

- B. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements in Division 16 Section "Grounding."
- C. Ground equipment and conductor. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross-talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- D. Ground radio alarm transmitter system and equipment as recommended by the manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of the system. Report results in writing.
- B. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the compliance of the system with requirements of Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests.
- D. Final Test Notice: Provide a minimum of 10 days' notice in writing when the system is ready for final acceptance testing.
- E. Minimum System Tests: Test the system according to procedures outlined in NFPA 72. Minimum required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Test conductors for short circuits using an insulation-testing device.
 - 3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
 - 4. Verify that the control units is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
 - 5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.

6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
 7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
 8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the periods and in the manner specified.
- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.
- G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.
- H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.5 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government's maintenance personnel as specified below:
1. Train Government's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of 8 hours' training.
 2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
 3. Schedule training with Government, through Architect, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested visits to Project site for this purpose.

3.8 SEQUENCE OF OPERATIONS

A. AFFF System:

1. Any AFFF alarm conditions will be transmitted from the AFFF panel to the Fire Alarm Control Panel (FACP), which in turn activate all the building alarm devices.
2. Activation of any AFFF tamper switch will be transmitted from AFFF panel to FACP and will provide a supervisory alarm at FACP.
3. Any trouble at the AFFF panel or system will be transmitted from AFFF panel to FACP and will provide a trouble alarm at FACP.
4. AFFF under-wing release shall be achieved with the following actions:
 - a. Automatic release of the cross-zoned rate compensated ceiling mounted heat detectors. The system will be activated only when two different zones are activated.
 - b. Manual release of the AFFF manual discharge stations.
 - c. Automatic release of the water flow alarm from the overhead wet pipe system.
5. Upon activation of any of the above three systems, a signal will be sent to the AFFF panel. This signal will provide an alarm at the AFFF panel and activate the AFFF blue strobe lights. This will also provide a signal (thru the releasing module in the AFFF panel) to the solenoid, which will open the deluge valve allowing the water flow in the AFFF piping system.
6. AFFF panel shall monitor water flow thru the AFFF water pipe and the hanger bay sprinkler water pipes.
7. AFFF panel shall also monitor tamper switch in the AFFF water pipes and the hanger bay sprinkler water pipes.
8. The blue lights will only act as signaling devices upon activation of any of the foam system detection devices and not the building fire alarm detecting system.
9. The activation of the IRRR flame detectors will only provide a general alarm at the FACP and will cause the building signaling devices and the AFFF blue lights to activate.

B. FACP (The Hangar Building)

1. Upon activation of any building and AFFF detection system a general alarm will be sent to the FACP and will cause the building signaling devices and the AFFF blue lights to activate.
2. Activation of any duct detector shall shut down the respective fan as shown on the Fire Alarm riser diagram.

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3. The FACP shall monitor the Building sprinkler system.
4. The systems will be transmitted to the base central fire department through the radio-based transmitter.
 - a. Trouble- due to the system trouble.
 - b. Supervisory- activation of any tamper switch.
 - c. Alarm- activation of any detection system.
 - d. Emergency- Activation of an eyewash.

END OF SECTION 13851

SECTION 13900 - BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Design and construction of the Fire Protection Systems shall be in accordance with the following design standards.

Air National Guard Engineering Technical Letter 01-1
Air Force Engineering Technical Letter 01-2
National Fire Protection Association (Latest Editions)
NFPA 1 la
NFPA 13
NFPA 20
NFPA 22
NFPA 24
NFPA 72
NFPA 409
Military Handbook 1008c

In the event that discrepancies arise between regulations and technical letters, the following general hierarchy shall be used:

Air Force ETL overrule NFPA Standards
Air National Guard ETL overrule Air Force ETL and NFPA Standards

- C. The following design provides the performance requirements necessary for the provision of the specified systems. Major equipment and piping have been shown to provide the general intent of the systems. The contractor shall utilize this information to design and build a complete and operational system. The submittal documents shall include, but not be limited to, hydraulic calculations, shop drawings, equipment selections, equipment locations and layout, trade coordination drawings, etc.
- D. Hydraulic calculations and fire protection shop drawings shall be stamped by a qualified Fire Protection Engineer as defined in Paragraph 1.6 Qualifications.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.

4. Sleeves.
5. Escutcheons.
6. Grout.
7. Mechanical demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Required Submittals
 1. The Contractor is responsible to submit all the required documents, test results, drawings and manuals. Examples include, but are not limited to, NFPA 13 and 72 forms, as-built drawings, complete O&M manuals, testing and commissioning plans and final reports, etc. These documents shall be required to be submitted a minimum of 30 days prior to the expected scheduling of Final ANG Acceptance Inspections/Testing and Commissioning. The documents shall be provided as a submittal for review and approval and acceptance inspections/testing will only be scheduled upon approval of the submission documents.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Design Requirements: Unless otherwise noted, systems shall meet the requirements of the most recent edition of the following publications: National Fire Protection Association (NFPA) 70, 72, 75 and 90A and 101.

- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 QUALIFICATIONS

- A. The shop drawings and calculations shall be sealed by a qualified FPE. For the purpose of meeting qualification requirements, a qualified FPE shall be defined as an individual meeting one of the following conditions:
 - 1. Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university, plus a minimum of 5 years' work experience in fire protection engineering.
 - 2. Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.
 - 3. Qualification as a GS/GM 804-series FPE.
 - 4. PE registration in a related discipline with a minimum of 5 years' work experience in fire protection engineering.

1.7 OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall provide a very comprehensive submittal regarding requirements for Fire Protection Systems Operations and Maintenance Manuals. Manuals shall be required to include original data on all materials, systems, components, equipment and warranties provided. Manuals shall include approved shop drawings and other as-built information. Manuals shall be professionally prepared, including printed spine and cover with full table of contents and tabbed indexing. Full size sheets, as required, shall be folded into special holding pockets. All manual data shall be required to be original copy. Faxed, hand written or illegible material is not acceptable. Typically, manuals should be prepared in three ring binders for ease of document addition or removal.
- B. O&M manuals shall be required to be completed, submitted and approved by no later than at the 75% construction complete stage. Three copies of final manuals are required. One copy is for

file, one copy is for fire department training and the other copy will be located in the O&M manual lock box, located in each mechanical room.

- C. Manuals shall be required to include, but not be limited to:
- Include full instructions on servicing and maintenance requirements.
 - Include operating instructions including start up, emergency shut down and start up, seasonal servicing and start up, etc.
 - Include owner's manuals for each item of equipment.
 - Include all equipment wiring diagrams
 - Include all piping and wiring systems diagrams and operational diagrams Include full parts lists and exploded schematic diagrams
 - Include full warranty information
 - Include all available manufacturer installation and O&M manuals
 - Include full names, addresses, phone numbers, suppliers, service companies, contract numbers and other points of contact/information relative to the job.
- D. The Contractor shall also provide three copies of original manufacturer operations, service and training manuals shall be provided for all fire protection equipment or systems provided. Examples of these types of manuals would include factory manuals for fire pumps, high expansion equipment and fire suppression control panels.

1.8 POSTED OPERATIONS INSTRUCTIONS

- A. The Contractor shall provide a very comprehensive submittal concerning the requirements for fire protection systems Posted Operations Instructions. Posted instructions shall be required to be completed with professionally prepared graphics, printed on full size sheets and shall be in color. Instructions shall be prepared for all fire protection systems and shall include all components.
- B. Posted instructions will include (but not be limited to) the following:
- Comprehensive schematics for Sprinkler- HE distributing systems
 - Facility floor plans showing location of all fire equipment and devices with coordinated identification. Show items such as fire walls at fire protection valve room.
 - System diagrams, including isometrics of special equipment and systems (fire alarm riser, fire pumps, HE system, etc.)
 - Valve charts
 - Equipment schedule
 - Wiring diagrams and schematics
- C. Posted Operations Instructions shall be framed in heavy gauge extruded metal frames, mounted under glass and shall be water/weather proof. Instructions will be permanently mounted in the reserved clear wall area (show reserved area in the design drawing details) in each fire protection room or mechanical room.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 13 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. All sprinkler system piping shall be minimum schedule 40 steel. All couplings in a facility shall be of one manufacturer.
- D. All sprinkler system piping shall be finish painted in both occupied and unoccupied spaces. Paint red above ceilings and in concealed spaces and provide flow direction identification. Paint in facility coordinated color in occupied and exterior spaces: If not painted red, provide systems identification, which also indicates direction of flow.
- E. Installation of cleated (screw type) flanges on all service piping is prohibited. Do not use victaulic type connections on the service side of facility alarm and isolation valve. Use only threaded or welded and flanged connections.
- F. Service entrance piping shall be sleeved and sealed through the facility foundation and shall enter below grade through foundation into a concrete service entrance pit. Service entrance pipe shall not be set in direct contact with floor concrete. Thrust blocks shall be installed on underground piping at all changes in direction.
- G. Sprinkler pendant placement shall be required to be carefully coordinated with all other trades.
- H. Fire system exterior appurtenances shall be finished in either brass or factory finish red (Siamese, water gong, trim ring, etc.) per the base standard finish style. Exterior piping and related components shall be painted to match adjacent facility finish.
- I. Sprinkler piping shall be capable of being fully and completely drained for maintenance purposes. Main drains and end of line drains to facility exterior shall be provided. Drains shall have cast in place concrete splash block or similar method to control runoff and erosion at the facility exterior.
- J. A test valve (inspectors test station) shall be installed at the end of each preaction system. This connection shall be piped from the end of the most remote branch line. This connection shall terminate outside the facility. Provide smooth bore stainless steel orifice giving a flow rate equivalent to one sprinkler head. Installation at the riser is not acceptable.
- K. No fire protection piping shall be installed over the top or within three lateral feet of any electrical panels, disconnects, transformers or other electrical devices. Provide heavy gauge galvanized steel hoods and shields (or stainless steel) that are shop fabricated for electrical rooms and communications rooms to protect the electrical equipment from water spray where a sprinkler system is installed. Drainage from these hoods shall be copper pipe, directed to floor drains.

- L. Fire protection piping support shall be directly from the facility structural system, except at the fire pump building. No other equipment or materials may be supported from the fire protection support system. Do not hang from the underside of roofing deck or from other equipment or materials. All support systems shall include full lateral and horizontal bracing. Design of support shall comply as a minimum, with seismic criteria as outlined in NFPA 13.
- M. All system valves shall have tamper switches provided.
- N. All wall and floor penetrations with fire protection piping shall be fully sleeved and sealed. Sleeve shall be schedule 40 steel and protrude minimum of 10.2 cm (4 inches) on either side of wall surface with trim ring. Proper penetration detail and sealant shall be specified for penetrations of rated walls and floors.
- O. The high expansion system components and sub systems shall be a separate unit from the building system and shall be factory built, UL approved "as built" for releasing agents. No field additions or modifications to the panel or system to make the system operate in the intended manner shall be allowed.
- P. Galvanized piping, fittings or devices are prohibited for use on all systems related to the HE or sprinkler systems. Consideration must be given for the removal of pumps and valves for maintenance.
- Q. High expansion piping shall be schedule 40 steel. All connections shall be either of threaded or flanged and bolted connection. Piping design shall show consideration for the removal of pumps, valves and other items for maintenance.
- R. Bollards (concrete filled, steel, set in floor) shall be placed around all fire protection equipment that is floor mounted.
- S. All identification and operations identifications shall be coordinated with and keyed to the posted operations instructions and the O&M manuals.

2.2 JOINING MATERIALS

- A. Refer to individual Division 13 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at ambient temperature.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at ambient temperature.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at ambient temperature.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Rough brass.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove fire protection systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 13 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 13 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

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- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 13900

SECTION 13915 - FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
 - 2. Preaction sprinkler systems.
 - 3. Surge arrestor.
- B. Related Sections include the following:
 - 1. Division 2 Section "Water Distribution" for piping outside the building.
 - 2. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
 - 3. Division 13 Section "Fire Suppression Control Systems" for alarm devices not specified in this Section.
 - 4. Division 13 Section "Electric-Drive, Horizontal Fire Pumps Diesel-Drive, Horizontal Fire Pumps" for fire pumps, pressure-maintenance pumps, and pump controllers.
 - 5. Division 13 Section "Fire-Extinguishing Foam Piping" for extinguishing systems.
- C. General Requirements
 - 1. Provide automatic preaction sprinkler protection in the hangar bay. Sprinkler protection must be designed for the hazard present in accordance with Air Force E.T.L. 01-2, MIL-HDBK-1008C and NFPA 13, 30, 34 and NFPA 409. If there is a conflict between the AF E.T.L. 01-2 and any provisions of an NFPA standard or code, the A.F. E.T.L. will take precedence.

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig (1200 kPa).
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- B. Preaction Sprinkler System: Automatic sprinklers are attached to piping. Actuation of crossed zone heat fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).
- B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves.
 - 2. Sprinkler Occupancy Hazard Classifications shall be per the Air National Guard Engineering Technical Letter 01-1.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design shall be per the Air National Guard Engineering Technical Letter 01-1.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft. (20.9 sq. m).
 - b. Storage Areas: 130 sq. ft. (12.1 sq. m).
 - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
 - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
- C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
 - 2. Pipe hangers and supports, including seismic restraints.
 - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

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5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 6. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
 - C. Approved Sprinkler Piping Drawings: Working plans, prepared according to ANG ETL 01-1 and NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
 - D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
 - E. Welding certificates.
 - F. Field quality-control test reports.
 - G. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on design of fire pump house.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. Design Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. Air National Guard Engineering Technical Letter 01-1.
 2. Air Force Engineering Technical Letter 01-2.
 3. NFPA 13, "Installation of Sprinkler Systems."

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

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1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern.
 - 2. Gaskets: AWWA C111, rubber.

2.3 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 - 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

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1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.
1. Grooved-Joint Piping Systems:
 - a. Available Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Ductilic, Inc.
 - 4) JDH Pacific, Inc.
 - 5) National Fittings, Inc.
 - 6) Shurjoint Piping Products, Inc.
 - 7) Southwestern Pipe, Inc.
 - 8) Star Pipe Products; Star Fittings Div.
 - 9) Victaulic Co. of America.
 - 10) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.4 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum working-pressure rating, and made of materials compatible with piping.
- B. Outlet Specialty Fittings:
 1. Available Manufacturers:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Corp.
 - c. Ductilic, Inc.
 - d. JDH Pacific, Inc.
 - e. National Fittings, Inc.
 - f. Shurjoint Piping Products, Inc.
 - g. Southwestern Pipe, Inc.
 - h. Star Pipe Products; Star Fittings Div.
 - i. Victaulic Co. of America.
 - j. Ward Manufacturing.

2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, or grooved outlets.
- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 1. Available Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 1. Available Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End and Croker Corp.
 - c. Potter-Roemer; Fire-Protection Div.
- E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
 1. Available Manufacturers:
 - a. AGF Manufacturing Co.
 - b. Central Sprinkler Corp.
 - c. G/J Innovations, Inc.
 - d. Triple R Specialty of Ajax, Inc.
- F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
 1. Available Manufacturers:
 - a. CECA, LLC.
 - b. Merit.

2.5 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig (1200 kPa) minimum pressure rating.
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 1. NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.

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2. NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
 3. NPS 3 (DN 80): Ductile-iron body with grooved ends.
 4. Available Manufacturers:
 - a. NIBCO.
 - b. Victaulic Co. of America.
- C. Butterfly Valves: UL 1091.
1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - a. Available Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) Milwaukee Valve Company.
 2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Available Manufacturers:
 - 1) Central Sprinkler Corp.
 - 2) Global Safety Products, Inc.
 - 3) McWane, Inc.; Kennedy Valve Div.
 - 4) Mueller Company.
 - 5) NIBCO.
 - 6) Pratt, Henry Company.
 - 7) Victaulic Co. of America.
- D. Check Valves NPS 2 (DN 50) and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Available Manufacturers:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Co.; Waterous Co.
 - c. Central Sprinkler Corp.
 - d. Clow Valve Co.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Firematic Sprinkler Devices, Inc.
 - h. Globe Fire Sprinkler Corporation.
 - i. Grinnell Fire Protection.
 - j. Hammond Valve.
 - k. Matco-Norca, Inc.
 - l. McWane, Inc.; Kennedy Valve Div.
 - m. Mueller Company.

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- n. NIBCO.
- o. Potter-Roemer; Fire Protection Div.
- p. Reliable Automatic Sprinkler Co., Inc.
- q. Star Sprinkler Inc.
- r. Stockham.
- s. United Brass Works, Inc.
- t. Venus Fire Protection, Ltd.
- u. Victaulic Co. of America.
- v. Watts Industries, Inc.; Water Products Div.

E. Gate Valves: UL 262, OS&Y type.

- 1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - a. Available Manufacturers:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Hammond Valve.
 - 3) NIBCO.
 - 4) United Brass Works, Inc.
- 2. NPS 2-1/2 (DN 65) and Larger: Cast-iron body with flanged ends.
 - a. Available Manufacturers:
 - 1) Clow Valve Co.
 - 2) Crane Co.; Crane Valve Group; Crane Valves.
 - 3) Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4) Hammond Valve.
 - 5) Milwaukee Valve Company.
 - 6) Mueller Company.
 - 7) NIBCO.
 - 8) Red-White Valve Corp.
 - 9) United Brass Works, Inc.

F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

- 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch Visual.
- 2. NPS 2 (DN 50) and Smaller: Ball or butterfly valve with bronze body and threaded ends.
 - a. Available Manufacturers:
 - 1) Milwaukee Valve Company.
 - 2) NIBCO.
 - 3) Victaulic Co. of America.

3. NPS 2-1/2 (DN 65) and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

- a. Available Manufacturers:

- 1) Central Sprinkler Corp.
- 2) Grinnell Fire Protection.
- 3) McWane, Inc.; Kennedy Valve Div.
- 4) Milwaukee Valve Company.
- 5) NIBCO.
- 6) Victaulic Co. of America.

2.6 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 (DN 50) and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig (4140-kPa) minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.7 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig (1200-kPa) minimum pressure rating.

1. Available Manufacturers:

- a. AFAC Inc.
- b. Central Sprinkler Corp.
- c. Firematic Sprinkler Devices, Inc.
- d. Globe Fire Sprinkler Corporation.
- e. Grinnell Fire Protection.
- f. Reliable Automatic Sprinkler Co., Inc.
- g. Star Sprinkler Inc.
- h. Venus Fire Protection, Ltd.
- i. Victaulic Co. of America.
- j. Viking Corp.

2. Riser Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include drain and pressure gages.

3. Deluge Valve and Preaction Valves: UL 260, cast-iron body, hydraulically operated, differential-pressure type. Include bronze seat with O-ring seals, trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 - a. Deluge valve shall be equal to Victaulic Series 758 Fire Loc actuated check valve with electric deluge trim.
 - b. Trim Set: Include trim for solenoid-operated discharge.
 - c. Provide externally resettable (without opening the valve assembly and without use of special tools) automatic water control (deluge) valves for preaction systems. Maximum valve size is 150 mm (6-inches).

B. Automatic Drain Valves: UL 1726, NPS 3/4 (DN 20), ball-check device with threaded ends.

1. Available Manufacturers:
 - a. AFAC Inc.
 - b. Grinnell Fire Protection.

C. Waste Cone

1. Waste cone shall be equal to Aurora Option 80 with 125 lb inlet flange.

D. Main Relief Valve

1. Diesel main relief valve shall be equal to Aurora Option 79 with 250 lb inlet flange.

E. Automatic Air Release Valve

1. Air release shall be equal to VAL-MATIC Model VM-15A.

2.8 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum pressure rating.

B. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Firematic Sprinkler Devices, Inc.
4. Globe Fire Sprinkler Corporation.
5. Grinnell Fire Protection.
6. Reliable Automatic Sprinkler Co., Inc.
7. Star Sprinkler Inc.

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8. Venus Fire Protection, Ltd.
9. Victaulic Co. of America.
10. Viking Corp.

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.
2. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Extended-coverage sprinklers.
2. Pendent sprinklers.
3. Quick-response sprinklers.
4. Sidewall sprinklers.
5. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.9 FIRE DEPARTMENT CONNECTIONS

A. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Guardian Fire Equipment Incorporated.
8. Potter-Roemer; Fire-Protection Div.
9. Reliable Automatic Sprinkler Co., Inc.
10. United Brass Works, Inc.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig (1200-kPa) minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR."

1. Type: Flush, with two 4-inch Storz inlets and square or rectangular escutcheon plate.
2. Finish: Polished brass.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm: UL 464, with 8-inch- (200-mm-) minimum-diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
 - 1. Available Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor.
- C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig (1725-kPa) pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element (not less than 0-90 seconds) to prevent false signals and tamperproof cover that sends signal if removed.
 - 1. Available Manufacturers:
 - a. ADT Security Services, Inc.
 - b. Grinnell Fire Protection.
 - c. ITT McDonnell & Miller.
 - d. Potter Electric Signal Company.
 - e. System Sensor.
 - f. Viking Corp.
 - g. Watts Industries, Inc.; Water Products Div.
- D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
 - 1. Available Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
 - d. Viking Corp.
- E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 1. Available Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.

- F. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

- 1. Available Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor.

2.11 PRESSURE GAGES

- A. Available Manufacturers:

- 1. AGF Manufacturing Co.
- 2. AMETEK, Inc.; U.S. Gauge.
- 3. Brecco Corporation.
- 4. Dresser Equipment Group; Instrument Div.
- 5. Marsh Bellofram.
- 6. WIKA Instrument Corporation.

- B. Description: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter, dial pressure gage with range of 0 to 250 psig (0 to 1725 kPa) minimum.

- 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

2.12 SYSTEM APPURTENANCES

- A. Surge Arrestor: Provide a surge arrestor (expansion tank) of not less than 38-liters (10-gallons) capacity for each separate wet pipe and preaction riser. Tanks must be listed and approved as a surge arrestor with a rated working pressure of not less than 1895 kPa (275 psi). The manufacturer shall engineer each surge arrestor installation based on approved shop drawing layouts.
- B. Provide a surge arrestor (expansion tank) of not less than 378.4 liters (100 gallons) for each separate fire pump. Tanks must be listed and approved as a surge arrestor with a rated working pressure of not less than 1724 kPa (250 psi). The manufacturer shall engineer each surge arrestor installation based on approved shop drawing layouts.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Design fire pump booster system to meet system demand.
- B. Provide shop drawings promptly and in writing.

3.2 EARTHWORK

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.3 EXAMINATION

- A. Review existing conditions at start of project.
- B. Proceed with installation only after approved layout shop drawings have been returned.

3.4 PIPING APPLICATIONS, GENERAL

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- E. Underground Service-Entrance Piping: Ductile-iron, push-on joint pipe and fittings and restrained joints.

3.5 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig (1200-kPa) Maximum Working Pressure:
 - 1. Use flanged or welded fittings to transition the fire protection water service entrance from horizontal to vertical as it enters the building. Do not use gasketed compression fittings (including locking type) or flanged fittings with set screws.
 - 2. Use flanged fittings for the suction and discharge piping in the fire pump house.
 - 3. Sprinkler-Piping Fitting Option: Specialty sprinkler fittings, NPS 2 (DN 50) and smaller, including mechanical-T and -cross fittings, may be used downstream from sprinkler zone valves.
 - 4. NPS 1-1/2 (DN 40) and Smaller: Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - 5. NPS 2 (DN 50): Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - 6. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - 7. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Grooved-end, black or galvanized, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

8. NPS 4 to NPS 14 (DN 100 to DN 150): Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
9. NPS 4 to NPS 14 (DN 100 to DN 150): Grooved-end, black or galvanized, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
10. Paint all exposed interior piping (color will be the same as the walls and/or ceiling, or a complementing color). Do not paint exposed interior fire protection piping red. Exposed piping in the fire pump house and fire protection valve room may be left unpainted.

3.6 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

3.7 JOINT CONSTRUCTION

- A. Refer to Division 13 Section "Basic Fire Protection Mechanical Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.
- D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 1. NPS 2 (DN 50) and Smaller: Use dielectric unions, couplings, or nipples.
 2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3. NPS 5 (DN 125) and Larger: Use dielectric flange insulation kits.

3.8 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 2 Section "Water Distribution" for exterior piping.
- B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.9 PIPING INSTALLATION

- A. Refer to Division 13 Section "Basic Fire Protection Mechanical Materials and Methods" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.
- D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- J. Install alarm devices in piping systems.
- K. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install sprinkler system piping according to NFPA 13.
 - L. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
 - M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
 - N. Drain preaction sprinkler piping.
 - O. Pressurize and check preaction sprinkler system piping.
 - P. Fill wet-pipe sprinkler system piping with water.
- 3.10 VALVE INSTALLATION
- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
 - B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
 - C. Install check valve in each water-supply connection.
 - D. Specialty Valves:
 1. Riser Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.
 2. Deluge and Preaction Valves: Install in vertical position, in proper direction of flow, in main supply to deluge system.
- 3.11 FIRE DEPARTMENT CONNECTION INSTALLATION
- A. Install wall-type, fire department connections in vertical wall.
 - B. Install ball drip valve at each check valve for fire department connection.
- 3.12 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to equipment to allow service and maintenance.
 - C. Connect water-supply piping to fire-suppression piping.

- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- F. Electrical Connections: Power wiring is specified in Division 16.
- G. Connect alarm devices to "FIRE SUPPRESSION CONTROL SYSTEM."
- H. Ground equipment according to Division 16 Section "Grounding and Bonding."
- I. Connect wiring according to Division 16 Section "Conductors and Cables."
- J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.13 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 13 Section "Fire Protection Identification."

3.14 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.
 - 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 5. Coordinate with fire alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.15 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

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3.16 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 13915

SECTION 13921 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes electric-drive, split-case centrifugal fire pumps and the following:
 - 1. Full-service fire-pump controllers.
 - 2. Fire-pump accessories and specialties.
 - 3. Pressure-maintenance pumps, controllers, accessories, and specialties.
 - 4. Alarm panels.
 - 5. Flowmeter systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump, Equipment, Accessory, Specialty, and Piping Pressure Rating: 175-psig (1200-kPa) minimum working-pressure rating, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump.
- B. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties, pressure-maintenance pumps, pressure-maintenance-pump controllers, and pressure-maintenance-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that fire pumps and drivers and fire-pump controllers, pressure-maintenance pumps, accessories, and specialties will withstand seismic forces. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of fire pump and fire-pump controller, signed by product manufacturer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and flowmeter systems to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of fire pumps, pressure-maintenance pumps, and controllers and are based on specific systems indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with standards of authorities having jurisdiction pertaining to materials, hose threads, and installation.
- E. Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CENTRIFUGAL FIRE PUMPS

- A. Description, General: UL 448, factory-assembled and -tested, electric-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head.
1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 2. Nameplate: Complete with capacities, characteristics, and other pertinent data.
- B. Fabricate base and attachment to fire pumps, pressure-maintenance pumps, and controllers with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.
- C. Single-Stage, Horizontally Mounted, Split-Case Fire Pumps:
1. Manufacturers:
 - a. A-C Pump; ITT Industries.
 - b. Armstrong Darling, Inc.
 - c. Aurora Pump; Pentair Pump Group.
 - d. Fairbanks Morse; Pentair Pump Group.
 - e. Paco Pumps, Inc.
 - f. Patterson Pump Company.
 - g. Reddy-Buffaloes Pump Co.
 - h. Sterling Peerless Pump; Sterling Fluid Systems Group.
- D. Electric Fire Pump
1. Furnish and install an Aurora Pump Horizontal Split Case Fire Pump or Engineer approved equal. The pump shall be UL and FM approved and rated to deliver 3000 GPM at a pressure boost of 140 PSI. The suction pressure will be flooded The pump shall be designed to deliver not less than 150% of rated capacity at a pressure not less than 65% of rated pressure. Pump and motor shall not exceed 1770 RPM. Shut off pressure shall

not exceed 151 PSI shut off pressure. Both the electric and the diesel pumps shall be of the same size, pressure, RPM and manufacture to minimize the parts requirements.

2. The pump shall be a horizontal split case, cast iron, bronze fitted, SAE 1045 steel shaft, bronze sleeves key locked and threaded so that they tighten with the rotation of the shaft. An O-ring shall seal between the impeller hub and the shaft sleeve to protect the pump shaft. Impellers are to be bronze, balanced and keyed to the shaft. Renewable bronze casing rings, dowel locked bronze wearing rings, heavy duty grease lubricated ball bearings with water slingers. Bearing housing shall be designed to flush lubricant through the bearing. The packing chamber shall be furnished with Teflon lantern rings. Stuffing boxes shall be equipped with bronze packing glands designed for easy removal for packing inspection and maintenance.
3. The driver shall be a foot mounted open dripproof, ball bearing type motor rated for 400 HP, 3/60/460 volt, 1770 RPM. The motor shall not exceed the 115% full load ampere rating at any condition of pump load. Locked rotor current shall not exceed the values specified in NFPA 20.
4. The pump shall be subject to an operation test at rated speed. A performance curve showing flow, total head, brake horsepower and efficiency is to be plotted. Certified curves shall be supplied to the customer. The pump shall be hydrostatically tested at two times the shut-off pressure or 250 PSI, whichever is greater.
5. The fire pump controllers shall be a factory assembled, wired and tested unit and shall conform to all the requirements of NFPA 20 and NFPA 70. The controller shall be listed by UL and approved by Factory Mutual.
6. The controller shall be of the combined manual and automatic type designed for Solid State Soft Starting reduced voltage of the fire pump motor having the horsepower, voltage, phase and frequency rating shown on the plans and drawings. The controller components shall be housed in a NEMA 12 floor mounted enclosure.
7. All controller components shall be front mounted, wired and front accessible for maintenance. The minimum withstand rating shall be 30,000 amps RMS symmetrical at 460 volt.
8. The controller shall include a motor rated combination isolating disconnect switch/circuit breaker, mechanically interlocked and operated with a single, externally mounted handle. When moving the handle from off to on, the interlocking mechanism shall sequence the isolating disconnect switch on first, and then the circuit breaker. When the handle is moved from on to off, the interlocking mechanism shall sequence the circuit breaker off first and then the isolating disconnect switch.
9. The isolating disconnect switch/circuit breaker shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the on position except by a hidden tool operated defeater mechanism. The isolating disconnect switch/circuit breaker shall be capable of being padlocked in the off position for installation and maintenance safety, and shall also be capable of being locked in the on position without affecting the

tripping characteristics of the circuit breaker. The controller door shall have a locking type handle and three point cam and roller vault type hardware. The circuit breaker trip curve adjustment shall be factory set, tested and sealed for the full load amps of the connected motor. The circuit breaker shall be capable of being field tested to verify actual pick up, locked rotor and instantaneous trip points after field installation without disturbing incoming line and load conductors.

10. The fire pump controller shall feature an operator interface with user keypad. The interface shall monitor and display motor operating conditions, including all alarms, events and pressure conditions. All alarms, events and pressure conditions shall be displayed with a time and date stamp. The display shall be a 2 line 20 character, vacuum fluorescent, dot matrix type designed to allow easy viewing from all angles and in all light conditions. The display and interface shall be NEMA rated for type 12 and shall be fully accessible without opening the controller door. The display and user interface shall utilize multiple levels of password protection for system security. A minimum of 3 password levels shall be provided. The display shall be capable of being programmed for any language.
11. The fire pump controller operator interface shall be capable of displaying true RMS digital motor voltage and current measurements for all three phases simultaneously. Displays requiring pushing button and selector switches to toggle between phases or current and voltage shall not be acceptable. Voltage and current shall be measured by true RMS technology to provide the most accurate measurement for all sine waves, including sinusoidal waveforms. Average responding meters shall not be acceptable.
12. The digital display shall indicate text messages for the status and alarm conditions of motor on, minimum run timer/off delay time, fail to start, under voltages, relief valve discharge, low suction pressure, emergency start, drive not installed, disk error, disk near full, sequential start time, local start, remote start, system battery low, over voltage, locked rotor trip, over frequency, motor over 320%, motor overload, printer error, pressure error. The sequential start timer and minimum run timer/off delay timer shall be displayed as numeric values reflecting the value of the remaining time.
13. LED Indicators, visible with the door closed, shall indicate power on, pump running, alarm, deluge open, phase failure, interlock on, emergency isolating switch open, low system pressure, phase reversal.
14. In addition to the standard alarm contacts required by NFPA 20, the digital display module shall have NO and NC contacts for remoter indications of any digitally displayed alarm and NO and NC contacts for remote indication of up to eight specified programmable alarms.
15. The digital display shall monitor the system and log the following. Motor calls/start, last trip currents, last breaker trip, minimum voltages, maximum voltages, last phase failure, last phase reversal, min/max pressure, elapsed motor run time, elapsed power on time, maximum run currents, last motor run time, last start currents, min/max frequency.

16. The controller shall be equipped with a dot matrix impact printer to record all operational and alarm events. The printer shall use standard 16# bond paper, commercially available at office supply stores. Thermal or electrostatic printers are not acceptable. The printer shall feature a mechanical take-up mechanism to prevent excessive paper buildup in the bottom of the controller during automatic operation. The printer shall automatically record all events and pressure settings. It shall allow the user to select the pressure recording frequency based upon either time or pressure deviation. If set for time based recording, the printer shall record the pressure every 30 minutes during standby and every 15 seconds during operation.
17. The controller shall record all operational and alarm events to system memory. All events shall be time and date stamped and include an index number. The system memory shall have the capability of storing 2500 events and allow the user access to the event log via the user interface. The user shall have the ability to scroll through the stored messages in groups of 1, 10, or 100.
18. The controller shall include a floppy disk drive to save all operational and alarm events. The floppy disk drive shall have the ability to store up to 1 year's worth of data in individual monthly files. Each event shall be time and date stamped. The controller shall also have the capability to save settings and values to disk through the user interface. The controller shall feature two independent communications ports to allow connectivity to computers, modems, or building management systems.
19. The controller shall be supplied with a solid state pressure transducer with range of 0-300 PSI. The solid state pressure switch shall be used for both display of the system pressure and control of the fire pump controller. Systems using analog pressure devices or mercury devices are not acceptable.
20. The start, stop and system pressure shall be digitally displayed and adjustable through the user interface. The pressure transducer shall be mounted inside the controller to prevent accidental damage. The pressure transducer shall be directly pipe mounted to a bulkhead pipe coupling without any other supporting members. Field connections shall be made externally at the controller couple to prevent distortion of the pressure switch element and mechanism.
21. A digitally set On Delay (sequential start) timer shall be provided as standard. Upon a call to start, the user interface shall display a message indicating the remaining time value of the On Delay timer. The controller shall be field programmable for manual stop, automatic stop. If set for automatic stopping, the controller shall allow the user to select either a minimum run timer or an off delay timer. Both timers shall be programmable through the user interface.
22. A nonadjustable restart delay timer shall be provided to allow the residual voltage of the motor to decay prior to restarting the motor. At least 2 seconds, but no more than 3 seconds, shall elapse between stopping and restarting the pump motor.
23. A weekly test timer shall be provided as standard. The controller shall have the ability to program the time, date and frequency of the weekly test. In addition, the controller shall

have the capability to display a preventative maintenance message for a service inspection. The message test and frequency of occurrence shall be programmable through the used interface.

24. A lamp test feature shall be included. The user interface shall also have the ability to display the status of the system inputs and outputs.
25. The controller shall not start the fire pump under single-phase condition. If the motor is already running when a phase loss occurs, the controller shall continue to run the motor, but still display a phase failure alarm.
26. The controller shall be equal to Firetrol, Inc. Model FTA1900 Solid State Soft Start/Stop reduced voltage controller with the Mark II Digital Center.

2.3 PRESSURE-MAINTENANCE PUMPS

- A. Pressure-Maintenance Pumps, General: Factory-assembled and -tested pumps with electric-motor driver, controller, and accessories and specialties. Include cast-iron or stainless-steel casing and bronze or stainless-steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.
 1. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
 2. Nameplate: Complete with capacity, characteristics, and other pertinent data.
- B. Multistage, Pressure-Maintenance Pumps: Multiple-impeller type complying with HI 1.1-1.2 and HI 1.3 requirements for multistage centrifugal pumps. Include base.
 1. Manufacturers:
 - a. Aurora Pump.
 - b. A-C Pump; ITT Industries.
 - c. Grundfos Pumps Corp.
 - d. Jacuzzi Brothers.
 - e. Paco Pumps, Inc.
 - f. Sterling Peerless Pump; Sterling Fluid Systems Group.
 - g. Taco, Inc.
 2. Driver: NEMA MG 1, open-drip-proof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
- C. Jockey Pump Specifications
 1. Furnish and install as shown on the plans an Aurora Pump Type 390 Vertical Multi-stage jockey pump or approved equal. The pump shall have the capacity of 20 gpm @ 140 psi. The pump is to be coupled with a 3500 rpm, 3 hp, 3 phase, 460 voltage with ODP enclosure using a rigid split coupling. Motor bearings shall be sized to allow 20,000

minimum hour B10 calculated life. The pump shall be constructed of 304 stainless steel impellers and diffusers, a high temperature mechanical seal with Carbon vs. Silicon Carbide, EPDM elastomers throughout, Tungsten Carbide against ceramic pump bushings and a cast iron motor bracket. Flanges will be ductile iron in slip ring design. The jockey pump shall be the same manufacturer as the main fire pump and meet all of the above specifications.

2. Furnish a jockey pump controller rated for 3 hp, 460 voltage with a HOA switch, fused disconnect, mercoid pressure switch, motor overload, minimum run timer, control circuit transformer, and power available pilot light, all in a NEMA 2 enclosure. The jockey pump controller shall be the same manufacturer as the main controller and meet all of the above specifications.

2.4 FIRE PUMP ACCESSORIES

A. The fire pump system shall include the following accessories:

1. Concentric discharge increaser.
2. Suction and discharge gages.
3. Casing relief valve (electric pump only).
4. Automatic air release valve.
5. 10" Test header with 12 - 2 ½" valves, caps and chains.
6. Ball drip valve.

2.5 ALARM PANELS

A. Description: Factory-assembled and -wired remote panel complying with UL 508 and requirements in NFPA 20. Include audible and visible alarms matching controller type.

1. Manufacturers:

- a. Cutler-Hammer.
- b. Firetrol, Inc.
- c. Hubbell Industrial Controls, Inc.
- d. Joslyn Clark.
- e. Master Control Systems, Inc.
- f. Metron, Inc.

2. Enclosure: NEMA 250, Type 2, remote wall-mounting type.

- a. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.

3. Features: Include manufacturer's standard features and the following:

- a. Motor-operating condition.
- b. Loss-of-line power.
- c. Phase reversal.

- d. Low-water alarm.

2.6 FLOWMETER SYSTEMS

- A. Description: Fire-pump flowmeter system that indicates flow to not less than 175 percent of fire-pump rated capacity. Include sensor of size to match pipe, tubing, flowmeter, and fittings.

- 1. FMG-Approved Manufacturers:

- a. Dieterich Standard Inc.
- b. Gerand Engineering Co.
- c. Hyspan Precision Products, Inc.
- d. Meriam Instruments Div.; Scott Fetzer Co.
- e. Preso Meters Corporation.
- f. Reddy-Buffaloes Pump Co.

- 2. UL-Listed Manufacturers:

- a. Fire Research Corp.
- b. Reddy-Buffaloes Pump Co.

- 3. Pressure Rating: 175-psig (1200-kPa) minimum.
- 4. Sensor: Venturi, annubar probe, or orifice plate, unless otherwise indicated.
- 5. Flowmeter: Compatible with flow sensor with dial not less than 4-1/2 inches (115 mm) in diameter or manufacturer's equivalent size.
- 6. Permanently Mounted Flowmeter: Suitable for wall mounting with copper tubing to connect to flow sensor.
- 7. Flow meter to be equal to Gerand Meter Model K3000-8.

2.7 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with range of 0- to 250-psig (0- to 1725-kPa) minimum. Include caption "WATER" on dial face.

- 1. Manufacturers:

- a. AGF Manufacturing Co.
- b. AMETEK, Inc.; U.S. Gauge.
- c. Brecco Corporation.
- d. Dresser Equipment Group; Instruments Div.
- e. Marsh Bellofram.
- f. WIKA Instrument Corporation.

2.8 GROUT

- A. Description: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

2.9 SOURCE QUALITY CONTROL

- A. Test and inspect fire pumps with their controllers according to NFPA 20 for certified shop tests.
- B. Verification of Performance: Rate fire pumps according to requirements indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.3 INSTALLATION

- A. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.
- B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and concrete base for grouting.
 2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.
- D. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.
- E. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- F. Install pressure gages on fire-pump suction and discharge at pressure-gage tapings.
- G. Support pumps and piping separately so weight of piping does not rest on pumps.
- H. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.
- I. Install flowmeters and sensors where indicated. Install flowmeter-system components and make connections according to manufacturer's written instructions.
- J. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical installer.

3.4 ALIGNMENT

- A. Align split-case fire-pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.
- E. Align vertically mounted, split-case pump and driver shafts after complete unit has been made plumb on concrete base, grout has set, and anchor bolts have been tightened.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in Division 13 Section "Fire-Suppression Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.

- C. Connect water supply and discharge piping to fire pumps. Connect water supply and discharge piping to pressure-maintenance pumps.
- D. Connect relief-valve discharge to point of disposal.
- E. Connect flowmeter-system sensors and meters according to manufacturer's written instructions.
- F. Connect controllers to pumps.
- G. Ground equipment according to Division 16 Section "Grounding and Bonding."
- H. Connect wiring according to Division 16 Section "Conductors and Cables."

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - a. Lubricate oil-lubrication-type bearings.
 - b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
 - 3. Starting procedure for pumps is as follows:
 - a. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
 - b. Open sealing-liquid supply valves if pump is so fitted.
 - c. Start motor.
 - d. Open discharge valve slowly.

- e. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.
 - f. Check general mechanical operation of pump and motor.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps, drivers, controllers, and pressure-maintenance pumps. Refer to Division 1 Section "Closeout Procedures Demonstration and Training."
- B. Testing:
 1. A factory-certified pump performance test shall be done prior to shipment of the unit. Results to be furnished to the Engineer. Contractor shall include a return visit by the manufacturer for inspection 6 months after equipment is placed on line for a performance inspection and to advise of any recommended maintenance procedures.
 2. The pump manufacturer shall assume unit responsibility and shall provide the services of a factory-trained representative to assist in the final field acceptance test in the presence of authority having jurisdiction, Engineer and Owner. Results of the test shall be furnished to the Engineer and Owner upon completion.
 3. Authorized factory representative for Aurora Pump is Hayes Pump Inc., West Concord, MA 978-369-8800; Colchester, CT 860-537-4436; Fairfield, NJ 973-202-0606.

END OF SECTION 13921

SECTION 13922 - DIESEL-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes diesel-drive, split-case centrifugal fire pumps and the following:
 - 1. Fire-pump controllers.
 - 2. Fire-pump accessories and specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump, Equipment, Accessory, Specialty, and Piping Pressure Rating: 175-psig (1200-kPa) minimum working-pressure rating, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump.
- B. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that fire pumps and drivers and fire-pump controllers, pressure-maintenance pumps, accessories, and specialties will withstand seismic forces." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of fire pump and fire-pump controller, signed by product manufacturer.
 - E. Source quality-control test reports.
 - F. Field quality-control test reports.
 - G. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and flowmeter systems to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of fire pumps, pressure-maintenance pumps, and controllers and are based on specific systems indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with standards of authorities having jurisdiction pertaining to materials, hose threads, and installation.
- E. Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CENTRIFUGAL FIRE PUMPS

- A. Description, General: UL 448, factory-assembled and -tested, diesel-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head.
 1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 2. Nameplate: Complete with capacities, characteristics, and other pertinent data.
- B. Fabricate base and attachment to fire pumps, pressure-maintenance pumps, and controllers with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.
- C. Single-Stage, Horizontally Mounted, Split-Case Fire Pumps:
 1. Manufacturers:
 - a. A-C Pump; ITT Industries.
 - b. Armstrong Darling, Inc.
 - c. Aurora Pump; Pentair Pump Group.
 - d. Fairbanks Morse; Pentair Pump Group.
 - e. Patterson Pump Company.
 - f. Reddy-Buffaloes Pump Co.
 - g. Sterling Peerless Pump; Sterling Fluid Systems Group.
- D. Diesel Fire Pump
 1. Furnish and install an Aurora Horizontal Split Case Diesel Fire Pump System or equal by Fairbanks, or Engineer approved equal to meet all of the specifications. The pump shall be UL and FM approved and rated to deliver 3000 gpm at a pressure boost of 140 psi. The pump shall be designed to deliver not less than 150% of rated capacity at a pressure not less than 65% of rated pressure. Pump and engine shall operate at a maximum speed of 1770 rpm. Pump shutoff pressure shall not exceed 151 psi. Both the electric and the diesel pumps shall be of the same size, pressure, rpm and manufacture to minimize the parts requirements.
 2. The pump shall be a horizontal split case, cast iron, bronze fitted, SAE 1045 steel shaft, bronze sleeves key locked and threaded so that they tighten with the rotation of the shaft. An O-ring shall seal between the impeller hub and the shaft sleeve to protect the pump Shaft. Impellers are to be bronze, balanced and keyed to the shaft. Renewable bronze casing rings, dowel locked bronze wearing rings, heavy duty grease lubricated ball bearings

with water slingers. Bearing housing shall be designed to flush lubricant through the bearing. Where the suction pressure is expected to average 40 PSI or below, the packing chamber shall be furnished with Teflon lantern rings. Stuffing boxes shall be equipped with bronze packing glands designed for easy removal for packing inspection and maintenance.

3. The Diesel Engine shall be equal to Model 3406B-DITA phase 1 as manufactured by Caterpillar having a horsepower of 460 at a maximum speed of 1750 RPM. The engine shall conform to all of the code requirements but not limited to overspeed/overcrank switch and drive, two contactor switches, low oil pressure and high water temperature warning switches, and fuel shut off solenoid, with wiring terminating in the junction box.

The engine shall be rated for 24 volt negative, 6 cylinders, 6" exhaust flange, 943 CFM, 3241 BTU rated heat, maximum of 35 gallons per minute for cooling water outlet.

4. The engine shall include the following accessories:
 - a. Stub Shaft
 - b. Oil bath air cleaner
 - c. Water cooled exhaust manifold
 - d. Heat exchanger
 - e. Mechanical speed governor
 - f. Fuel Filter
 - g. Lube oil filter and by-pass valve
 8. Lube oil cooler and relief valve
 9. Fuel Pump
 - h. Instrument Panel with tachometer, hour meter, oil pressure gage, water temp gage, ammeter, hand speed control and start switch.
 - i. Starting system including generator/alternator, starting motor and voltage regulator.
 - j. Exhaust silencer, industrial type.
 - k. Flexible exhaust connectors.
5. Cooling water system shall supply water from the pump to the engine heat exchanger. Include four manual shut off valves, two strainers, pressure regulating valve, automatic solenoid valve and pressure gage.
6. Batteries shall be provided with the engine, dual lead acid to match the engine, and supplied with battery racks for a minimum of 12" off the floor and located as close as practical to the engine.

E. Diesel Fire Pump Controller

1. The fire pump controller shall be a factory assembled, wired and tested unit and shall conform to all the requirements of NFPA 20 and NFPA 70. The controller shall be manufactured in the United States and shall be listed by UL and approved by FM. The controller shall be 24 volt negative ground for use with a diesel engine listed for fire service.
2. The controller shall be furnished in a NEMA 4 water tight enclosure. A pressure transducer shall be mounted inside of the controller cabinet, affixed to a bulkhead fitting that is welded to the bottom of the enclosure. The controller shall be equipped with a DC driven

pressure recorder. All internal components shall be front mounted and wired for ease of inspections and maintenance. All standard pilot lights shall be of the LED type for long service life and shall be visible through the break-away window in the enclosure door.

3. The diesel engine controller shall be furnished as standard, with remote alarm contacts for engine running, engine trouble and main switch not in automatic. Also, the controller shall be equipped with circuits for interlock shutdown, remote start as standard. The controller shall be equipped with safety shutdown feature such that when the engine is started by the weekly test clock or test button, it shall shutdown if low oil pressure or high water temperature occur. However, when the engine is started by system pressure drop or remote start signals, it will shut down only on an overspeed condition. The controller shall have two externally operable engine crank push-buttons allowing both sets of batteries to be used to manually crank the engine under hard starting conditions.
4. All control logic functions shall be processed by a microcontroller. The microcontroller shall include independent start and stop pressure setting adjustments, a switch selectable, LCD, lighted display for start, stop and system pressure and a shutdown model selector switch. The microcontroller shall have quick connect terminal points for ease of field replacement. The diesel engine controller shall be equipped with a DC powered digital readout weekly test program timer and shall not be dependent on AC power operation. The timer shall be mounted such that the time can be viewed whenever the door is closed. Analog clocks with rotating dials having push-pull tabs are not acceptable.
5. The controller shall have normally open and normally closed contacts for remote alarm of Engine Run, Engine Trouble and Selector switch mis-set. The controller shall be equal to a Firetrol Model FTA1100 Microcontroller type diesel engine fire pump controller with the following options: Local low fuel, remote low fuel, Low pump room temperature with thermostat with both local and remote alarms, three sets of extra engine running contacts for air louver combustion, leak detection fuel spill both local and remote alarms.

F. Fuel Tank

1. Double-wall above ground fuel tank having a minimum capacity of 572 gallons with 515 usable gallons with leak detection sensor wired to the main fire pump control panel. The tank shall be furnished with a fill tube, whistle fill vent, flame arrestor, manual shutoff valve, low fuel levels switch, oil level gages, braided bronze flexible connectors, and lockable fuel cap. Tank shall be compliant with NFPA 20 and UL 142 requirements.

G. Exhaust System: ASTM A 53/A 53 M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld-type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe.

1. Exhaust Connector: Flexible type.
2. Exhaust Silencer: Industrial type.
3. Exhaust insulation shall be 2-inch hydrous calcium silicate, temperature limit to 1200°F (649°C), density at least 13.8, thermal conductivity of 0.40, at a mean temperature of 300°F, compressive strength not less than 200 psi at 5% compression, modulus of rupture

of 70 psi, equal to Schuller "Thermo-12 Gold." Provide field-applied rewettable glass fabric outer finish, or with outer finish equal to adjoining insulation outer finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.3 INSTALLATION

- A. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.
- B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 - 1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and concrete base for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.
- D. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.

- E. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- F. Install pressure gages on fire-pump suction and discharge at pressure-gage tappings.
- G. Support pumps and piping separately so weight of piping does not rest on pumps.
- H. Install fuel system according to NFPA 20.
- I. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.
- J. Refer to Division 13 Section "Basic Fire Protection Materials and Methods" for basic piping installation and joint construction.
- K. Install water supply and drain piping for diesel-engine heat exchangers. Extend drain piping from heat exchangers to point of disposal.
- L. Install exhaust system piping for diesel engines. Extend to point of termination outside structure. Install pipe and fittings with welded joints, and components having flanged connections with gasketed joints.
- M. Install condensate drain piping for diesel-engine exhaust system. Extend drain piping from low points of exhaust system to condensate traps and to point of disposal.
- N. Install flowmeters and sensors where indicated. Install flowmeter-system components and make connections according to manufacturer's written instructions.
- O. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical installer.

3.4 ALIGNMENT

- A. Align fire-pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in Division 13 Section "Fire-Suppression Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect water supply and discharge piping to fire pumps. Connect water supply and discharge piping to pressure-maintenance pumps.
- D. Connect relief-valve discharge to point of disposal.
- E. Connect cooling-system water supply and drain piping to diesel-engine heat exchangers.
- F. Connect exhaust system piping to diesel engines.
- G. Connect flowmeter-system sensors and meters.
- H. Connect controllers to pumps.
- I. Ground equipment according to Division 16 Section "Grounding and Bonding."
- J. Connect wiring according to Division 16 Section "Conductors and Cables."

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - a. Lubricate oil-lubrication-type bearings.
 - b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.

- c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
3. Starting procedure for pumps is as follows:
- a. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
 - b. Open sealing-liquid supply valves if pump is so fitted.
 - c. Start motor.
 - d. Open discharge valve slowly.
 - e. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.
 - f. Check general mechanical operation of pump and motor.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps, drivers, controllers, and pressure-maintenance pumps. Refer to Division 1 Section "Closeout Procedures Demonstration and Training."

3.8 TESTING

- A. A factory-certified pump performance test shall be done prior to shipment of the unit. Results to be furnished to the Engineer. Contractor shall include a return visit by the manufacturer for inspection 6 months after equipment is placed on line for a performance inspection and to advise of any recommended maintenance procedures.
- B. The pump manufacturer shall assume unit responsibility and shall provide the services of a factory-trained representative to assist in the final field acceptance test in the presence of authority having jurisdiction, Engineer and Owner. Results of the test shall be furnished to the Engineer and Owner upon completion.
- C. Authorized factory representative for Aurora Pump is Hayes Pump Inc., West Concord, MA 978-369-8800, Colchester, CT 860-537-4436, Fairfield, NJ 973-202-0606.

END OF SECTION 13922

SECTION 13956 - FIRE-EXTINGUISHING FOAM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fixed, high-expansion foam fire-extinguishing systems and the following:
 - 1. Piping and piping specialties.
 - 2. Proportioning tanks and proportioning devices.
 - 3. Foam concentrate,
 - 4. Discharge devices.
 - 5. Detection and alarm devices.
- B. Related Sections include the following:
 - 1. Division 13 Section "Fire Suppression Piping."
 - 2. Division 13 Section "Commissioning of Fire Protection Hi-Ex Foam Systems"

1.3 DEFINITIONS

- A. Hi-Ex: High Expansion Foam.

1.4 SYSTEM DESCRIPTION

- A. Description: Engineered, fixed-type, automatically actuated, high-expansion foam fire-extinguishing system for hydrocarbon-liquid fires. System includes diaphragm proportioning tanks and devices as described in Air Force E.T.L. 01-2 and NFPA 11A.

1.5 PERFORMANCE REQUIREMENTS

- A. Design fixed-type, automatically actuated, high-expansion foam systems for Class B, flammable-liquid fires and obtain approval from authorities having jurisdiction. Include use of 2.75 percent Hi-Ex foam concentrate for 2.75 percent concentrate and 97.25 percent water foam solution to be discharged from discharge devices as appropriate for areas being protected.
- B. Piping and Piping Specialties: 175-psig (1200-kPa) minimum working pressure, unless otherwise indicated.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fitting materials and methods of joining.
 - 2. Pipe hangers and supports.
 - 3. Piping seismic restraints.
 - 4. Valves.
 - 5. Proportioning tanks and proportioning devices.
 - 6. Foam concentrate.
 - 7. Discharge devices. Include flow characteristics.
 - 8. Detection and alarm devices. Include electrical data.
 - 9. Foam generators.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include design calculations. Include the following for each hazard area, drawn to scale:
 - 1. Include plans, elevations, sections, details, and attachments to other Work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Design Calculations: For amount of foam concentrate required for each hazard area.
 - 4. Plans: Show the following:
 - a. Foam-solution proportioning tanks and devices, piping, discharge devices, detector and alarm devices, and accessories.
 - b. Method of attaching hangers to building structure.
 - c. Fire alarm panel.
 - d. Equipment and furnishings.
 - 5. Limit velocity in underground mains to 10 FPS and 20 FPS aboveground.

- C. Permit-Approved Drawings: Working plans, prepared according to NFPA 11A, that have been approved by authorities having jurisdiction. Include design calculations.

- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

- E. Maintenance Data: For components to include in maintenance manuals specified in Division 1.

1.7 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for

installations of high-expansion foam fire-extinguishing systems that are similar to those indicated for this Project in material, design, and extent.

- B. Source Limitations: Obtain foam concentrate, proportioning tanks, and major accessories through one source.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of foam fire-extinguishing systems and are based on the specific system indicated. Other manufacturers' foam fire-extinguishing systems complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. NFPA Compliance: Fabricate and label Hi Ex fire-extinguishing systems to comply with NFPA 11A.
- F. ASME Compliance: Fabricate piping to comply with ASME B31.1.
- G. FM Compliance: Provide components that are FM approved and that are listed in FM's "Fire Protection Approval Guide."
- H. UL Compliance: Provide foam concentrate and equipment complying with UL 162, "Foam Equipment and Liquid Concentrates," and with systems that are listed in UL's "Fire Protection Equipment Directory."

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Discharge Devices: One foam generator.
 - 2. Foam Concentrate: Not less than 200 percent of amount installed.

1.9 GENERATOR PERFORMANCE

- A. Rate of Discharge. The minimum rate of discharge or total generator capacity will be calculated in accordance with NFPA 11A; however, it will never be less than $0.8 \text{ m}^3/\text{min}/\text{m}^2$ ($2.6 \text{ ft}^3/\text{min}/\text{ft}^2$). Application rates in the range of 0.8 to $1.2 \text{ m}^3/\text{min}/\text{m}^2$ (2.6 to $4 \text{ ft}^3/\text{min}/\text{ft}^2$) are required to meet the performance requirements.
- B. The minimum rate of discharge or total generator capacity will be calculated from the following formula:

$$R = ([V/T] + R_s) \times C_N \times C_L$$

where:

R = Rate of discharge in M³/min (ft³/min)

V = Submergence volume in m³ (ft³) determined by the following formula:

$$V = A \times D$$

where:

A = Area of the aircraft servicing floor and adjacent floor areas not cut off from the aircraft servicing floor m² (ft²)

D = Depth = 1 meter (3.28 feet) (see A.F. ETL 01-2) which is greater than the 0.6-meter (2-foot) minimum foam depth over the hazard required in NFPA 11A.

T = Submergence time in minutes = 4 (see A.F. ETL 01-2)

RS = Rate of foam breakdown by sprinklers in ft³/min (m³/min) determined by the following formula:

$$R_S = S \times Q$$

where:

S = Foam breakdown from sprinkler discharge = 0.0748 cubic meters per minute – L/min (10 cubic feet per minute – gpm)

Q = Estimated total discharge from maximum number of sprinklers expected to operate in L/min (gpm).

C_N = Compensation for normal foam shrinkage = 1.15. This is an empirical factor based on average reduction in foam quantity from solution drainage, fire, wetting of surfaces, and absorbency of stock.

C_L = Compensation for loss of foam due to leakage around doors and windows and through unclosable openings determined by the design engineer after proper evaluation of the structure. This factor cannot be less than 3.0.

1.10 ACTIVATION

A. The following will activate the low-level high-expansion foam systems:

1. Manual foam activation station located at main exits from aircraft servicing area.
2. Roof or ceiling level crossed-zoned heat detection system associated with preaction system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ansul, Inc.

2.2 PIPES

- A. Steel Pipe: ASTM A 795 or A53, Type E or Type S; Schedule 40.

2.3 PIPE FITTINGS

- A. Grooved-End Fittings: UL listed and FM approved; ASTM A 536 ductile-iron castings; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.4 JOINING MATERIALS

- A. Refer to Division 13 Section "Basic Fire Protection Materials and Methods" for basic joining materials.
- B. Keyed Couplings: UL 213, AWWA C606, approved or listed for fire-protection service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.5 VALVES

- A. Valves NPS 2 (DN50) and Smaller: Bronze body with threaded ends according to the following:
 - 1. Gate Valves: UL 262, OS&Y type or, if not available in size required, provide MSS 80, Class 125, rising-stem type acceptable to authorities having jurisdiction.
 - 2. Check Valves: UL 312, swing-check type or, if not available in size required, provide MSS 80, Class 125, swing-check type acceptable to authorities having jurisdiction.
- B. Valves NPS 2-1/2 (DN65) and Larger: Cast-iron body with flanged ends according to the following:
 - 1. Gate Valves: UL 262, OS&Y type,
 - 2. Check Valves: UL 312, swing-check type.

2.6 PROPORTIONING TANKS

- A. Description: Bladder-type proportioning tank complying with UL 162 and the 1995 ASME Boiler and Pressure Vessel Code: Section VIII. Include bladder, internal piping, fill and drain, pipe assembly, glass sight gage, piping, and valves.

- 1. Orientation: Horizontal design with saddle support.

- B. Proportioning Device: Venturi type complying with UL 162 and of capacity to match design flow.

2.7 FOAM CONCENTRATE

- A. Description: 2.75 percent Hi-Ex liquid concentrate, complying with UL 162, for making 2.75 percent concentrate and 97.25 percent water Hi-Ex fire-extinguishing foam solution.

2.8 PRESSURE GAGES

- A. Description: Comply with UL 393, with 3-1/2-inch- (90-mm) minimum diameter dial, 0- to 300-psig (0- to 2500-kPa) dial range, and caption "WATER" on dial face.

2.9 DISCHARGE DEVICES

- A. High Expansion Foam Generators

- 1. The foam generators shall be powered by water reaction motor. The water reaction motor shall provide both the screen wetting solution and the energy to drive the fan. The foam generators shall not require any outside power source, such as electricity or engines.
 - 2. All foam generators designed for fixed installation shall be equipped with a stainless steel screen for maximum reliability under fire conditions.
 - 3. The foam generators shall be Underwriters Laboratories (UL) listed and/or Factory Mutual (M) approved.
 - 4. The generators shall be ROCKWOOD JET-X generators as manufactured by Ansul Inc.

2.10 DETECTION DEVICES

- A. Comply with NFPA 11A and NFPA 72.

- 1. Valve Supervisory Switches: UL 753, electrical, single pole, double throw, with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 2. Other Detectors: Comply with NFPA 11A and NFPA 72.

2.11 ALARM DEVICES

- A. Description: UL listed or FM approved, low voltage, and surface mounting, unless otherwise indicated.

- B. Bells: 8-inch (150-rmm) diameter, minimum.
- C. Horns: 90 to 94 dBA. Coordinate with Base. Horn for foam system shall not match fire alarm horn.
- D. Rotating Beacon - Blue.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated. Refer to Division 3 Section "Cast-in-Place Concrete" and Division 13 Section "Basic Fire Protection Materials and Methods."

3.2 PROPORTIONING TANK INSTALLATION

- A. Install proportioning tanks on concrete bases.
- B. Install tanks level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Anchor tanks to substrate.

3.3 PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
- B. Foam-Concentrate Piping: 304 stainless steel welded with flanged joints.
- C. Foam-Solution Piping NPS 2 (DN50) and Smaller: Steel pipe ASTM A795 or A53, threaded fittings; and threaded joints.
 - 1. Do not use cast-iron fittings for dry piping that may be exposed to fire.
- D. Foam-Solution Piping NPS 2-1/2 to NPS 6 (DN65 to DN150): ASTM A795 or A53, steel pipe, grooved-end fittings, keyed couplings, and grooved joints.

3.4 PIPING INSTALLATION

- A. Install Hi-Ex foam piping and other components level and plumb, unless otherwise shown on plans.

- B. Refer to Division 13 Section "Basic Fire Protection Materials and Methods" for basic pipe installation and joint construction.
- C. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and grooved-end fittings with keyed couplings and lubricant according to manufacturer's written instructions.
- D. Install pipe and fittings, valves, and discharge devices according to requirements listed in NFPA 11A, Chapter 5, "Installation Requirements;" and in ASME B31.1.
 - 1. Support piping using supports and methods according to NFPA 13 and Division 13 Section "Hangers and Supports."
 - 2. Install detection and alarm devices according to NFPA 11A, NFPA 72 and "Fire Suppression Control System."

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect electrical devices control system. Electrical power, wiring, and devices are specified in Division 13 Section "Fire Suppression Control System."
- D. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 LABELING

- A. Install labeling on piping, equipment, and panels according to NFPA 11A and Division 13 Section "Fire Protection Identification."

3.7 CHARGING SYSTEM

- A. Fill proportioning tanks with foam concentrate after field quality-control testing is complete and satisfactory results have been achieved.

3.8 FIELD QUALITY CONTROL

- A. Professional Engineer: Inspect installed Hi-Ex fire-extinguishing systems, prepare installation report, and certify that installation complies with the Contract Documents, calculations, and comments of authorities having jurisdiction.

- B. Comply with operating instructions and procedures in NFPA 11A, Chapter "Testing and Acceptance." Include the following inspections and tests to demonstrate compliance with requirements:
1. Check mechanical items.
 2. Inspect equipment and fire-extinguishing foam concentrate, and check mountings for adequate anchoring to substrate.
 3. Check electrical systems.
 4. Flush piping.
 5. Perform acceptance test.
 6. Perform pressure test.
 7. Perform operating test.
 8. Perform discharge test.
 9. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
 - a. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- C. Perform the following field quality-control testing:
1. After installing foam fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section "Inspection and Test Procedures," and Section 8, "System Function Tests." Certify compliance with requirements.
 3. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start systems to confirm proper operation. Remove malfunctioning components, replace with new components, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 4. All fire system testing shall be recorded on videotape and 3 copies provided to the Government.

END OF SECTION 13956

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SECTION 13968 – FIRE PROTECTION HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 13 Section "Fire-Suppression Piping" for fire protection piping.
- D. See Division 13 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.

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- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.

14. Tolco Inc.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

- 1. B-Line Systems, Inc.; a division of Cooper Industries.
- 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
- 3. GS Metals Corp.
- 4. Power-Strut Div.; Tyco International, Ltd.
- 5. Thomas & Betts Corporation.
- 6. Tolco Inc.
- 7. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head.
- c. Masterset Fastening Systems, Inc.
- d. MKT Fastening, LLC.
- e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Available Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Do not hang or support piping from fire pump house structure.
- B. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- C. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- D. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility.
 3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 4. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 5. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
 6. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 7. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. C-Clamps (MSS Type 23): For structural shapes.

6. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
7. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
8. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- L. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Fastener System Installation:
 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

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3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 13968

SECTION 13969 – FIRE PROTECTION VIBRATION AND SEISMIC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Seismic snubbers.
2. Restraining cables.

B. Definitions:

1. A_v : Effective peak velocity related acceleration coefficient.
2. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

1.2 PERFORMANCE REQUIREMENTS

- A. A_v : Refer to Structural Drawings.
- B. Component Seismic Coefficient: Refer to Structural Drawings.
- C. Performance Criteria Factor: Refer to Structural Drawings.
- D. Attachment Amplification Factor: Refer to Structural Drawings.

1.3 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 2. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 3. Details for Interlocking Snubbers: Include load deflection curves up to 1/2-inch (13-mm) deflection in x, y, and z planes.

1.4 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-

restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a registered professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 deg rees to the weakest mode.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. California Dynamics Corp.
4. Kinetics Noise Control, Inc.
5. Loos & Co., Inc.; Cableware Technology Division.
6. Mason Industries, Inc.
7. TOLCO Incorporated.
8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
9. Vibration Eliminator Co., Inc.
10. Vibration Isolation Co., Inc.
11. Vibration Mountings & Controls/Korfund.

- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

- C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
- E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
- B. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- C. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- D. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- E. Install resilient bolt isolation washers on equipment anchor bolts.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Inspect isolator seismic-restraint clearance.
 2. Inspect minimum snubber clearances.

3.3 ADJUSTING

- A. Adjust snubbers according to manufacturer's written recommendations.
- B. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

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- C. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

END OF SECTION 13969

SECTION 13970 – FIRE PROTECTION IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following fire protection and mechanical identification materials and their installation:
1. Equipment nameplates.
 2. Equipment markers.
 3. Equipment signs.
 4. Pipe markers.
 5. Valve tags.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.
- B. Fire Protection Systems
1. Mark all exposed interior piping at 8-meter (26 foot) intervals, with plastic wrap-around-type labels conforming to ASNE/ANSI A13.1-1996, scheme for the identification of piping systems, indicating the type of fluid carried and direction of flow. Labels are not required on sprinkler system branch lines and pipes less than 51 mm (2-inches) in nominal size. The following legends are required:
 - a. Fire Protection Water – Used on dedicated potable and non-potable fire protection water supply lines.
 - b. Foam Concentrate – Used on high-expansion foam concentrate lines.
 - c. Fire Sprinkler or Sprinkler Fire – Used on standard water-only sprinkler systems.
 - d. High Expansion Foam – Used on lines supplying low-level high-expansion foam generator.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 2. Location: Accessible and visible.
 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/16 inch (1.6 mm) 1/8 inch (3.2 mm), unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 deg rees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.

5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme. Provide 5/32-inch (4-mm) hole for fastener.
 1. Material: 0.032-inch- (0.8-mm-) thick brass.
 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of fire protection equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Fuel-burning units, including boilers.
 2. Pumps and similar motor-driven units.

3. Heat exchangers, coils and similar equipment.
 4. Fire pumps, jockey pumps, alarm valves and high expansion foam system components.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers as required per NFPA:
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Include signs as required per NFPA:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches (38 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide,

lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.

- B. Locate pipe markers and color bands where piping is exposed in finished spaces; fire pump building and fire protection valve room; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. Near major equipment items and other points of origination and termination.
 - 5. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 6. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
 - 7. As required per NFPA.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. As per NFPA Standards.
 - 2. Valve-Tag Color:
 - a. As per NFPA Standards.
 - 3. Letter Color:
 - a. As per NFPA Standards.

3.5 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 13970

SECTION 13995 - COMMISSIONING OF FIRE PROTECTION HI-EX FOAM SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Air National Guard 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. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Commissioning Team;

List of team members who will represent the Contractor in the precommissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted Work.

Test Procedures;

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

Test Schedule; "G"

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

SD-06 Test Reports

Test Reports; "G"

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

1.2 SEQUENCING AND SCHEDULING

- A. The work described in this Section shall begin only after all work required in related Sections, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

- A. The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officers Representative
U	Using Agency's Representative

- B. Each checklist shown in the appendices shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

- A. The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

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B. Pre-Commissioning Checks

1. Pre-commissioning checks shall be performed for the items indicated on the checklists. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

C. Functional Performance Tests

1. Functional performance tests shall be performed for the items indicated on the checklists. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors.

END OF SECTION 13995

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Grout.
 - 6. Equipment installation requirements common to equipment sections.
 - 7. Painting and finishing.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.

- 2. Dielectric fittings.
- 3. Mechanical sleeve seals.

B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

- A. Arrange for pipe spaces and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

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- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. EpcO Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.

- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Sleeves are not required for core-drilled holes.

- L. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

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7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Formed-Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 15050

SECTION 15051 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Equipment installation requirements common to equipment sections.
5. Supports and anchorages.

1.2 QUALITY ASSURANCE

A. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.3 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.4 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

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- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.

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- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- O. Verify final fixture locations for roughing-in.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 15051

SECTION 15051 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Equipment installation requirements common to equipment sections.
5. Supports and anchorages.

1.2 QUALITY ASSURANCE

A. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.3 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.4 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

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- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.