimension.

2.4.3 Filtration Media Information

Filtration Media- Silica Sand
The silica sand shall have an effective size between 0.45 mm and 0.55 mm. The media shall have a density of 100 lbs/cubic foot. Ninety five percent shall be larger than or equal to 0.50 mm.

30 X 40 Mesh High Density
The high density secondary support media shall be garnet and have an effective size of between 30 and 40 mesh with a density of 130 lbs/cubic foot.

8 X 12 Mesh High Density
The high density primary support media shall be garnet and have an effective size of between 8 and 12 mesh with a density of 140 lbs/cubic foot.

1/8 X 1/16 Quartz Gravel Under Bedding
The secondary support media shall be a gravel or quartz consisting of 1/8"

x 1/16" hard, rounded stones with an average density of 100 lbs/cubic foot. The graval shall contain not more than 5 percent by weight of thin, flat, or elongated pieces (elongated pieces are those that in the largest dimension exceeds three times the smallest dimension).

1/4 X 1/8 Quartz Gravel Under Bedding
The primary support media shall be a gravel or quartz consisting of 1/4" x 1/8" hard, rounded stones with an average density of 100 lbs/cubic foot. The gravel shall contain not more than 5 percent by weight of thin, flat, or elongated pieces (elongated pieces are those that in the largest dimension exceeds three times the smallest dimension).

Support Media Type: 1/4" X 1/8" quartz gravel underbedding Depth of media: Cover the bottom distributors plus 2"

Layer 2 Media Type: 1/8" X 1/16" quartz gravel Depth of media: 2.5" typically

Layer 3 Media Type: 8X12 mesh high density garnet Depth of media: 2.5" typically

Layer 4 Media Type: 30X40 mesh high density garnet Depth of media: 2.5" typically

Layer 5 Media Type: 0.45-0.55 mm Filter Sand (silica) Depth of media: 24" typically

PART 3 EXECUTION

3.1 EXAMINATION

The Contractor shall verify all dimensions in the field and advise the Engineer of any discrepancy before performing the work. All equipment will be installed by the Contractor.

3.2 PREPARATION

3.2.1 Fabrication

Work not required to be performed in the field shall be performed in a factory under controlled conditions.

3.2.2 System Installation

The system shall be installed such that proper wastewater flow through the unit and required effluent conditions as specified in Paragraphs Design Criteria or Cartridge and Bag Design Criteria (as applicable) will be achieved and maintained. Upon completion of installation, the Contractor shall coordinate with the VenCOR to verify proper installation. Contractor shall install and VenCOR shall inspect electrical work as specified in Section 26 05 00.00 40 Common Work Results for Electrical. Install control panel and 120V power feeder as specified in Section 26 05 00.00 40 Common Work Results for Electrical.

If the Installation, Inspection or Operating Performance Test reveals deficiencies, corrective measures shall be taken until the system satisfies all of the specified requirements. The Contractor shall coordinate with the VenCOR for this testing. Remedies shall be completed at no additional cost to the Owner.

3.3 PAINTING

Painting shall be performed in accordance with applicable requirements provided in Section 09 90 00 PAINTS AND COATINGS, and additional requirements provided herein.

3.3.1 Metal surfaces

Me, except aluminum, bronze, brass, galvanized steel, and stainless steel shall be painted. Surface preparation and painting shall be performed in the shop or in the field as indicated. Manufactured items, such as motors and switchboards, shall be finished with the manufacturer's standard finish.

3.3.2 Preparation and Application

Ferrous metal surfaces shall be prepared in accordance with SSPC SP 6/NACE No.3 and painted with two or three coats of MIL-DTL-24441 epoxy paint to achieve a total dry film thickness of 150 microns (6 mils). Master Painter's Institute (MPI) #120 Epoxy, High Build, Self Priming, Low Gloss, is an acceptable replacement to MIL-DTL-24441.

3.3.3 Coating Testing

Coating shall be examined for flaws and tested for thickness. Thickness of coatings shall be measured wet and dry using a commercial film thickness gauge. The Owner shall be notified in advance of any painting. Additional coats shall not be applied until the previous coat has been approved. Repair or additional coats shall be accomplished at no additional cost to the Owner

3.3.4 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair shall consist of preparing the affected area in compliance with SSPC SP 6/NACE No.3 and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, the surface shall be prepared and additional coats applied in the affected area in compliance with the manufacturer's instructions.

3.4 VALVE AND PIPE INSTALLATION

3.4.1 Valves

Valves shall be installed as nearly as possible in the position shown. Valves shall be erected and supported in their respective position free from distortion and strain on appurtenances during handling and installation. Material shall be inspected for defects in workmanship and material. Debris and foreign material shall be cleaned out of valve openings and seats; operating mechanisms shall be operated to check their proper functioning, and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced.

3.4.2 Piping

Piping shall be installed to accurate lines and grades. Where temporary supports are used they shall be sufficiently rigid to prevent shifting or

distortion of the pipe. Provision shall be made for expansion where necessary. Piping shall pitch toward low points, and provision shall be made for draining these low points. A sufficient number of unions or flanges shall be used to allow for the dismantling of all water pipe, valves, and equipments. Installation of piping including cleaning, cutting, threading and jointing, shall be in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE .

3.5 FILTER TANK

3.5.1 Erection of Equipment

Equipment shall be properly aligned. The unit shall be turned to a vertical position and set in place. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved, the stationary assembly shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations. Bracing and shipping support shall be removed from the bottom and/or interior of the tank. Piping shall be connected as indicated. Valves shall be closed.

3.6 UNDERDRAIN

The underdrain shall be installed in accordance with approved shop drawings and requirements of the manufacturer, including instructions of the manufacturer's representative. The filter tank shall be cleaned and washed prior to installation of the underdrain. Broken or defective components shall be replaced. The manufacturer-supplied underdrain shall not be modified. Following installation, the underdrain system shall be completely cleaned and washed free of loose materials and debris. Any damaged surfaces shall be restored to the original or equivalent coating. Internal water pressure or testing of the system shall not be performed for a minimum of 3 days after completion of installation. The underdrain system shall be maintained in clean condition until installation of filter media.

3.7 FILTER MEDIA INSTALLATION

Media shall be installed by Contractor under the supervision of the VenCOR. Before installing the filter media, check all piping connections and ensure filter components are in good condition and proper position. Media shall be placed to the depths required by the manufacturer A minimum freeboard of 12 inch shall be left between the top of the media and the top of the tank.

3.7.1 Media Layers

Each layer of media shall be completed before the next layer above is started. Each layer of media shall be deposited so as not to disturb the level surface of the layer below. Any media which is made dirty before or after placement shall be removed and replaced.

3.7.2 Cleaning of Media

The filter media shall be backwashed, scraped, and skimmed in accordance with AWWA B100 to remove excess fine material upon completion of placement of each layer. The number of washes, the wash rate and duration of wash required to achieve the specified gradation for each layer shall be in accordance with the recommendations of the filter media supplier.

3.8 IDENTIFICATION SYSTEMS

3.8.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.8.2 Color Coding

Color coding for piping identification shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.9 FIELD TESTS AND INSPECTIONS

Contractor to perform field tests in the presence of the Owner and Manufacturer's representative and provide labor, equipment, and incidentals required for the tests. Provide for disposal of all waste residuals resulting from the tests. Notify the Owner and Manufacturer's representative 2 days prior to the date and time for the acceptance tests. Any deficiencies found shall be rectified and work affected by such deficiencies shall be retested.

3.9.1 Field Service

The owner has obtained services of Multimedia Filters and Bag Filters system manufacturer's representative to verify the installation and connection requirements of all equipment and materials for its complete operation.

VenCOR's representative shall be on site for three separate events, a 3-day trip during installation and landing of wires, a 3-day trip during initial startup, and a 2-3 day trip during acceptance testing/training.

3.9.2 Initial Operation

Following completion of installation of the treatment systems and after the Contractor and manufacturer's representative agree the system is ready for operation, the system shall be operated over an initial operating period not to exceed 3 days. Demonstrate proper operation of the equipment, including, but not limited to, the ability of the system to produce the minimum specified effluent requirements detailed in Paragraphs Design Criteria or Cartridge and Bag Design Criteria (as applicable), proper operation of the media cleaning equipment, and the control system ability to provide the correct operational logic to optimize the filtration process.

3.9.3 Acceptance Testing

Acceptance testing shall commence not sooner then 2 days and not later than 2 days following approval of the initial operation. The acceptance tests shall demonstrate the ability of the filtration system to meet the effluent specified requirements when operating at the design flow rate and to demonstrate the control system ability to provide the correct

operational logic to optimize the filtration process. The tests shall be conducted over 3 days of continuous operation. 1 effluent samples shall be collected during each 4 hour period. Samples shall be taken not less than 2 hours nor more than 4 hours apart. For the filtration system to qualify for process acceptance, the average value of each of the filtered water effluent parameters monitored during the continuous testing shall not exceed the values of the specified parameters. In the event that the specified filtered water quality requirements are not met during the period that acceptance testing is conducted, the defective equipment or operation shall be modified or replaced and the testing repeated. The schedule for retesting is subject to approval by the Contractor.

Submit test reports in booklet form showing field tests performed to adjust each component and to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

3.10 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 24 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover all of the items contained in the Operating and Maintenance Instructions. The instructions shall include, but shall not be limited to the following:

a. System layout showing piping, valves and controls and installation requirements.

b. Approved wiring, logic, and control diagrams prepared in accordance with ANSI/ISA 5.1 including a drawing index, legend and symbols list, and abbreviations and identifiers.

c. A control sequence describing startup, operation, and shutdown; including the functional and operational description of the control system covering the procedures for programming, operation, startup, shut-down, and calibration.

d. Operating and maintenance instructions for each piece of equipment, including checkout, troubleshooting, and servicing.

e. Manufacturer's bulletins, cut sheets and descriptive data, parts list, and recommended spare parts.

3.11 OPERATING AND MAINTENANCE INSTRUCTIONS

Provide operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of equipment and their basic operating features. Also, provide maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guides. The instructions shall include simplified diagrams for the system as installed. The manual shall require valves be numbered and tagged and shall provide a schematic indicating the number of each valve. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the

facility, name of the Contractor, and contract number.

-- End of Section --

TABLE-2
TREATMENT PLANT UNIT PROCESS GOALS

Parameters	Units	Equalization Tank with Neutralization, Iron Oxidation, and Aeration		Multi Media Filtration		Advanced Oxidation Process Technology		Liquid Granular Activated Carbon	
		Influent [(a)]	Effluent	Influent	Effluent	Influent	Target Effluent	Influent	Target Effluent
Organics									
Trichloroethene	ug/L	1.8/5	<5	<5	<5	<5	<1	<1	<1
Tetrachloroethene	ug/L	ND/1	<1	<1	<1	<1	<1	<1	<1
Freon 113	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
1,1-Dichloroethene	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
cis-1,2-Dichloroethene	ug/L	ND/0.5	<1	<1	<1	<1	<1	<1	<1
1,4-Dioxane	ug/L	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.5/1.5	0.1 to 0.3	0.1 to 0.3	0.1 to 0.3
Inorganics									
Iron - dissolved	mg/L	1.5/2.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Iron - total	mg/L	1.5/2.5	1.5/2.5	1.5/2.5	<0.3	<0.3	<0.3	<0.3	<0.3
Suspended Solids	mg/L	<1	3 to 5	3 to 5	<1	<1	<1	<1	<1
Ozone	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	6	2	<0.1
Hydrogen Peroxide	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	6	2	<0.1
Sodium Hypochorite	mg/L	<0.1	<0.1	1 to 2	<1	<1	<1	<1	<0.1
pH	Standard Unit	4.5 to 5.5	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2	6.8 to 7.2

(a) Average/maximum.

< - Less than.

µg/L - Microgram per liter.

mg/L - Milligram per liter.

SECTION 50 01 01

PROCESS PUMPS

PART 1. GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to install three (3) set of non-clog End-suction Centrifugal Pumps, one (1) set of non-clog submersible pumps, and three (3) chemical corrosion resistant submersible pumps as detailed in the Pump List (Section 2.1 below) Installation shall be complete and include, but not be limited to: pumps, controls, flanges, couplings, discharge pipe, and appurtenances as shown on the Contract Drawings and as specified herein

1.2 RELATED SECTIONS

Section 01 11 00 Summary of Work

Section 01 33 00 Submittal Procedures

Section 01 78 00 Closeout Submittals

Section 01 78 23 Operation and Maintenance (O&M) Data

Section 41 10 02 Process Piping

Section 26 20 00 Interior Distribution System

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

<u>AMERICAN IRON & STEEL INSTITUTE (AISI)</u>

AISI 1045 Steel

<u>AMERICAN NATIONAL STANDARD INSTITUTE/AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ANSI/ASME)</u>

ANSI/ASME B73.1M-2012 Specification for Horizontal End-Suction Centrifugal Pumps for Chemical Process

<u>HYDRAULIC INSTITUTE STANDARDS FOR CENTRIFUGAL, ROTARY, AND RECIPROCATING PUMPS (HI)</u>

ANSI/HI 1.1-1.6 Centrifugal Pumps

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 240 316/316L Stainless Steel INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001 Quality Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG1 Motors and Generators

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 Submittals:

1. Shop Drawings: Submit shop drawings for pumps including, dimensions, materials of construction, bills of materials, motor data, certified performance curves, parts lists, pumps mounting arrangement, and tie in connections.

2. Product Data: Submit product data describing equipment features, materials of fabrication, general dimensions, pump curves, and general operating parameters.

3. Factory Tests: Test reports in booklet form showing the results of factory tests performed.

4. Field Tests and Inspections: Test reports in booklet form showing results of the field tests performed to adjust each component following the installation of the system and the field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

5. Operation and Maintenance Data: Provide instructions containing the manufacturer's operating and maintenance instructions for the equipment including spare parts.

Operation and Maintenance Manuals

1. Submit the operation and maintenance (O&M) manual and required number of copies in accordance with Section 01 78 23.

2. Submit the name, address, and contract information for the local pump distributor and service shop for the specific make and model of pumps provided.

1.5 QUALIFICATION AND WARRANTY

Manufacturer Qualification

1. The Pumps shall be supplied by a reputable Manufacturer having at least ten (10) years’ experience in the design and fabrication of pumps for the treatment of groundwater and water.

Warranty

2. Manufacturer shall provide warranty in accordance with Section 01 78 00 of the specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect all equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 TOOLS AND SPARE PARTS

All tools required for normal operation and maintenance of each piece of equipment shall be furnished. Special tools recommended by the Manufacturer shall also be furnished. An inventory log shall be maintained and stored with the tools. All items shall be suitably packed and protected for long periods of storage. The manufacturer recommends that one whole pump be kept as spare.

1.8 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on a conceptual arrangement of equipment (ITT Goulds (Xylem)Pump Models) and piping. Should the Contractor propose to furnish equal equipment of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed equipment into the design and submit the necessary revised Contract Drawings and Technical Specifications for review and approval by the Owner’s Representative.

The horizontal centrifugal end-suction Pumps and Submersible pumps shall be manufactured by ITT Goulds (Xylem) Pumps, Inc. of Seneca Falls, New York or Approved equal will be considered acceptable.

All products, whether named as "acceptable" or proposed as "equal" must fully comply with these specifications.

All pumps supplied under this section must be of the same manufacturer.

PART 2. PRODUCTS

2.1 PUMPS

Provide the pumps shown below in the pump list. The proposed equipment is subject to verification of capacity per the field pump test as performed by the Contractor.

1. Pumps and motors shall be preassembled as a single unit

2. Motors shall have a 1.15 service factor.

3. Pumps Motor shall be capable of running on Variable Frequency Drives (VFDs). Pump Motor shall be a Totally Enclosed Fan-Cooled (TEFC) motor.

4. Motors shall comply with Section 26 20 00 Interior Distribution System. The following power sources are anticipated: 480 V, 3 phase, 60 Hz. Motors shall be inverter duty capable of operation.

PUMPING SYSTEM LIST:

Pump ID	Manufacturer / Model	Size	Operating Flow (gpm)	TDH (ft)	Motor (HP)
P-100A P-100B (MMF Feed Pumps)	ITT GOULDS (END SUCTION PUMPS) Model 3196 XLTi	6 x 8 - 13/6V	DESIGN=1500 MAXIMUM=1800	126 132	75
P-400A P-400B (LGAC Feed Pumps)	ITT GOULDS (END SUCTION PUMPS) Model 3196 XLTi	8 x 10 - 13/5V	DESIGN=1500 MAXIMUM=1800	44 46	30
P-500A P-500B (Backwash Supply Pumps)	ITT GOULDS (END SUCTION PUMPS) Model 3196 MTi	4 x 6-10H/6V	950	61	20
P-800A P-800B (Building Sump Pumps)	Xylem (Goulds Water Technology) Model 3888D3	3” 125# ANSI FLANGE	150	40	5
P-911 P-921 P-931 (Chemical Room Sump Pumps)	BJM Pumps Perfecta Model IGF32-FWLZ-115	1.25” NPT-F discharge FLANGE	30	15	0.4

2.2 MATERIALS OF FABRICATION

ANSI CENTRIFUGAL END SUCTION PROCESS PUMPS

1. Pump Casing: 316 Stainless Steel
2. Impeller: 316 Stainless Steel
3. Frame Adapter: Ductile Iron
4. Bearing Frame: Cast Iron

5. Motor Shaft: 304 Stainless Steel

6. Shaft Sleeve: 316 Stainless Steel

7. Stuffing Box Cover: 316 Stainless Steel

8. Labyrinth Oil Seals: Carbon Filled Teflon with Viton O-Ring

9. O-Ring, Impeller: Glass Filled Teflon

10. O-Ring, Bearing Housing: Buna-N Elastomer

11. Motor Support Ductile Iron

BUILDING SUMP PUMPS

1. Casing: Gray Cast Iron (ASTM A48 Class 30)

2. Impeller: Gray Cast Iron (ASTM A48 Class 30)

3. Type of Seal: Mechanical Seals

4. Rotating Face: Carbon

5. SEAL:

Stationary Face	Ceramic/Silicone Carbide
Elastomers	BUNA
Metal Components	Stainless Steel
Rotating Face	Silicon Carbide

6. Seal Housing: Cast Iron

7. Seal Housing to Bearing Housing: AISI 300 SS

8. Ring – Bearing Housing to Seal Housing: BUNA-N, AS568A-265

9. Lower Ball Bearing: Steel

10. Motor: Stainless Steel Shaft

11. Plug – Motor Cover ½" NPT: AISI 300 SS

12. Motor Cover: Cast Iron

13. Bearing Housing: Cast Iron

2.3 PROCESS PUMP CONSTRUCTION

Provide pumps of back pull-out design with registered fit between the pull-out assembly and the casing permitting removal of the complete

rotating assembly without disconnection of suction or discharge connections.

All major castings and moldings shall be produced in the pump manufacturer's own foundry, under the manufacturer's direct supervision.

The pump envelope dimensions shall conform in all respects to ANSI Specification B73.1M, latest edition.

Impeller

1. Clearances in all leakage paths must be renewable through an axial adjustment of the impeller and shaft assembly, which shall be accomplished without removing the pump or pumping elements from the installed location.

2. The impeller shall be threaded onto the shaft and sealed with a glass filled Teflon O-Ring, which shall be fully confined.

3. Impeller wear rings shall not be used to prevent the possibility of crevice corrosion.

4. Impeller shall be supplied with back pump-out vanes to reduce axial thrust and pressure on shaft seals. Impeller shall be balanced to ISO Specification 1940 Figure 2, Level G2.5

Casing

1. Class 150 pump casing shall be furnished with Class 300 wall thickness to provide maximum corrosion and erosion allowance. Pressure retaining capability shall be certified by the Hydrostatic Test report.

2. The pump shall be furnished with a fully confined casing gasket to prevent corrosives from contacting registered fits.

3. Flanges shall be ANSI B16.5 flat face for improved sealing and interchangeability, and to ensure proper gasket loading and retention.

4. Casings shall be furnished with 3/8" NPT (min.) tapped and plugged drain connection on the pump volute.

Shaft Sealing

1. Pump shall be supplied with a single unbalanced pusher type cartridge mechanical seal for positive shaft sealing. Seal shall be furnished with Silicon Carbide versus carbon faces, and a 316 stainless steel gland.

2. The seal chamber shall be Taper Bore Plus type or equal. The seal chamber shall be designed to effectively keep solids (up to 10% by weight) away from seal parts and ensure adequate cooling of the mechanical seal cavity.

Provide pump shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the stuffing box cover. Shaft deflection at all operating points shall not exceed the limits

specified in ANSI B73.1M, latest edition. Machine the shaft of carbon steel (for maximum strength) and isolate the shaft from the pumped media with a replaceable Type 316 stainless steel shaft sleeve.

Bearings

1. Radial Bearings shall be SKF 6309 single row roller bearings or approved equal. Average B-10 bearing life shall not be less than 87,600 hours.

2. Thrust Bearings shall be SKF 5309 A/C3 double row angular contact bearings or approved equal. Average B-10 bearing life shall not be less than 87,600 hours.

3. Maximum bearing span shall not be less than 6.75".

4. Bearing Frame shall be protected from contamination by INPRO VBXX-D bearing isolators on both the in-board and outboard sides of the bearings. Isolators shall be constructed of bronze stators and stainless-steel rotors. Lip seals shall not be acceptable.

5. Pump shall be supplied with an over-sized oil sump to promote cooler bearing operation and extended life. Casing shall be provided with a minimum 1" diameter sight glass for visual inspection of oil level and condition.

6. To enable consistent monitoring of pump bearing temperature and vibration conditions, the pump bearing frame shall be furnished with machined condition monitoring sites.

Condition Monitoring: Pump bearing frame shall be equipped with an onboard, battery- powered condition monitor. Monitor shall constantly measure vibration and temperature at the thrust bearing, and alert when pre-determined levels have been exceeded via two blinking RED LED’s. Rated battery life shall not be less than 3-5 years.

Contractor shall provide 316 SS pump mount anchor bolts.

2.4 CHEMICAL SUMP PUMP CONSTRUCTION

PUMP REQUIREMENTS

The chemical sump pump shall be manufactured by BJM Pumps Perfecta model IGF32-FWLZ-115 or Approved Equal.

Supply (qty) __3___, __1 1/4___ inch discharge electric submersible chemical resistant pump(s). The pump shall be driven by a close coupled 0.4 HP, submersible electric motor with a nominal rating 115 volts, 1 phase, 60 Hz, 3450 RPM.
The pump shall be capable of delivering __30___ US GPM flow at _15____ FT TDH. The pump shutoff head shall be at least 27 FT TDH. The pump shall be capable of a maximum submergence depth of 33 ft. Minimum submergence depth at Pump Off: 38 mm

DESIGN AND CONSTRUCTION

The pump suction cover, motor housing and upper volute shall be designed and constructed of glass filled PPO. The pump base/strainer shall be constructed of PPO.
The pump top cover shall be constructed of nylon. The pump handle shall be constructed of PP. The pump shall be equipped with 316SS Hardware with Buna-N and FKM Elastomers – IGF Model.

Impeller
The pump shall be supplied with a multi-vane impeller constructed of glass filled PPO.
The impeller shall be affixed to the motor rotor shaft by placing it on the shaft, locked in place by a drive flat molded into both the impeller hub and pump shaft. The impeller shall then be tightened to the shaft with a screw and lock washer screwed into threads tapped into the end of the shaft.

Strainer
The pump shall be fitted with a replaceable strainer and suction cover. The suction cover be constructed of glass filled PPO and shall be press fit into place. The strainer shall be constructed of PPO and shall be screwed directly to the pump housing. The strainer shall pass solids up to ¼".
Pump Housing/Motor Housing
The upper pump housing and motor housing should be molded as 1 piece constructed of glass filled PPO.

Discharge Flange
The pump shall be supplied with a 1.25" NPT-F discharge flange screwed directly into the pump/motor housing. The pump shall also be supplied with a 1.5" tapered hose discharge flange as an alternate. The discharge flanges shall be constructed of glass filled PPO.

Seals
The pump shall be supplied with two lip seals to protect the motor from the pumped liquid. The seals shall be constructed of FKM Lower Seal/FKM Upper Seal – IGF Model, TIGF* Model
*TIGF lip seals to utilize an o-ring of same material as lip seal in place of SS garter spring.

Motor
The pump motor shall be an oil filled Permanent Split Capacitor motor designed specifically for submersible pump usage and continuous duty of pumped liquid up to 135 degrees F. The stator windings and leads for Perfecta motors shall be insulated with moisture resistant Class F insulation rated for 311 degrees F.

The motor horsepower shall be non-overloading over the full range of the performance curve, from shut-off to full flow. The combined service factor (frequency, voltage and liquid specific gravity) of the motor shall be 1.10.
The motor shall be protected from failure from overheating and from low voltage or high amperage by a thermal overload switch built into the stator windings.
The pump/motor housing shall be constructed of glass filled PPO. The motor top cover shall be constructed of nylon.

Rotor / Pump Shaft

The rotor (pump) shaft shall be constructed of 316SS – IGF Model
Rotor shall be made of steel with cast aluminum insulation and shall be dynamically balanced.

Bearings
The upper bearing shall be a single row deep groove ball bearing.
The lower bearing shall be a single row deep groove ball bearing.
The upper and lower bearings shall be lubricated by NSF Approved ISO 32 mineral oil.
Minimum bearing L10 life shall be 30,000 hours.

Power Cable
The pump shall be supplied with a 22 foot power cable (15' on TIGF with alternate lengths optional) connected to the motor lead wires in a water and oil resistant sealed cable entry. The power cable shall be sized in accordance with NEC standards. The outer jacket of the power cable shall be oil resistant and capable of submergence in water to 104 degrees F.
Power cables shall be type SJOW. For GF and IGF models, the power cable shall have a Neoprene outer jacket. For TIGF model, the outer jacket shall be EPDM.
The power cable entry shall be sealed by a cable grommet between the cable and the power cable entry.
Float Switch (not available on TIGF)
The pump shall be (choose one) supplied with an integral float switch. The float switch body shall be constructed of PE. The float switch cord shall be type SJOW with a Neoprene outer jacket.

TESTING
At the end of the assembly process, each pump is high potential tested to UL/CSA standards and then dry run tested. BJM Pumps® also performs qualification audits on each production lot to confirm product quality.

OVERALL
The pump shall be 10.12 inches in height; 7.5* inches long; 6.5 inches wide and shall weigh 13.5 lbs.

2.5 SOURCE QUALITY CONTROL

Equipment Tests

1. Hydrostatically test assemble pump to 150% of maximum working pressure (dead head pressure). Coordinate pump testing with the Owner's Representative so he/she can witness the tests.

Verification of Performance

1. Field test all pumps after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or over-heating.

2. Any pump which fails to meet any of the contract specifications will be modified, repaired or replaced by the Contractor at no additional cost to the Owner.

PART 3. EXECUTION

3.1 EXAMINIATION

After becoming familiar with all details of the work, verify dimensions in the field, and advise the Remedial Project Manager (RPM), FEAD CM or Engineer of any discrepancy before performing the work.

3.2 INSTALLATION

Installation of the pumps and all appurtenances shall be in accordance with the manufacturer’s recommendations.

The pump shall be inspected visually prior to installation.

Equipment installation shall be in accordance with the manufacturer's written instructions and in the presence of the Manufacturer’s representative.

3.3 FIELD TESTS AND INSPECTIONS

Field tests shall not be conducted by the Contractor until such time that the entire installation is complete and ready for testing.

As part of the installation inspection, the Contractor shall operate the pumps and check for excessive noise, vibration or heating, and for discharge adequacy. The pumps shall be tested over the full range of flow conditions.

The pump and suction/discharge piping shall be inspected by the Contractor in the presence of the Owner’s Representative for leakage.

If the installation inspection reveals deficiencies, corrective measures shall be taken by the Contractor until the pumps satisfy the specified requirements.

3.4 MANUFACTURER’S SERVICES

The Contractor shall provide the following personnel:

1. One (1) representatives of the Manufacturer who is experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of equipment – for a minimum of 3 days (8 hours a day).

Conduct a video recorded training course for designated operating, maintenance and support staff members. The training period shall be a total of 4 hours of normal working time. Field training shall cover each item contained in the operating and maintenance manual.

-- END OF SECTION --

SECTION 50 02 01

GLASS FUSED TO STEEL BOLTED STORAGE TANK

PART 1 - GENERAL

1.1 SUMMARY

A. Under this section, the manufacturer's authorized tank dealer (MATD) shall furnish all required labor, materials and equipment to provide and erect a Model 17x26 Glass-Fused-to-Steel Bolted Water Storage Tank constructed of factory prefabricated glass-fused-to-steel, bolt-together steel panels. The factory in which the panels are produced for this project shall be ISO-9001 certified for this process and located in the United States of America.

B. Each tank structure shall include a foundation, floor, free span dome and other accessory components as shown on the contract drawings and described herein. Note that painted, powder coated, stainless steel or galvanized bolt-together tanks shall not be deemed acceptable.

C. All required tank materials and principal appurtenances shall be supplied by the tank manufacturer. Tank structures and appurtenances shall be new and not previously used.

D. A site and project specific foundation shall be designed by the tank manufacturer or MATD with the applicable state PE stamp and must be provided with the bid submission. No third-party designs will be allowed. The tank manufacturer shall be solely responsible for the tank structural steel design.

E. Tanks shall be designed, manufactured, and glass coated in the United States of America, by a tank manufacturer specializing in the production of glass-coated, bolt-together steel tank systems. All structural steel utilized in the tank structure shall be produced in, and the glass-fused-to-steel process must take place in the United States of America.

1.2 REFERENCES

A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. ASTM International
2. American Water Works Association (AWWA)
   a. Tank steel panel materials, design, fabrication and erection shall comply with AWWA D103, latest revision, for factory-coated bolted carbon steel tanks, unless specified otherwise herein.
3. American National Standards Institute (ANSI)
4. National Sanitation Foundation (NSF)
   a. All material furnished by the tank manufacturer which is in contact with the stored water, including vitreous glass-

fused-to-steel panels, joint sealant, encapsulated bolt heads, etc., shall be certified and listed by the National Sanitation Foundation (NSF) to meet NSF/ANSI Standard 61. The tank as a complete system needs to be certified. Certification of a coating type alone will not be sufficient to meet this requirement.

5. NACE International (NACE)
6. American Institute of Steel Construction (AISC)
7. Occupational Safety and Health Administration (OSHA)
8. FM Approvals
   a. Certification of annual review of quality control procedures of the manufacturing plant by FM is required upon request.
9. American Welding Society (AWS)
10. International Organization for Standardization (ISO)
   a. The tank manufacturer's manufacturing facility and quality assurance program shall be certified to comply with ISO 9001 standards.

1.3 SUBMITTALS

A. Before executing any work in this section, the tank manufacturer or MATD shall submit job specific structural calculations for tank and foundation, general arrangement drawings and specifications for the tank structure, foundation, joint sealant and all appurtenances. There shall be no deviation from the drawings and specifications, except upon written order from the engineer. Submittal documentation for the tank and foundation shall be sealed by the tank manufacturer's Professional Engineer licensed and registered in the applicable state.

B. Product Data "catalog cuts" and spec sheets provided shall be marked to specifically indicate the equipment and materials proposed for this project. Indicate selections with arrows, and cross out irrelevant data.

C. NSF 61 certification of tank system and individual components (tank, sealant, anodes, and bolts) shall be provided with submittals.

D. Submittals shall include certification that each applicable Section of AWWA D103, latest revision, is met. Any exceptions taken shall be noted with full explanation given for the deviation.

E. All engineering costs which are caused by changes in design from the plans and specifications are to be borne entirely and unconditionally by the General Contractor. Approval by the Engineer of the shop drawings submitted by the General Contractor shall in no way relieve the General Contractor of full responsibility for the accuracy and completeness of the design and of the shop drawings.

F. A submittal substitution review deposit in the amount of $2,000, payable to the Owner, shall be submitted, upon Engineer's request, with the request for review of any substitution deviations from the plans and specifications. The deposit will be used by the engineer at a rate of $150/hour to review such requests, regardless of whether the substitution is approved or rejected. The owner will return any unused funds to the petitioner within 45 days of approval of submittals.

G. Documentation shall be submitted certifying tank design and manufacture in the United States of America. Documentation shall also be submitted certifying that the steel is produced and glass coated in the United States of America.

H. Copy of the Builder Certification Program sponsored by the tank manufacturer certifying factory training and experience of the MATD building employees shall be submitted to the Engineer.

I. Documented qualifications of MATD building employees including their project construction foreman shall be submitted upon request, for review. The MATD foreman shall have construction experience of at least five years in bolted glass fused to steel construction of the manufacturer's tank being provided and at least (3) of that manufacturer's specific glass fused to steel tank projects that are fully complete. Construction experience shall be for tanks of similar size and climate as to the one specified herein. Owner reserves the right to reject, without penalty, any and all proposed foremen that do not meet the required experience requirements.

J. The tank manufacturer shall provide a standard Operation and Maintenance Manual upon approval of the drawings and completion of the tank installation.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Tank manufacturer's Professional Engineer experienced, licensed and registered in the applicable state is responsible to sign and seal documentation for tank manufacturer's tank and/or foundation design. Evidence of professional liability insurance shall be provided at a minimum coverage of $1,000,000.

2. The tank manufacturer shall be a specialist in the design and fabrication with a minimum of 15 years of documented glass fused to steel tank manufacturing experience in the United States of projects in similar climates, sizes and applications. The tank manufacturer shall employ a staff of full-time design engineers, and shall own and operate its steel fabrication and glass coating facilities.

3. The MATD shall have constructed, with its own direct employees, at least 15 of the specific manufacturer's glass-fused-to-steel tanks designed to AWWA D103, latest revision, that are equal or greater in size than the specified tank, operating satisfactorily in a similar application within the United States for a minimum of (10) ten years. The MATD shall provide with their bid submission the project name, location, application, size, capacity, contact information and year each tank was put into service.

4. Manufacturers and MATD lacking the experience requirements listed in this section or elsewhere in the contract documents will NOT be considered without prior approval. Strict adherence to the standards of design, fabrication, erection, product quality, and long-term performance established in this specification will be required by the engineer and owner.

5. Builders lacking the experience requirement will not be considered unless they provide a satisfactory 5-year 100% performance bond in lieu of evidence of experience and long-term operation.

B. Source Limitations

1. Tank and dome in this Section shall be furnished and erected by a single MATD.
2. Tank and dome in this Section shall be manufactured and fabricated by a single source with all fabrication and engineering design performed by in-house full time staff.

1.5 PACKAGING, DELIVERY AND HANDLING

A. All sheets that pass factory inspection and quality control checks shall be protected from damage prior to packaging for shipment.

B. Protective layers shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment.

C. Individual stacks of panels shall be wrapped in heavy waterproof cover and steel banded to wood pallets built to the roll-radius of the tank panels. Tank components shall be delivered from the factory by truck(s) dedicated to this delivery with no other loads on the same truck. This procedure minimizes contact or movement of finished panels during shipment.

1.6 WARRANTY

A. If within a period of one (1) year from date of completion (or 14 months after delivery), the tank structure or any part thereof shall prove to be defective in material or workmanship upon examination by the manufacturer, the manufacturer will supply a replacement part, will repair, or allow a credit for same.

B. The warranty shall be further extended with the use of a manufacturer supplied Cathodic Protection system as follows: the glass coated product zone surfaces, that portion of the tank interior below the normal high elevation of the contained liquid will not corrode under normal and proper use, maintenance and operation during the period expiring on the earlier of (i) 60 months after the date of installation or (ii) 62 months after shipment from the factory.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The tank shall be supplied and constructed by Statewide Aquastore, Inc. headquartered in East Syracuse, New York or Approved Equal. Tank manufacturer shall be CST Industries, Inc., of DeKalb, IL or pre-approved alternate. No other tank manufacturer shall be deemed acceptable for the base bid. This requirement is intended to protect the owner so that no one bidder gains an unfair advantage by quoting a lesser product that does not comply with the minimum performance and demonstrated successful experience set forth in these specifications.

B. All pre-approval requests must be made at least 10 business days prior to the specified bid date or they will not be considered. Only bids from

tank manufacturers and MATD who have successfully prequalified will be considered. Bidders will be notified via addendum allowing or disallowing the pre-approval request. If bidder fails to pre-qualify and provide the documentation deemed necessary by the engineer to evaluate proposed alternate equipment, the proposed tank manufacturer and/or MATD will be rejected.

C. The Engineer is the sole authority for determining conformance to the specifications and whether to pre-quality a proposed supplier. Under no circumstances will they be required to prove that an alternate product is not equal to the specified equipment. The Engineer's decision or judgment on these matters will be final, conclusive and binding.

D. Naming of a manufacturer does not relieve them from complying with the performance features, the salient features, and any country-of-origin requirements of the contract documents. The contract documents represent the minimum acceptable standards that will be allowed.

E. The Engineer's selection of factory applied glass-fused-to-steel bolt together tank construction for this project has been predicated upon specific criteria, construction methods, and an optimum coating resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details will not be permitted. To assure the greatest availability and quality of tank and appurtenant components, and/or spare parts, preference will be given to U.S. manufacturers.

F. The Engineer/Owner reserves the right to evaluate all bids based on long term, 40–50-year life cycle cost of operation, coating, and maintenance. Values to be used in this evaluation will be at the discretion of the Engineer to determine which tank best fits the Owner's needs. The Engineer will add such costs, dependent upon the type of tank offered, to the bidder's price to determine the effective low bid for purposes of making the award.

G. Only a MATD shall be allowed to furnish and install the tank. Sub-contracting of the tank erection by the MATD shall not be permitted. Building crews shall comply with the tank manufacturer's requirements for building practices and equipment used on the job.

H. In order to assure uniform quality and ease of maintenance and obtaining service or spare parts from as few places to the maximum extent possible, it is the intent of these specifications that equipment under this section including, but not limited to, the tank, foundation design, cathodic protection system and dome shall be supplied by a single manufacturer and its MATD. The tank manufacturer and MATD assume the responsibility for proper installation and functioning of equipment.

2.2 DESIGN REQUIREMENTS

A. Tank structures shall be vertical, cylindrical, flat bottom, glass coated, bolt together steel construction. Epoxy, powder coated, galvanized or stainless steel are not considered equal and will not be considered.

B. Tank design shall be in accordance with AWWA D103, latest revision/ASCE 7-16. BS EN ISO 28765 and other foreign designs or codes are not considered equal and will not be accepted.

C. The factory coated glass-fused-to-steel bolt together tank shall have a nominal diameter of 17 feet, with a nominal sidewall height (to roof eave) of 26 feet.

D. Tank capacity shall be 30,000 gallons (usable, U.S gallons)at 18.28 feet liquid depth. Design freeboard shall be 90 inches.

E. Finished floor elevation shall be set as shown on drawings.

F. Loads to be considered in the tank and roof design shall include basic live, seismic and snow loads.

G. Specific Gravity of Stored Contents: 1.0

H. Net allowable soil bearing capacity: 4000 PSF (per Geotechnical Report)

I. Seismic Design

1. Map Spectral Response
   a. S_s : 0.245
   b. S_1 : 0.055
2. Importance Factor based on Category (I_E): IV
3. Site Class: Class D per Geotechnical Report
4. Long Period Transition Period (T_L) : 6

J. Snow Load

1. Ground Snow Load: 30 PSF.
2. Importance Factor (I_s): 1.2
3. Thermal Factor (C_t) : 1.2
4. Exposure Factor (C_e) : 1.0

K. Wind Load turn

1. Basic Wind Speed: 136 mph
2. Risk Category: III
3. Exposure Category: B

L. Frost Depth: 48inch per Geotechnical Report

M. Load cases (include the self-weight of the structure in all of the following load combinations) shall be analyzed to determine the controlling stresses, as follows:

1. Normal operating conditions (full tank) with a full snow load.
2. Empty tank, no snow.
3. Wind, or earthquake, on empty tank, full snow.
4. Wind, or earthquake, on empty tank, snow on leeward side of dome.
5. Wind, or earthquake, on empty tank, no snow

N. Concrete Floor

1. The tank floor shall be constructed of reinforced concrete as shown on contract drawings. If imported backfill is used, the backfill under the floor/footing shall be compacted and tested to a minimum of 95% of proctor. Backfill material shall be approved by Engineer prior to use on site.

2. The floor design shall include an embedded glass-coated starter sheet ring per the manufacturer's design and in accordance with AWWA D103, latest revision. The floor and foundation are an integral part of the tank assembly, therefore the tank foundation and floor slab shall be constructed by the MATD.

O. Aluminum Geodesic Dome Roof

1. The tank roof shall be furnished and manufactured by the tank manufacturer. Roofs shall be designed to AWWA D108 and ADM – 2010 and be constructed of triangular aluminum panels as shown on contract drawings. Roofs shall be clear span and self-supporting. Center post supports are not permitted. Materials shall be AA6005A-T61, AA6061-T6 or AA3003-H16. All metal components of the aluminum dome structure shall be aluminum or 300 series stainless steel. Alternate aluminum dome manufacturers wishing to be considered must pre-qualify with the engineer in order to register as an acceptable alternate.

2. Connection forces shall be transferred through gusset plates connected to the top and bottom flanges of the beam struts. The connections shall be designed as moment connections; a minimum of four bolts shall be used to connect the gusset plate to each strut flange. The structural analysis shall be performed using non-linear, second order, stiffness analysis models in accordance with ADM 2010 Chapter C. Stability shall be provided for the structure as a whole and for each of its components. The available strengths of members and connections determined in accordance with Section C.3 shall equal or exceed the required strengths determined in accordance with Section C.2.

3. No galvanized, aluminized, painted, or plated steel shall be used anywhere in the dome above the mounting bracket base plates. Dissimilar materials in the supporting structure shall be isolated from the aluminum dome by means of a composite elastomeric gasket. Designs that incorporate raised battens, overlapping panels and/or designs that incorporate fasteners which penetrate panels and attach to structural members are expressly prohibited.

4. Roof live loads and dead loads shall be carried by tank sidewalls, without additional support. A roof hatch, with a hinged gasket cover and locking hasp, shall be provided near the outside tank ladder.

5. Roofs are aluminum in color and shall be constructed of non-corrugated, triangular geodesic aluminum panels, which are sealed and firmly clamped in an interlocking manner within a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a dome structure. Fabric type flashing is not allowed.

6. The dome shall be self-supporting from the periphery structure with horizontal thrust contained by an integral tension ring. The entire structure shall be designed as a watertight system under all design loads and temperature conditions. The design shall include sealant to be completely encapsulated by applying it to the gusset cover's inner circumference, beneath the gusset cover's top closure plates.

7. The top surface of the batten bars must be completely flush with the triangular panel surfaces so that no ponding of water occurs at cover joints. Raised batten bars, overlapping panels, and/or panel

attachment fasteners that penetrate panels are expressly prohibited.

8. The walkway and handrail, if supplied with the roof, shall be constructed of aluminum.

9. The roof manway opening shall be at least 30” square. The opening shall have a curb of at least 4” in height, and the cover shall have a downward overlap of at least 2”. The manway shall be aluminum.

10. Dome Materials
    a. Triangulated dome frame struts: 6061-T6 aluminum or 6005A-T61.
    b. Structural frame gussets: 6061-T6 aluminum, 0.3125 inch nominal thickness.
    c. Triangular closure panels: .050 inch nominal thickness, 3003-H16 aluminum Sheet.
    d. Perimeter tension/compression ring: 6061-T6 aluminum or 6005A-T61.
    e. Fasteners: Fasteners shall be designed with a factor of safety of 2.34 on ultimate strength and 1.65 on yield strength. Threaded fasteners shall be 304 stainless steel. Lockbolts shall be 7075-T73 aluminum, 304 or 305 stainless steel. Screws shall be aluminum or 300 series stainless steel.
    f. Sealant: Silicone by Pecora, General Electric Silpruf or equal and shall be resistant to ozone and UV. Sealer shall conform to Federal Specification TT-S-00230.
    g. Gaskets: Silicone, General Electric SE-44/88 or equal. Gaskets shall conform to ZZ-R-765, Class 2, Grade 50 or equal. Neoprene may be substituted but only if shielded from UV light. Gaskets must be 1/8” thickness minimum.
    h. Anchor Fasteners: Series 300 stainless steel.
    i. Dormers, doors, and hatches: 6061-T6, 5086-H34 or 5052-H36 or 5052-H32 aluminum, 0.090inch nominal thickness.
    j. The tank supplier shall perform all manufacturing work described herein with mechanics skilled and experienced in the fabrication of aluminum dome roof structures. Fabrication shall be done in an ISO 9001 certified facility.
    k. All field work shall be completed by the MATD qualified erection crew. Sub-contracting of the roof manufacturing or erection is not allowed.
    l. Field re-fabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable. Any indication of improper fit-up of parts shall be immediately reported to the fabricator.
    m. All sealant joints shall be tooled slightly concave after sealant is installed. Care shall be taken to keep sealant confined to the joint in a neat manner. Any sealant applied outside of the joint shall be removed so that the panels will be free from misplaced sealant. All gasket materials shall be continuous, splices will not be allowed.

2.3 MANUFACTURING PROCESS

A. Glass Coating

1. The glass coating system shall be in full accordance with the requirements of AWWA D103, latest revision. Coating frits shall be individually tested in accordance with PE1 Test T-2. (Citric acid at room temperature). The coating process shall employ equipment that evenly coats the sheet surface and all four exposed sheet edges.

B. Surface Preparation

1. Following the de-coiling and shearing process, sheets shall be steel grit blasted on both sides to the equivalent of SSPC PC-10 (near white metal blast cleaning). Sandblasting and chemical pickling of steel sheets is not acceptable. The surface anchor pattern shall be not be less than 1.0 mils. (.0001inches). Sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.

C. Cleaning

1. After fabrication and prior to application of the coating system, all sheets shall be thoroughly cleaned by Coral COR Clene 16 caustic wash with 140°F hot water, then a two stage rinse followed immediately by hot air drying. Inspection of the sheets shall be made for traces of foreign matter, soil particles, grease or rust. Any such sheets shall be re-cleaned or grit-blasted to an acceptable level of quality.

D. Coating Application

1. Manufacturer shall maintain and use supplementary directional spray nozzles using an automated machine process to consistently coat the sheet edge profiles per PE 101 standard. The sheet edges shall be coated with the same vitreous enamel glass coating as the panel surface.

2. All sidewall sheets shall receive one coat of a catalytic nickel oxide glass pre-coat to both sides, followed by air-drying.

3. A second coat of milled cobalt blue glass shall be made to both sides of the sheets and then dried.

4. A third cover coat of milled titanium dioxide white glass shall then be applied to the inside of the sheet. This milled glass shall be formulated with 18% to 22% titanium dioxide to produce a finish interior surface with optimum strength, resilience, and resistance to conditions normally found in potable water storage tanks. This specific coating shall be Aquastore Vitrium. Any alternate three coat system must be submitted for approval and acceptance by the Engineer prior to bid.

5. The sheets shall then be fired at a minimum temperature of 1500 °F in strict accordance with ISO 9001 quality process control procedures, including firing time, furnace humidity, temperature control, etc.

6. The 4 continuous sheet edge enamel thickness shall be 5 mils.

7. The dry film interior coating thickness shall be 10-18 mils min. The dry film exterior coating thickness shall be 7-15 mils min. This is a three coating process.

8. The finished tank inside sidewall glass coating shall be white. Cobalt Blue finished interior color will not be accepted. The standard tank sidewall finished outside color shall be Cobalt Blue. (Munsell standard 7.5 PB 2/4.) Finished outside colors shall not vary noticeably among tank panels. Off color panels will be rejected; replacement panels of matching color shall be supplied by the tank manufacturer.

E. Sheet Edge Coating

1. Prior to sheet glassing all four (4) exposed rectangular continuous sheet edges, including starter sheets, for each specific sheet radii shall be mechanically rounded in profile resulting in an optimized radius and adhere to The Porcelain Enameling Institute's Technical Manual PEI-101.

2. The sheet surface next to the edge must remain flat, post process, to prevent 'bulging' to less than 0.030 inches (0.79mm) relative to the flat, while being rolled. All (4) exposed sheet edges will then be directionally sprayed by nozzles, using an automated machine process, and coated with the same vitreous enamel glass coating as the sheet surface.

3. Sheet edge encapsulation will have an enamel coating minimum DFT (dry film thickness) of 5 mils (127 microns). Coating adhesion shall be tested in accordance with ISO 28765 Class 2 or better. Sheet face and sheet edge must meet the same glass quality test. Rounded sheet edge encapsulation will not have exposed uncoated steel.

4. The process shall be equal in all respects to Edge Coat II by CST Industries, Inc.. Sealer or glass overspray as edge coating shall not be an acceptable alternative and nozzle spray must be directionally oriented toward the edges to ensure consistency of coverage. The coating shall have a tensile strength of 1500 psi.

2.4 SOURCE QUALITY CONTROL

A. The manufacturer's quality system shall be ISO 9001 certified and refer to ISO (International Organization of Standardization) for the following testing and procedures.

1. Coated sheets shall be inspected for mil thickness using a calibrated magnetic induction type electronic dry film thickness gage with a valid calibration record. Test frequency shall be a minimum of every gage change and/or a minimum of every half hour.

2. Coated sheets shall be measured for color using an electronic colorimeter with a valid calibration record. Test frequency shall be a minimum of every gage change and/or a minimum of every half hour. The color must fall within the specified tolerance or it shall be rejected.

3. An electrical leak detection test shall be performed on the interior and exterior surface of each panel after fabrication.

Inside wet sheet surfaces shall be inspected using a low voltage wet sponge holiday tester in accordance with ASTM D5162-91 Method A. The tester shall be used at a voltage of 67.5 volts (+/- 10 %) and set so the alarm is sounded if the electrical resistance of the glass coating falls below 125,000. The tester shall have a valid calibration record. The testing solution used to wet the sponge shall contain a low suds wetting agent added at a ratio of not more than ½ fluid oz. per gallon of water. Every sheet shall be 100% tested for holidays in the factory and any sheet with a discontinuity shall be rejected.

4. Adherence of the glass coating to the tank steel shall be tested in accordance with ISO standards. Any sheet that has poor adherence will be rejected. Coating adhesion shall be tested in accordance with ISO 28765 Class 2 or better. Sheet face and sheet edge must meet the same glass quality test.

5. Glass coating shall be tested for fishscale by placing the full size production sheets in an oven 400°F for one hour. The sheets will then be examined for signs of fishscale. Any sheet exhibiting fishscale shall be rejected and all sheets from that gage lot will be similarly tested. The minimum frequency of testing for this shall be five times per month.

B. The tank manufacturer shall provide documentation upon request (prior to tank fabrication), of the above tests including mill reports and traceable documents to demonstrate the source of steel used in the manufacture of this project specific tank.

2.5 MATERIALS

A. Plates and Sheets

1. Plates and sheets used in the construction of the tank shell, floor, or roof shall comply with the minimum standards of AWWA D103, latest revision. All steel shall be smelted and produced in the United States of America.

2. The annealing effect created from the glass coated firing process shall be considered in determining ultimate steel strength and yield strength of the steel used for calculations detailed in AWWA D103, latest revision. In no event shall a yield strength greater than 50,000 psi be utilized for such calculations detailed in AWWA D103, latest revision, unless the tank manufacturer can substantiate the use of higher values because of a documented testing program.

3. The tank manufacturer shall have and provide for the Engineer’s review, upon request, published ultimate tensile and yield strength values for the proposed steel. In addition, per AWWA D103, latest revision, the tank manufacturer shall have test results for the most recent two (2) year period to substantiate the use of Fu and Fy values used in the tank manufacturer’s design calculations if the values exceed 70 percent of the published values.

4. Design requirements for mild strength steel shall be ASTM A-1011 Grade 30 with a maximum allowable tensile stress of 12,135 psi.

High strength steel shall be ASTM A-1011 Grade 50 with a maximum allowable tensile stress of 21,167 psi.

5. When multiple vertical bolt line sheets and plates of ASTM A-1011 Grade 50 are used, the effective net section area shall not be taken as greater than 85% of the gross area. Multiple vertical bolt line sheets and plates shall be manufactured such that holes are staggered in the vertical bolt lines and that no two adjoining holes are in-line horizontally, except at the center of the sheet or plate

6. When Rolled Structural Shapes are used, the material shall conform to minimum standards of ASTM A36 or ASTM A992.

7. Minimum acceptable sheet thicknesses:
   a. Course 1 0.1046in
   b. Course 2 0.1046in
   c. Course 3 0.1046in
   d. Course 4 0.1046in
   e. Course 5 0.1046in
   f. Course 6 0.1046in
   g. Foundation 0.1345in

8. Chemical compositions for mild steel and high strength steel shall be stated in the submitted mill certifications. Raw steel for plates and sheets shall conform to the following composition requirements. These specifications refer to the design tensile strength after firing. The steel shall have the following chemical composition
   a. Carbon (Mild) 0.06% maximum
   b. Carbon (HSS) 0.10% maximum
   c. Manganese 1.50% maximum
   d. Phosphorus 0.04% maximum
   e. Sulfur 0.05% maximum
   f. Aluminum 0.08% maximum

9. Vertical tank seams shall be offset. Straight seam 4 corner joints are not acceptable.

B. Horizontal Web Stiffeners

1. Stiffeners shall be of the "web truss" design, with extended tail to create multiple layers of stiffener, permitting wind loads to be distributed around the tank. Stiffeners shall be fabricated of steel with hot dipped galvanized or epoxy coating. Rolled angle stiffeners shall not be permitted for intermediate horizontal wind stiffeners.

2. Maximum web stiffeners allowed is 1 at the bottom of Course 2. Additional stiffeners may be desired at the time of tank erection, if telecommunications equipment mounting will be required per contract documents.

C. Bolt Fasteners

1. Bolts used in tank lap joints shall be 1/2-13 UNC-2A rolled thread and shall meet the minimum requirements of AWWA D103, latest revision.

2. SAE J429 Grade 5/ASTM A325 (1-1/4” bolt length or less) and heat treated to a tensile strength of 120,000 psi min and a proof load of 85,000 psi min. and having an allowable shear stress with threads excluded from the shear plane of 29,454 psi min.
3. SAE J429 Grade 8/ASTM A490 (bolts greater than 1-1/4”) and heat treated to a tensile strength of 150,000 psi min and a proof load of 120,000 psi min. and having an allowable shear stress with threads excluded from the shear plane of 36,818 psi min.
4. The bolt finish shall be zinc coated, mechanically deposited 2.0 mils minimum per ASTM B695.
5. The entire bolt head shall be encapsulated up to the splines on the shank with high impact polypropylene copolymer. Resin shall be stabilized with an ultraviolet light resistant material such that the color shall appear black. The bolt head encapsulation shall be certified to meet the ANSI/NSF Standard 61 for indirect additives.
6. All lap joint bolts shall be properly selected such that threaded portions will not be exposed in the "shear plane" between the sheets. In addition, bolt lengths shall be sized as to achieve a neat and uniform appearance. Excessive threads extending beyond the nut will not be permitted.
7. All lap joint bolts shall include a minimum of four (4) splines, .002 inches minimum on the underside of the bolt head at the shank in order to resist rotation during torque wrench application.

D. Sealants

1. The lap joint sealant shall be a one component, moisture cured, polyurethane compound. The sealant shall be manufactured by a United States supplier as well as be suitable for contact with potable water and shall be certified to meet NSF/ANSI 61.
2. The sealant shall be used to seal lap joints, bolt connections and for sheet edge fillets. The sealant shall be CST Industries, Inc., Manus Bond 75-AM Sealer. The sealant should have a curing rate at 73°F and 50% RH and be tack free in 6 to 8 hours. Final cure time should be 10 to 12 days. Sealer shall be resistant up to 100-ppm chlorine concentration during disinfection. Neoprene gaskets and tape type sealer shall not be used.
3. The sealant shall cure to a rubber like consistency, have excellent adhesion to the glass coating, low shrinkage and be suitable for interior and exterior use.
4. Due to poor compatibility with chlorine, the sealant Sika 1A shall not be used on potable water storage tanks.

E. Roof Vent

1. A properly sized aluminum vent assembly in accordance with AWWA D103, latest revision, shall be furnished and installed above the maximum water level. A curbed opening shall be provided at the apex of the dome. At maximum possible rate of water fill or withdrawal, the resulting interior pressure or vacuum shall not exceed 0.5-inch water column.

2. Protection against birds and protection against ice plugging shall be provided. An insect screen shall be provided and designed to open should the screen become plugged by ice formation.
3. The vent shall be constructed of aluminum such that the hood can be unbolted and used as a secondary roof access.

F. Pipe Connections

1. Where pipe connections are shown to pass through tank panels, they shall be field located, saw cut, (acetylene torch cutting or welding is not permitted), and utilize an interior and exterior flange assembly. Tank shell reinforcing shall comply with AWWA D103, latest revision. CST Industries, Inc. Manus Sealer shall be applied on any cut panel edges or bolt connections.
2. Overflow piping shall be irrigation grade seamless aluminum tubing. Twenty four mesh non corrodible screen shall be installed within the pipe.

G. Ladder Assemblies

1. An AWWA D103, latest revision and OSHA 1910 compliant external tank ladder shall be furnished and installed as shown on the contract drawings. Ladders shall be aluminum and utilize grooved, skid-resistant rungs.
2. Personal fall arrest system, safety cage and step-off platforms (as required by OSHA 1910 or customer submittal drawings) shall be fabricated of galvanized steel. Ladders shall be equipped with a hinged lockable entry device at the bottom of the ladder. Step off platform shall be at maximum intervals of every 30’.

H. Access Doors

1. Each tank shall be provided with one (1) 30-inch diameter bottom access door as shown on contract drawings. The access door and tank shell reinforcing shall comply with AWWA D103, latest revision.
2. A davit to hold the cover plate is required.

I. Identification Plate

1. A manufacturer’s nameplate shall list the tank serial number, tank diameter and height, maximum design capacity, intended storage use, and date of installation. The nameplate shall be affixed to the tank exterior sidewall at a location approximately 5' from grade elevation in a position of unobstructed view.

J. Cathodic Protection System

1. The tank manufacturer will provide a passive cathodic protection system designed specifically for the project tank, consisting of sacrificial anodes which provide protection for the portion of the structure immersed in liquid. The anodes are attached to the floor, and bolted through existing shell sheet bolt holes. Lead wires and buss bars are used to ensure continuity between anodes and all structure shell sheets.

2. The cathodic protection system shall be designed by a licensed professional engineer employed by the tank manufacturer. The system shall be designed to protect the tank.
3. The resistivity of the water to be stored in the tank will determine the type and number of anodes.

K. Plastic Encapsulated Cap

1. High density polyethylene co-polymer caps and sealant shall be used to cover the bolts, nuts and washers exposed on the exterior sidewall of the tank.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Employees of the MATD shall be experienced in the construction of the specified glass-fused-to-steel tank and should be trained in a factory training program receiving builder certification by the tank manufacturer, and shall be employed full time by the authorized dealer.

B. Supervisory personnel of the erection crew shall identify themselves to responsible personnel of the Engineer or Inspector upon initially entering the job site. Only trained and certified personnel will be allowed on site.

C. Tank Foundation

1. The tank foundation shall be built in accordance with the contract drawings and/or approved shop drawings. Foundation shall be designed by the manufacturer's or MATD's licensed engineer and built by the MATD to safely sustain the structure and its live loads. Floor rebar shall be epoxy coated.

D. Concrete Floor

1. Only embedded starter ring designs are acceptable for concrete floors. Slot mount base foundations, rebate base, and flat base designs which do not include an embedded base ring will not be allowed.
2. Leveling of the starter ring shall be required and the maximum differential elevation with the ring shall not exceed 1/8 inch, nor exceed 1/16 inch within any 10 feet of circumference.
3. In no case shall the backfill elevation vary more than one (1) foot around the periphery of the tank shell.
4. A leveling plate assembly, consisting of two anchor rods and a slotted plate shall be used to secure the starter ring, prior to encasement in concrete. Installation of the starter ring on concrete blocks or bricks, using shims for adjustment, is not permitted.
5. Place one butyl rubber elastomeric waterstop seal on the inside surface of the starter ring below the concrete floor line. Place one bentonite impregnated water seal below the butyl rubber seal. After the previous water seals have been installed, install a continuous fillet of "Sika Swell" on top of the butyl rubber elastomeric waterstop at the juncture of the tank sidewall and

butyl waterstop. Install materials in accordance with CST Industries, Inc. instructions.

6. Tank footing design shall be based on the soil bearing capacity given by the Engineer, as determined by geotechnical analysis performed by a licensed soils engineer. Copies of the Geotechnical Report will be provided to the bidder prior to bid date by the Owner or Engineer.

7. Concrete floors may be poured monolithically for all tank diameters. For larger structures, floors shall be quadrant poured. Concentric ring pouring shall not be allowed. Floors shall be designed in accordance with ACI 350.

E. Tank Structure

1. Field erection of the glass-coated, bolted-steel structures and components shall be in strict accordance with the procedures established by the manufacturer and performed by MATD who is regularly engaged in erection of the manufacturer’s glass-fused-to-steel tanks, using experienced factory-trained certified erectors directly employed by the MATD.

2. Only specialized erection jacks and building equipment developed and supplied by the tank manufacturer shall be used to erect the tanks.

3. Particular care shall be taken in handling and bolting of the glass-coated steel tank panels, appurtenances and members to avoid abrasion of the coating system. Every sheet shall be 100% tested for interior holidays in the field. Prior to liquid test, all surface areas shall be visually inspected. Chips or scrapes in the glass coating shall be repaired per the tank manufacturer's recommended procedure.

4. An electrical coating leak test shall be performed during erection using a wet sponge nine-volt leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with manufacturers published touch-up procedures.

5. No backfill is to be placed against the tank sidewall without prior written approval by the tank manufacturer and/or MATD. Any backfill allowed shall be placed strictly in accordance with the instructions of the tank manufacturer and/or MATD.

3.2 FIELD TESTING

A. Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling to its overflow elevation.

B. Any leaks disclosed by this test shall be corrected by the MATD in accordance with the manufacturer's recommendations.

C. Water required for testing following completion of tank erection will be furnished by the Owner. Disposal of water, if required, following testing is by the Owner. Labor and equipment necessary for hydrostatic tank testing shall be included in the contract price of the tank.

3.3 DISINFECTION

A. The tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA C652, latest revision, "Disinfection of Water Storage Facilities".

B. Acceptable method of disinfection: Chlorination Method 1, 2 or 3 per AWWA C652.

C. Acceptable form of chlorine for disinfection: Sodium Hypochlorite, as specified in AWWA C652.

D. Disinfection shall not take place until the tank sealant is fully cured (10 to 12 days at 73°F and 50% relative humidity or equivalent).

3.4 FIRST YEAR INSPECTION

A. On or near the (1) year anniversary date of initial tank use (but not more than (14) months from date of delivery of tank materials to job site), the MATD shall make a visual inspection of the tank interior coating and appurtenances, tank exterior coating and appurtenances, and the immediate area surrounding the tank for evidence of leakage. A written summary of the inspection report will be filed with the tank owner and the tank manufacturer.

B. Water required for the inspection process will be furnished and disposed of by the Owner.

END OF SECTION

SECTION 50 03 01

FLOATING DECANTER

PART 1. GENERAL

1.1 SCOPE OF WORK

Furnish all labor, equipment, materials, and incidentals to install one floating decanter system (FD-xx) for decanting the Backwash Waste Storage Tank T-xx contents. The system supplier shall provide materials and equipment which are as specified below, as shown on the design drawings, and are suitable for the service intended.

The unit shall be furnished and installed with equipment for mooring the decanter inside the tank from three cables and compression springs attached near the top lip of the open tank.

The decanter system shall be designed to cause minimal disturbance of the sludge blanket. Decanter shall discharge by gravity through a 4" flexible hose with flange connection, cam and groove fittings. Hose shall connect to the tank nozzle fitting inside the tank.

All equipment shall be Type 316L Stainless Steel.

1.2 RELATED SECTIONS

Section 01 01 00 Scope of Work

Section 01 33 00 Submittals Procedures

Section 01 78 00 Closeout Submittals

Section 01 78 23 Operation and Maintenance (O&M) Data

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

<u>AMERICAN IRON & STEEL INSTITUTE (AISI)</u>

AISI 1045 Steel

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM A 240 316/316L Stainless Steel

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001 Quality Systems

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 Submittals:

Pre-construction submittal:

1. Product Data: Manufacturer's descriptive data and technical literature and engineering data sheets for the equipment. Product data shall include selected model number, rated flow capacity, dimensions, weights, accessories, and warranty coverage.

2. Shop Drawings, including:

   a. General arrangement drawings and manufacturer's data covering installation instructions, dimensions, weight, detailed specifications, materials of construction, parts, devices, and other information required to verifycompliance with these specifications.

   b. Proposed layout and anchorage requirements.

   c. Clearances for maintenance and operation.

3. Manufacturer's certificates, including the name and address of the production facility. Provide manufacturer’s certification in writing, that the equipment and materials of construction will meet or exceed minimum requirements as specified.

Operation and Maintenance Manual

1. Submit the operation and maintenance (O&M) manual and required number of copies in accordance with Section 01 78 23.

1.5 DELIVERY AND STORAGE

Protect all equipment, delivered, and designated for storage, from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.6 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on Aquaturbo Systems AQUA DECANT® Model AD-50-G floating gravity decanter round with gravity discharge. Should the Contractor propose to furnish an equivalent system of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed floating decanter into the design and submit the necessary revised Contract Drawings and Technical Specifications for review and approval.

1.7 QUALIFICATION AND WARRANTY

Manufacturer Qualification:

1. The decanter shall be supplied by a reputable Manufacturer having at least ten (10) years' experience.

Warranty

2. Manufacturer shall provide warranty in accordance with Section 01 78 00 of the specifications.

PART 2. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

The floating decanter shall be manufactured by Aqua Systems, Inc, Springdale, Arkansas, Parkson, Evoqua, or approved equal. The model shall be AQUA DECANT® AD-50-G Floating Decanter Round with Gravity discharge or approved equal.

The floating decanter and components shall be assembled, piped, and tested in the shop prior to shipment. Field assembly shall be minimized.

The manufacturer shall furnish all tools, materials, labor, and appurtenances necessary for the complete fabrication, testing and shipment of the floating decanter system.

The decanter and connecting hose shall be new and unused.

2.2 SYSTEM REQUIREMENTS

Service: The floating decanter shall be designed to remove decant water inside the Backwash Waste Storage Tank (T-xx) with the rise and fall of the water surface. The decant will discharge by gravity to sanitary sewer manhole. On and Off control of decant water will be provided by BFV-xx.

Maximum Flow rate: 220 gpm

2.3 EQUIPMENT DESCRIPTION

The floating decanter shall be constructed of 316 stainless steel. The decanter shall have a ring design that is filled with suitable material to allow the decanter to float on the water surface and support its own weight.

The floating decanter shall be attached inside the tank using three 316 Stainless Steel mooring cables with SS thimble, clips, quick connectors, and compression springs to be provided under this specification. The mooring cables shall be 3/16" diameter and be of suitable tensile strength to support the decanter. The recommended cable type is 7 x 19 316 stainless steel (7 skeins of 19 wires). The mooring cables shall be of a suitable length to allow the decanter to float up and down the entire height of the tank to adequately decant the supernatant. The decanter operating range will be determined in the field.

2.4 EQUIPMENT APPURTENANCES

Lifting Lugs: Individual equipment and or each field assembled part over 100 pounds in weight shall be provided with lifting lugs for ease of handling.

Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the floating decanter in a location that visible is at eye level. The plate shall bear the Manufacturer’s name, address, phone number, equipment model number (according to P&IDs), and serial number.

2.5 SPARE PARTS & TOOLS

Contractor shall provide one set of recommended spare parts for floating decanter and related accessories.

Contractor shall supply one set of any special tools required for assembly, disassembly, or for adjustment of the equipment supplied.

PART 3. EXECUTION

3.1 INSTALLATION

Verify all dimensions in the field and advise COR of any discrepancy before performing the work. All products shall be carefully inspected for defects in workmanship and material.

Prior to installation, the Contractor shall submit a lifting and installation plan for this decanter.

Installation shall be in accordance with manufacturer's printed instructions and in the presence of the manufacturer’s field representative.

The Contractor or installer shall provide certification from the manufacturer that the equipment has been properly installed.

3.2 FIELD TESTS

Functional Testing: Prior to startup, all equipment components shall be inspected by the Contractor for proper setting, connections, and satisfactory installation. Testing shall be coordinated with that of the Backwash Waste Storage Tank (T-xx).

Test Report: Contractor shall provide a test report that shall include as a minimum a description of the test, methodology used, data and time when test was performed and the results of the testing. All testing results shall be reported, including test results that failed to meet the requirements. Should test runs fail to meet the requirements, an explanation shall be provided with the rationale for failure of the test.

3.3 REMEDY

If the Installation, Inspection or Field Tests reveals deficiencies, corrective measures shall be taken until the System satisfies all of the specified requirements. Remedies shall be completed at no additional cost to the Owner.

3.4 MANUFACTURER SERVICES

Contractor shall provide equipment manufacturer's field representative during the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of equipment. The representative shall also conduct a field training course for the designated operating and maintenance staff members. Training shall be coordinated with the onsite Owner's Representative. The field instructions shall cover the items contained in the Operating and Maintenance Instructions, as well as demonstrations of routine maintenance operations. Prepare a video of the field training course for a permanent record for future training use.

END OF SECTION

SECTION 50 04 01

WASTEWATER MONITORING
PARSHALL FLUME MANHOLE

PART 1. GENERAL

1.1 SCOPE OF WORK

Furnish all labor, equipment, materials, and incidentals to install one wastewater monitoring parshall flume manhole for backwash waste tank discharge to sewer pipe as shown on drawings. The system supplier shall provide materials and equipment which are as specified below, as shown on the design drawings, and are suitable for the service intended.

1.2 RELATED SECTIONS

Section 01 01 00 Scope of Work

Section 01 33 00 Submittals Procedures

Section 01 78 00 Closeout Submittals

Section 01 78 23 Operation and Maintenance (O&M) Data

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 478: Standard Specification for Circular Precast

Reinforced Concrete Manhole Sections

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 Submittals:

Pre-construction submittal:

1. Product Data: Manufacturer's descriptive data and technical literature and engineering data sheets for the equipment. Product data shall include selected model number, rated flow capacity, dimensions, weights, accessories, and warranty coverage.

2. Shop Drawings, including:

   a. General arrangement drawings and manufacturer's data covering installation instructions, dimensions, weight, detailed specifications, materials of construction, parts, devices, and other information required to verifycompliance with these specifications.

   b. Proposed layout and anchorage requirements.

   c. Clearances for maintenance and operation.

3. Manufacturer's certificates, including the name and address of the production facility. Provide manufacturer’s certification in writing, that the equipment and materials of construction will meet or exceed minimum requirements as specified.

Operation and Maintenance Manual

1. Submit the operation and maintenance (O&M) manual and required number of copies in accordance with Section 01 78 23.

1.5 DELIVERY AND STORAGE

Protect all equipment, delivered, and designated for storage, from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.6 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on Park USA (A Northwest Pipe Company) Model FLP-03. Should the Contractor propose to furnish an equivalent system of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed parshall flume manhole into the design and submit the necessary revised Contract Drawings and Technical Specifications for review and approval.

1.7 QUALIFICATION AND WARRANTY

Manufacturer Qualification:

1. The parshall flume manhole shall be supplied by a reputable Manufacturer having at least ten (10) years' experience.

Warranty

2. Manufacturer shall provide warranty in accordance with Section 01 78 00 of the specifications.

PART 2. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

The parshall flume manhole shall be manufactured by Park USA (A Northwest Pipe Company) or Approved equal. The model shall be FLP-03 Wastewater Monitoring Parshall Flume Manhole or approved equal.

The parshall flume manhole and components shall be assembled, piped, and tested in the shop prior to shipment. Field assembly shall be minimized.

The manufacturer shall furnish all tools, materials, labor, and appurtenances necessary for the complete fabrication, testing and shipment of the parshall flume manhole system.

The manhole and components shall be new and unused.

2.2 SYSTEM REQUIREMENTS

Service: The parshall flume manhole shall be designed to monitor flow discharge from Backwash Waste Storage Tank (T-550) to sewer pipe and shall include a parshall flume, ultrasonic transducer and transmitter.

Maximum Flow rate: 507 gpm discharge to 3" parshall flume.

2.3 EQUIPMENT DESCRIPTION

CONCRETE: CLASS 1/11 Concrete with design strength of 4500 psi at 28 days. Monolithic construction at floor, first stage of wall and baffle with sectional riser to required depth. Contractor to field verify all elevations.

REINFORCEMENT: Grade 60 reinforced with steel rebar confirming to ASTM A615 on required centers or equal structural design is based on AASHTO HS-20 loading.

ACCESS COVER: Minimum 24" diameter, constructed of ductile iron, lockable and hinged with safety blocking system. H20 traffic rating with nameplate "WASTEWATER FLUME ASSEMBLY".

2.4 EQUIPMENT APPURTENANCES

- Ultrasonic Transducer and a local transmitter shall be mounted outside the manhole and send a 4-20 mA flow signal to plant PLC.

  Controller, data logging, NEMA-X panel and pH sensor are not required.

  Inlet and Outlet pipes: 3-inch

  Depth: 4’-0" from Grade EL to CL of pipes (Contractor shall field verify all elevations)

PART 3. EXECUTION

3.1 INSTALLATION

Verify all dimensions in the field and advise COR of any discrepancy before performing the work. All products shall be carefully inspected for defects in workmanship and material.

Prior to installation, the Contractor shall submit a lifting and installation plan for this equipment.

Installation shall be in accordance with manufacturer's printed instructions and in the presence of the manufacturer’s field representative.

The Contractor or installer shall provide certification from the manufacturer that the equipment has been properly installed.

3.2 FIELD TESTS

Functional Testing: Prior to startup, all equipment components shall be inspected by the Contractor for proper setting, connections, and satisfactory installation. Testing shall be coordinated with that of the Backwash Waste Storage Tank (T-550).

Test Report: Contractor shall provide a test report that shall include as a minimum a description of the test, methodology used, data and time when test was performed and the results of the testing. All testing results shall be reported, including test results that failed to meet the requirements. Should test runs fail to meet the requirements, an explanation shall be provided with the rationale for failure of the test.

3.3 REMEDY

If the Installation, Inspection or Field Tests reveals deficiencies, corrective measures shall be taken until the System satisfies all of the specified requirements. Remedies shall be completed at no additional cost to the Owner.

3.4 MANUFACTURER SERVICES

Contractor shall provide equipment manufacturer's field representative during the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of equipment. The representative shall also conduct a field training course for the designated operating and maintenance staff members. Training shall be coordinated with the onsite Owner's Representative. The field instructions shall cover the items contained in the Operating and Maintenance Instructions, as well as demonstrations of routine maintenance operations. Prepare a video of the field training course for a permanent record for future training use.

END OF SECTION

SECTION 50 05 01

OXYGEN AND OZONE SYSTEM
02/11

PART 1 GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and appurtenances required to provide an oxygen and ozone generation system complete with all required operating components. The system shall be complete and operational with all control equipment and accessories as shown on the contract drawings. The system shall be installed by the Contractor and tested and commissioned by the manufacturer.

This specification covers the equipment and installation requirements for self cooled air compressor, air dryer, oxygen generator, ozone generator and distribution system, air receiving and oxygen buffer tanks, gas separator tank, ozone destructor skid, and chiller.

The units shall be furnished and installed with all necessary equipment including control and power panel and simple PLC control and any other auxiliaries for a complete and operable system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM F593	(2017) Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-4.1	(2009) Cleaning Equipment for Oxygen Service; 6th Edition

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ANSI/ISA 5.1	(2009) Instrumentation Symbols and Identification

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2019; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; ERTA 1 2019) National Electrical Code

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for review and approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Oil Free Screw Compressors; G

Heatless Dessicant Air Dryers; G

Air Filter and Receiving Tank; G

PSA Oxygen Generator; G

Oxygen Receiving Tank; G

Ozone Generator; G

Ozone Catalytic Destructor; G

Ozone Chiller; G

Local Controls and Panels; G

Drawings showing shop and erection details and chemical application locations; including cuts, codes, connections, holes, bolts, welds, anchorage, installation details, wiring diagrams, schematic diagrams, component identification tables and directory, and clearances for maintenance and operations.

SD-03 Product Data

Oil Free Screw Compressors; G

Heatless Dessicant Air Dryers; G

Air Filter and Receiving Tank; G

PSA Oxygen Generator; G

Oxygen Receiving Tank; G

Ozone Generator; G

Ozone Catalytic Destructor; G

Ozone Chiller; G

Calculations; G

Commissioning/Demonstration Plan; G

Manufactured Units

Performance Requirements; G

Qualifications; G

SD-06 Test Reports

Performance Requirements; G

SD-07 Certificates

Oxygen and Ozone System

Field Training

SD-10 Operation and Maintenance Data

Oil Free Screw Compressors; G

Heatless Dessicant Air Dryers; G

Air Filter and Receiving Tank; G

PSA Oxygen Generator; G

Oxygen Receiving Tank; G

Ozone Generator; G

Ozone Catalytic Destructor; G

Ozone Chiller; G

Maintenance; G

1.4 QUALIFICATIONS

1.4.1 Contractor

Provide documentation of a minimum of 10 years of experience in the construction of water, wastewater, industrial wastewater, or hazardous and toxic waste water treatment facilities. The Contractor is responsible for installation and start-up of the equipment supplied, as well as operator training.

1.4.2 Equipment Manufacturer

Submit a statement by the equipment manufacturer listing any exception to or deviations from the contract drawings and specifications. Written evidence that equipment and accessories are a product of a qualified and experienced manufacturer. Statement indicating the system is capable of treating the wastes to the levels identified.

1.4.3 Oxygen and Ozone System Supplier

Equipment provided shall duplicate equipment that has been in satisfactory service for a minimum of 10 years prior to bid opening. The system supplier shall be responsible for furnishing a complete prepackaged system. The supplier need not manufacture the entire system, but shall coordinate the selection, assembly, installation, and testing of the entire system as specified.

1.4.4 Manufacturer's Representative

Provide services, as specified, of a qualified manufacturer's field representative experienced in the installation, adjustment, and operation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system. Include a statement indicating the operators designated to train the on site operators have been trained to operate the installed equipment.

1.4.5 Welding

Perform welding following qualified procedures, using performance qualified welders and welding operators. Furnish a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators to the Remedial Project Manager (RPM), FEAD CM or Engineer prior to beginning any work on the equipment.

1.5 REGULATORY REQUIREMENTS

The system shall conform to all federal, state, regional, and local regulations concerning chemical storage, air, noise and water pollution control requirements.

1.6 PRE-SUBMITTAL CONFERENCE

Assemble the primary process designer, equipment and major component suppliers, electrical and mechanical subcontractors, and major component manufacturer's representatives at the construction site prior to preparation of the Contractor's submittal for government approval. This meeting is intended to ensure that facility construction is properly scheduled; power, control, plumbing, space interfaces are verified; and responsibilities coordinated among subcontractor's and suppliers and reflected on the Contractor's submittals.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver equipment free of structural or other damage and place in storage, in accordance with the manufacturer's requirements, protected from structural damage, the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants that could otherwise damage its components.

1.8 SEISMIC LOADS

The structural aspects of the system shall be sufficient to meet the current editions of the NYC Construction Code and the International Building Code requirements for Seismic Design Category = B.

1.9 WARRANTY

Manufacturer shall provide warranty in accordance with Section 01 77 00 of the specifications.

PART 2 PRODUCTS

2.1 OXYGEN AND OZONE SYSTEM DESCRIPTION

2.1.1 Oil Free Screw Compressors:

Furnish and install two (2) oil free compressors rated for 140 cfm compressed air with 50 HP motor. Compressors shall be fixed speed unit Model CSG55-2 manufactured by Kaeser or approved equal.

The air compressor shall be water-cooled with a heat exchanger cooling water system capable of 20 gpm @ inlet pressure 14-17 psi and outlet pressure 10 - 13 psi. The inlet water temperature for heat exchanger shall be 40-95 F with outlet temperature range of 50-104 F.

The compressor shall include connection for condensate drain, valves and appurtenances. The compressor shall have solenoid valves and manual valve to control the operation of heat exchanger water flow.

2.1.2 Heatless Dessicant Air Dryers:

Furnish and Install two (2) heatless desiccant air dryer skid mounted systems shall include required piping, fittings, valves and appurtenances. Air dryer shall be rated for inlet flow of 165 scfm @ 100 psi and average outlet air flow of 140 scfm. The air dryer shall be model KAD 165 manufactured by Kaeser or approved equal.

The air dryer shall be capable of producing pressure dew points as low as -94 F with a standard control with 4 min fixed cycle time. The purge rate of air dryer shall be maximum 30 scfm @ 100 psi.

The air dryer shall include a standard purge pressure and adjusting valve and flow indicator, inlet and outlet shuttle valves, standard moisture indicator and separate top fill and bottom drain ports.

2.1.3 Air Filter and Receiving tank:

Furnish and Install two (2) filters for the specified air dryer system and one (1) air receiving tank with sufficient capacity for generating oxygen as specified.

2.1.4 PSA Oxygen Generator:

Furnish and Install one (1) skid mounted pressure swing adsorption (PSA) oxygen generator system for producing oxygen from compressed air and which is Microprocessor controlled. The oxygen generator shall be rated for 621 SCFH to generate sufficient oxygen to meet the ozone loading demand. Oxygen generators shall be Model AS-K manufactured by AirSep or approved Equal.

The generator shall have a product flow range of 750 - 900 SCFH and standard product pressure of 45 psi with purity of 93%.
The product dew point shall be -100°F (-73°C).

The generator shall have compressed air inlet connection of 1” NPT and product gas outlet of ¾” NPT.

2.1.5 Oxygen Receiving Tank:

Furnish and Install one (1) oxygen receiving tank for above specified oxygen generator.

2.1.6 Ozone Generator:

The Furnish and install one (1) ozone generator and distributor system type TPF37-XTL-O manufactured by DE NORA Water technologies or approved equal. This system shall be capable of generating a maximum of 6 ppm of ozone with nominal power rating of 24.6 KW.

The ozone generator shall include 37 tubes in a tube bundle with 37 dielectrics. The tube material shall be 316 stainless steel. tube material.

The ozone generator vessel shall have oxygen and ozone inlet and outlet connection, cooling water inlet and outlet connections with safety and water drain valves. The vessel material shall be 316 and 304 stainless steel. The vessel shall meet ASMT design code standard ASME VIII Div. 1 Ed. 2019 – PED 2014/68/UE.

The ozone vessel shall have a maximum allowable working pressure of 36 psig and test pressure (horizontal) of 52 psig.

Furnish and install associated ozone injection tubing, piping, valves, sample ports, hydrogen peroxide static mixer, and appurtenances per contract drawings and specifications.

2.1.7 Ozone Catalytic Destructor:

Furnish and install one (1) ozone catalytic destructor system for above specified ozone.

2.1.8 Ozone Chiller:

Furnish and install one (1) ozone chiller system rated for 6.7 Tons of cooling, nominal power is 12.84 kW. Chiller shall be MPC Model manufactured by Motivair or approved equal.

Furnish and install associated ozone injection tubing, piping, valves, sample ports, hydrogen peroxide static mixer, and appurtenances per contract drawings and specifications.

2.1.9 Equipment Appurtenances

Supporting Skid: The system and all appurtenances shall be supported on a structural frame and painted to prevent corrosion.

Lifting Lugs: Individual equipment and or each field assembled part over 100 pounds in weight shall be provided with lifting lugs for ease of handling.

Anchor Bolts: All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts, nuts, and washers shall be Type 316 stainless steel.

Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the equipment in a location that is visible at eye level. The plate shall bear the Manufacturer's name, address, phone number, equipment model number, serial number, and equipment ID number (to match the P&IDs).

2.1.10 Spare Parts & Tools

Contractor shall provide one set of recommended spare parts for and related accessories supplied.

Contractor shall supply one set of any special tools required for assembly, disassembly, or adjustment of the equipment supplied.

2.2 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and which essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Remedial Project Manager (RPM), FEAD CM or Engineer, reasonably convenient to the site.

2.3 NAMEPLATES

Provide each major item of equipment with the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Nameplates shall be provided for, but not limited to, each contact vessel, pumps, motors, oxidant equipment and accessories, and electrical components.

2.4 MATERIALS

2.4.1 Bolts, Nuts, Anchors and Fasteners

Bolts, nuts, anchors and fasteners shall be stainless steel in conformance with ASTM F593.

2.5 ELECTRICAL

Electrical products shall be in accordance with electrical specifications. Reactor vessels shall be independently grounded.

2.5.1 Local Controls and Panels

Manual or automatic controls, protective or signal devices required for the operation specified, and any control wiring required for controls and devices, shall be provided. Enclosures for local power and control panels shall conform to NEMA ICS 6.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Remedial Project Manager (RPM), FEAD CM or Engineer of any discrepancy before performing the work. Compare the limits of work for the equipment supplied to field conditions to ensure the limits previously identified for piping, electrical and control interfaces meet the actual physical requirements at the facility. Bring any discrepancies to the attention of the Remedial Project Manager (RPM), FEAD CM or Engineer for correction.

3.2 PREPARATION

Provide the reactor vessel, hydrogen peroxide storage and feed system, with an equipment pad isolated from the floor slab as detailed on the drawings . Reinforced concrete shall be designed and installed in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. Prior to placing ozone piping, or other equipment, into service it shall be cleaned by one of the methods specified in CGA G-4.1. Piping and equipment used to store or feed hydrogen peroxide shall be passivated in accordance with the hydrogen peroxide supplier's requirements.

3.3 EQUIPMENT INSTALLATION

Perform the equipment installation as indicated on the drawings, shop drawings, manufacturer's instructions and recommendations. Piping, valves, fittings, and appurtenances shall be installed in accordance with the manufacturers recommendations, as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE, or as otherwise indicated. All valves, fittings, meters and other appurtenances shall be given unique identification numbers corresponding to those used in operation and maintenance manuals, and in submittals prepared. Identification numbers shall be placed on brass identification tags and securely fastened to all valves, fittings, meters and other appurtenances. Tags shall not be less than 1-1/2 inches in diameter with depressed black figures 1/2 inch high. Piping for wet ozone service shall be PVDF, stainless steel, or PTFE. Piping for dry ozone service shall be PVDF, stainless steel, or PTFE. Oxygen Piping shall be copper or stainless steel. Hydrogen peroxide piping shall be stainless steel, PTFE or PVDF.

3.4 ELECTRICAL WORK

Perform electrical work in accordance with the drawings and applicable requirements of electrical specifications. Equipment shall be appropriate for continuous duty, and installation in a dusty, humid and corrosive environment. Electrical equipment and wiring shall comply with NFPA 70.

3.5 TOOLS

Provide tools to the Remedial Project Manager (RPM), FEAD CM or Engineer prior to the onsite training identified in paragraph FIELD TRAINING.

3.6 PAINTING/CORROSION PROTECTION

All ferrous surfaces shall be coated or painted. Color shall be as indicated on the paint schedule or as otherwise approved. Factory painted items shall be touched up as needed. Factory painted items requiring touch up in the field shall be thoroughly cleaned of all foreign material, primed and top coated with the manufacturer's standard factory finish in accordance

with the manufacturer's recommendations, including dry finish thickness. Equipment which did not receive a factory finish shall be painted in accordance with the requirements indicated in Section 09 90 00PAINTS AND COATINGS. Painting corrosion resistant metals such as brass, bronze, aluminum, copper, galvanized steel and stainless steel is not required unless otherwise specified.

3.10 FIELD TESTS AND INSPECTIONS

All accessories shall be factory tested prior to shipment to the job site.

3.10.1 Testing and Inspection

Contractor shall be responsible for conducting all testing and inspections. Contractor shall engage the services of a qualified and certified testing agency that is approved to conduct tests and inspections of all equipment and materials installed prior to operation and putting in service. The testing and inspection shall be conducted under a certified PE in the state of New York where applicable. All testing and inspection reports shall be submitted to Remedial Project Manager (RPM), FEEAD CM, or Engineer for review and approval.

3.10.2 Field Service

Manufacturer's field service representative shall be engaged to verify the installation and connection requirements of all equipment and materials for its complete operation.

The certified testing agency representative and manufacturer's field representative will work together to complete all testing and inspection requirements.

3.11 MANUFACTURER'S SERVICES

Provide a manufacturer qualified service representative, experienced in the installation, adjustment, operation and maintenance of the equipment specified, for a minimum of 3 days to supervise the installation, adjustment, testing, and to provide instruction in the operation, and maintenance of the equipment. During the startup and one years operating period, the major equipment suppliers shall be required to be onsite 2 times to verify that the equipment is installed and operates properly, and to provide trouble shooting and technical assistance.

3.12 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members. The training shall include operation of individual components as well as the integrated system, maintenance needs and procedures, instrument calibration, safety issues and emergency procedures, control and alarm features, troubleshooting equipment and control problems, and laboratory analytical procedures. Training shall be provided during normal working time and shall start after the system is functionally complete but prior to performance testing. Field training shall cover all of the items contained in the operating and maintenance manuals. The first period shall be at system startup and the second as defined by the Remedial Project Manager (RPM), FEAD CM or Engineer. Upon completion, submit

certificates indicating the designated personnel have received training specified and have successfully operated the installed equipment.

3.13 MAINTENANCE

3.13.1 Extra Materials

Furnish the initial supplies to fill the vessels, as well as all consumables during the startup, prove out, and initial operation period. At the time the Contractor turns the plant over to the long term Operation and Maintenance Contractor, the vessels storing consumables such as hydrogen peroxide shall be refilled within two days prior to the plant turn over.

3.13.1.1 Spare Parts

The supplier shall provide a minimum of the following spare parts:

3.13.2 Maintenance Service

The ozone generator dielectrics shall be cleaned in accordance with the manufacturer's recommendations immediately prior to the conclusion of the Contractor's operating period; or after one year, if greater than one year after startup, and at the conclusion of the Contractor's operating period.

3.13.3 Operating Instructions

Submit six complete copies of operating instructions outlining the step-by-step procedures required for system start-up, operation and shutdown, routine maintenance, potential breakdowns and repairs, and troubleshooting. The instructions shall include drawings and schematics of the system as installed. The instructions shall include the manufacturer's name, model number, service manual parts list and brief description of all equipment and their basic operating features. The instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves and controls, process flow diagrams, piping and instrumentation diagrams with all valves, meters, and similar units identified.

b. Approved wiring and control diagrams prepared in accordance with ANSI/ISA 5.1 including a drawing index, legend and symbols list, and abbreviations and identifiers.

c. A control sequence describing startup, how to make adjustments to the equipment during operation, standard and emergency shutdown procedures.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and other periodic maintenance and inspection information as well as trouble shooting guides.

e. Manufacturer's bulletins, cut sheets and descriptive data, parts lists, and recommended spare parts, and sources of supply for all major pieces of equipment.

-- End of Section --