



Discover a World
of Opportunity™

Design & Construction Standards:
TECHNICAL GUIDELINES

Division 21

21 13 13 Wet Pipe Sprinkler Systems

21 31 13 Fire Pumps

FACILITY MANAGEMENT

April 2016

SECTION 21 13 13

WET PIPE SPRINKLER SYSTEMS

PART 1 SYSTEM DESIGN DESCRIPTION

1.01 RELATED

- A. "General Requirements", DPS Design and Construction Standards of the Project Manual and project specific bid documents pertain to and are hereby made part of the work of the Specification Section.

1.02 DESCRIPTION OF WORK

- A. The work under this Section includes furnishing all fire suppression equipment, piping and specialties and all labor necessary to make the complete installation of the Fire Suppression System as indicated on the drawings and specified herein.

1.03 SYSTEM DESCRIPTION

- A. Water Service: Underground connections to a reliable water works system, including all piping, valves, thrust blocks, and related items (inspection fees, etc.).
- B. Coordination with the water utility provider:
 - 1. Contractors to contact a Plan Review Coordinator at Denver Water Sales to obtain existing water line and street tap locations and applicable drawings.
 - 2. Contractors shall include all Denver Water Document Submittals and Fees, including but not limited to the Plan Review Fee, Inspection Fees, Recording Fees, Expedite Fees, etc.
- C. Automatic Sprinkler System: A sprinkler system, for fire suppression purposes, is an integrated system of underground and overhead piping:
 - 1. The portion of the sprinkler system above ground is to be a network of specially sized or hydraulically designed piping installed in the building, structure or area generally overhead, and to which sprinklers are connected in a systematic pattern. The system includes a controlling valve and a device for actuating an alarm when the system is in operation. The system is activated by heat from a fire and discharges water over the fire area.
 - 2. The following areas are to be provided with an automatic fire sprinkler system: Entire building including all rooms, stairways, equipment rooms, closets, overhangs, canopies, crawlspaces, chases, shafts, vaults, basements, confined spaces, plenums, stage (under), and required heated and unheated attic or concealed areas.
- D. Fire Department Connections: A connection through which a Fire Department can pump water into a standpipe system or a sprinkler system.

1.04 GENERAL DESIGN REQUIREMENTS

- A. All areas of the facility shall be protected by the automatic sprinkler system, unless specifically waived by NFPA-13 or otherwise approved, in writing, by the AHJ.
- B. All sprinkler and standpipe systems shall be hydraulically calculated to verify proper pipe sizes in strict accordance with NFPA-13. A safety factor of ten (10) psi shall be included in hydraulic calculations.
- C. The System Design Engineer and/or Contractor shall include a Double Check Back Flow Prevention device in

the hydraulic calculation.

- D. This section includes specific requirements for the system(s) that pertain to an individual project. System Design Engineer and/or Contractor shall complete the density and area data for each system or each hazard classification within the project. Contract documents shall identify the hazard classification of each area within project boundary, including minimum density (gpm/ft²), minimum operation area (ft²). Inside hose stream (gpm), outside hose stream (gpm) shall be included per NFPA-13. Domestic demand (gpm) shall be per actual site conditions:
1. Exposure protection system as calculated.
 2. Piping C factors for new, existing, aboveground, and underground shall be included in contract documents. NOTE: For existing piping older than five years, the C factor is not to exceed one hundred (100). The C factor shall be one hundred twenty (120) for new steel piping.
 3. Maximum Sprinkler Head Spacing for Light Hazard, Ordinary Hazard, and Extra Hazard occupancies shall be per NFPA-13.
 4. Special System Considerations:
 - a) System Zoning: zoning and sub-zoning shall be identified and indicated in contract documents.
 - b) Existing Equipment: When an existing system is being expanded, enough of the existing system shall be indicated on plans to make all conditions clear:
 - i) Sprinklers (make/model/etc.)
 - ii) Piping
 - iii) Valves (make/model/etc.)
 - iv) Mechanical Fittings (make/model/etc.)
 5. Municipal fire apparatus pumping capacity.
- E. When the domestic and fire suppression system water supplies are interconnected, the domestic demand (gpm) shall be added to the fire suppression system demand at the point of connection. Calculate domestic demand in accordance with applicable codes based on fixture units.
- F. When existing system equipment and components are installed in a multi-level building, the System Design Engineer shall modify existing system to ensure equipment and components are confined to each level.
- G. Existing system equipment and components, which may be reused, shall be within the scope of each project and shall comply with current codes and these standards:
1. The use of existing features and equipment may be considered. Systems Design Engineer shall conduct survey, prior to 100% documents, and determine and specify the extent to which the existing systems and devices shall be used.
 2. Before considering existing equipment or piping systems for use in the new project, all such equipment or system shall be tested/ inspected by the Fire Suppression Contractor to assure their operational integrity and current code compliance.
 - a) This shall include, as a minimum:
 - i. Sprinkler heads

- ii. Pipe Schedules
 - iii. Electrical Devices
 - iv. Specialty Valves
 - v. If the existing equipment is not compatible with the new equipment, the existing equipment shall be removed and new equipment installed.
3. New equipment shall be of the same manufacturer, make, and model as the existing, where specified in this section.
 4. Existing flow switches older than five (5) years of age shall be replaced. Existing flow switches that are less than five (5) years old shall be tested for proof of proper operation and compliance to current codes.
 5. Prior to the installation of any new backflow preventer, the existing water main shall be thoroughly flushed to prevent potential debris from damaging the new backflow preventer. Provide one (1) backflow repair kit resulting from damage created by potential debris after flushing the existing water main.
 6. The Contractor shall include in their respective bid/RFP a unit price for the replacement each existing piece of existing system equipment and component which includes, as a minimum:
 - a) Sprinkler heads
 - b) Sprinkler pipe
 - c) Electrical Devices
 - d) Specialty Valves
 - e) Alarm devices (including programming)
 - f) Graphic annunciator
 - g) Flow and tamper switches (including break away locks)
 - h) All building elements and/or devices that may require relocation. Refer to Part 0.01.F.

H. Fire Department Connections (FDC):

1. The location of the FDC shall be determined prior to submitting the bid. The FDC shall be located in a location that is acceptable to the AHJ, e.g. Denver Fire Department.
2. In buildings with an existing FDC, the Systems Design Engineer and/or Contractor shall NOT assume that the existing FDC is located in a location approved by the AHJ.
3. Provide drain facilities, piped to the outside of the building for Fire Department Connection piping; such drains shall be coordinated with DPS.

NOTE: System Design Engineer and/or Contractor shall determine and specify if drain shall discharge in an acceptable location inside the building. Such drain shall be sized to accept full flow of the system.

4. At system drains terminating at the exterior of the building, provide a 6'-0" long (minimum) concrete splash block. Splash block shall drain to a pervious surface.
5. Where more than one Fire Department Connection is used for the sprinkler system in a building, they shall be interconnected so that the entire sprinkler system is fed by each of the Fire Department Connections.

- Provide a horn/strobe at each FDC location.
6. Where more than one Fire Department Connection is used for the standpipe system or combination standpipe/sprinkler system in a building, they shall be interconnected so that the entire system is fed by each of the Fire Department Connections.
 7. Contractor shall provide a Knox box FDC caps key to and approved by AHJ. Must register with DFD for site location.
- I. The System Design Engineer and/or Contractor shall obtain existing water flow information from the AHJ to perform hydraulic calculations, includes but is not limited to:
1. The specifications shall require a water flow test by System Design Engineer and/or Contractor for installations that incorporate more than fifteen (15) sprinklers.
 2. Water flow testing shall follow industry standard process and shall be conducted in accordance with the AHJ and NFPA-13.
 3. The System Design Engineer and/or Contractor shall use the more conservative water supply tests results in hydraulic calculations.
 4. Flow velocity in underground water mains shall not exceed sixteen (16) feet per second. Velocity in aboveground sprinkler system piping shall not exceed twenty (20) feet per second.
 5. Water supply flow test(s) shall be conducted by the contractor and witnessed by DPS. Test(s) shall be conducted in strict accordance with AHJ. The City of Denver Fire and Building Inspection Department shall be invited to witness the test(s). Notify the City of Denver Water Department of the time and location of the test(s) prior to operating hydrants. Procedures specific to each project, including date and time, shall be submitted to DPS for approval two weeks prior to conducting tests.
 6. System Design Engineer and/or Contractor shall notify DPS which hydrants will be tested in consultation with the AHJ.
 7. The hydraulic calculations shall be calculated back to a looped water main and be based on the available water supply flow test results. In the case of dead-end type mains, calculations shall include piping to the point where the flow test is effective.
 8. The hydraulic calculations shall prove the hydraulically most remote and demanding areas of not less than 1,500 square feet to allow for flexibility in building use. Velocity pressure may be neglected in the hydraulic calculations. This may involve submitting auxiliary hydraulic calculations to prove that the most remote and demanding area was calculated.
 9. Hydraulic calculation submittals shall clearly define and annotate all devices which will cause friction loss with equivalent lengths of pipe. This includes vane-type electrical water flow switches (assume ten (10) feet of equivalent length of pipe).
 10. For hydraulic calculation purposes, the friction loss coefficient for existing piping over ten (10) years in age, the Hazen Williams design C values given in NFPA-13, shall be reduced by a factor of ten for pipes five years or more in service. This includes non-circulating water mains and above ground piping.
 11. Open sprinkler type exposure protection system demand shall be added to the automatic sprinkler demand.
 12. For systems (closed or open head type), incorporated as part of a rated construction of glazing assembly, the specific design criteria shall be proven through hydraulic calculations.
 13. Sprinkler heads to be quick response type with a k factor of 5.6 or 8.0.

- J. Fire Pumps (If required):
1. The need for a fire pump shall be determined by the System Design Engineer and/or Contractor, based on hydraulic calculations.
 2. When design calculations indicate that a fire pump is necessary, provide an electric fire pump to provide adequate pressure for the fire sprinkler system.
 3. The System Design Engineer and/or Contractor is responsible for providing associated Architectural and/or Engineering design services and construction costs associated with the installation of the fire pump which includes, but is not limited to:
 - a) Wall construction and fire-rated wall/ceiling assemblies
 - b) Room ventilation
 - c) Coordinate gas and electric service provider, e.g. Xcel Energy, regarding new utility requirements.
 - d) Requirements associated with the demolition of existing equipment that may be replaced such as diesel pumps; including removal of existing fuel tanks, removal of existing fuel, etc.
 - e) Applicable permit fees and service fees.
- K. Sprinkler systems protecting buildings classified as ordinary hazard shall not be connected to a 6-inch dead-end type supply main if the main also supplies a fire hydrant. The minimum size supply main shall be 8-inch for this situation (from the looped main to the hydrant).
- L. Each fire suppression system shall be monitored by the building fire alarm system. All buildings equipped with fire sprinkler systems shall be equipped with an exterior local alarm (horn and strobe) initiated by the flow detection device. Coordinate with DPS Design and Construction Standards:
1. Coordinate with the fire alarm system to determine the need for addressable modules.
 2. Fire maps: Coordinate fire map requirements with the fire alarm system and with requirements of the Denver Fire Department. Indicate fire protection zones on map.
- M. The fire sprinkler piping and heads shall not penetrate any Artwork (Paintings) and/or Murals on existing walls or ceilings, unless approved by DPS in writing.
- N. The System Design Engineer and/or Contractor shall design the system according to the latest requirements of the City and County of Denver. Denver Fire Department is the AHJ.
- O. The fire sprinkler piping shall be painted and shall be routed through classrooms on the corridor side. Avoid pipe routing through the corridor and stairwells. Any piping in the corridors, hallways, stairwells, auditoriums, and other spaces indicated by DPS shall be enclosed in a soffit as shall any other fire sprinkler piping located in any corridor.
- P. Exposed fire sprinklers and associated piping shall be located on the perimeter of all classrooms and all other rooms, except mechanical rooms. Exceptions shall be pre-approved by DPS in writing.
- Q. **Only Approved Term & Supply Fire Suppression Contractors are allowed to install the Fire Suppression System. Contact DPS Purchasing for a list of the Approved Term & Supply Fire Suppression Contractors.**
- R. For any work associated with the fire suppression system, the Fire Suppression Subcontractor shall be responsible for coordinating and forwarding all modifications (including but not limited to flow switches, tamper switches, pressure switches, fire pump, deluge system, etc.) to the Fire Alarm System Designer and/or Contractor to be added to the fire alarm system and graphic annunciator. All fire alarm system modifications

shall be completed by the Fire Alarm Contractor in accordance with DPS Design and Construction Standards and the AHJ.

- S. Anyone working on the fire sprinkler system must have a Denver Fire Sprinkler License issued by the Denver Fire Department for the current year. Conform to and follow the maximum apprentice ratio in accordance with the AHJ.
- T. If required, the System Design Engineer and/or Contractor shall include the complete design and installation of an electric Fire Pump, Jockey Pump, Compressor, and all associated components (verifying flow calculations with Fire Suppression System Designer and local water authority, e.g. Denver Water Department).

1.05 MISCELLANEOUS REQUIREMENTS

A. System Sub-Section Zoning:

- 1. Sub-section zoning shall be accomplished by providing individual zone water flow detection, zone control valve, zone drain, gauge, and inspectors test connection. Zone drains are to be piped to a common drain and/or to the exterior of the building. (Water Flow and Tamper Switches are to report to the Fire Alarm Control Panel {FACP} individually. Coordinate with DPS Fire Alarm Design and Construction Standards).
- 2. As required by NFPA-13 under protection area limitations. System Design Engineer and/or Contractor to minimize the number of sprinkler zones while meeting the above requirements and providing adequate zones to facilitate identification of the zone/area of the fire origin (i.e.: Basement – 1st Floor – 2nd Floor or Basement – East Wing – West wing).

B. Locations:

1. Classrooms, Office, Restrooms, Auditoriums, and Corridor Sprinklers:

- a) The fire sprinkler piping shall be routed through classrooms on the corridor side. Avoid pipe routing through the corridor. All exposed piping in the Auditorium, corridors, hallways, and stairwells shall be enclosed in a soffit as shall any other fire sprinkler piping located in any corridor.
- b) Fire sprinklers and associated piping shall be located on the perimeter of all classrooms. Exceptions must be pre-approved by DPS in writing prior to commencing with fabrication and/or construction.
- c) Contractor shall submit construction drawing details of soffits and/or pipe enclosures to DPS for review and approval prior to starting construction. Soffit/d pipe enclosure details shall be specific to the Project and address specific conditions encountered within the building.

2. Gymnasium Sprinklers: Locate all gymnasium requirements under 1 location.

- a) Sprinkler mains, branches and sprinkler heads are not to be located where they interfere with the climbing equipment. Locate a minimum of four (4) feet from climbing equipment including, but not limited to ropes, climbing walls, etc.
- b) Sprinkler mains, branches and sprinkler heads are not to be located where they interfere with retractable basketball hoops, nets, etc.

3. Stairway Sprinklers:

- a) Provide fire sprinkler coverage at each floor level.

C. Sprinkler Piping – Coring, Patching and Painting:

1. Coring and Patching:

- a) All work performed shall be of premium quality, all penetrations through walls, floors, and ceilings shall be performed with pilot holes with final size drilling to be performed from both sides of the walls, ceilings and floors in order to minimize "blowouts" from the drilling. For all required core drilling and Hammer Drilling, the Contractor shall not use water and must use vacuums with HEPA filters to eliminate/ minimize debris and dust while coring.
- b) Contractor shall be responsible for patching and repairs extending twelve inches (12") beyond the outside diameter of installed pipe, unused cores, and/or penetrations in walls, floors, and ceilings. This includes patching and repairs of all coring and drilling activities completed by Coring Contractor's, DPS Coring Contractor's, and/or Fire Suppression Contractor's. If the patching and repairs will be greater than the patching specified above, DPS must be notified prior to completing the patching and repairs.
- c) Patch any holes or surface damage to adjacent surfaces caused by Contractor work.
- d) Contractor shall utilize professional forces to accomplish all cutting, patching, and sealing of surfaces needing to be penetrated to complete Contractor work. Fire rated assemblies shall be fire safed/ caulked as required.
- e) Contractor to provide and install all necessary blocking/backing required for Contractor's work.
- f) Contractor shall hire professional finishers for all patching, tradespersons such as electricians or day laborers are not acceptable for performance of this work. The Contractor shall be granted a maximum of two (2) inspections for patching. Should the Contractor fail to complete patching to the satisfaction of the Owner after the second inspection, the Owner shall hire an independent Contractor to complete patching at the expense of the Contractor, such expense shall be with held from the final payment on this contract. **Fire caulk all penetrations through floors, walls, and ceilings.**
- g) Square off all wall/ceiling patches.

2. Painting:

- a) All painting shall be completed in accordance with DPS Design and Construction Standards:
 - i) Kitchen and Food Preparation areas: All exposed Piping shall be paint to provide cleanable surface for sanitary purposes, verify color with DPS.
 - ii) Corridor, Stairways and Hallways: Where applicable, all new soffits shall be painted to match existing wall colors.
 - iii) Classrooms and Offices: All exposed Piping shall be painted to match existing wall colors.
 - iv) All new soffits shall be painted to match existing wall color.
 - v) All exposed piping in mechanical rooms shall be painted red.
- b) Square off all painting of patches and cover the entire patch.
- c) Contractor shall hire professional painters for all painting, tradespersons such as electricians or day laborers are not acceptable for performance of this work.

1.06 SYSTEM DESIGN CONSIDERATIONS – PIPE SYSTEMS

A. Wet pipe systems:

- 1. Shall be used in the majority of system applications.
- 2. Auxiliary drains must be accessible and have signage.

B. Dry pipe systems:

1. For use in heated and unheated areas susceptible to freezing conditions such as attic or concealed areas.
2. System shall be monitored for low air pressure.
3. System air pressure shall be maintained by an automatic air compressor powered from a dedicated circuit supplied from the building emergency circuit, where available. If a building emergency circuit is not available, the Contractor must connect to an un-used lockable circuit-breaker(s). Provide a keyed disconnect switch for maintenance of the compressor.
4. All low point drains shall be accessible.

C. Antifreeze Systems:

1. All antifreeze systems shall have UL listed expansion tank.
2. Shall have a high point valve for venting.
3. Antifreeze systems shall not be installed unless specifically approved, in writing, by DPS.
4. If these systems are approved by DPS, they shall only be used for small incidental areas susceptible to freezing. Antifreeze systems shall be limited to a 40 gallon capacity maximum, and have an individual reducing pressure backflow preventer.
5. Only DowFrost (Propylene Glycol with inhibitor) antifreeze agent shall be used in antifreeze sprinkler systems.
6. Antifreeze systems shall be hydrostatically tested prior to introducing antifreeze solution into the system.
7. Antifreeze systems shall be no more than 40 gallon capacity.

D. Deluge Systems:

1. The deluge valve assembly, including the valve, trims packages and actuation system, shall be UL listed and approved by Factory Mutual, as a complete assembly.
2. Fire detection spacing for deluge systems shall be in accordance with NFPA 72 including applicable appendices. Coordinate with the fire alarm system.
3. Deluge valve actuation by electronic means shall be through an approved agent releasing panel supplied and installed by the Fire Alarm Contractor and must be UL listed and compatible with the building fire detection system. This includes but is not limited to detection, manual pull and releasing means for the deluge water curtain (protecting the proscenium opening).

E. Exposure Protection Systems:

1. The exposure sprinkler system shall have an independent supply from the vertical or main riser, prior to any other sectional controls, with a supervised control valve and distinctive flow detection.
2. Where needed, systems incorporating open sprinklers shall be controlled by the operation of detection devices designed for the specific application and supplied by the Fire Suppression Contractor.
3. If the systems incorporate dry pipe, deluge, or pre-action valves, the requirements for each type of system in applicable codes and these standards shall apply.

F. Elevator and Electrical Equipment:

1. The installation of sprinkler systems in elevator machine rooms and shafts shall be in compliance with or exceed the requirements of ANSI A117.1-2003, and/or the AHJ, and/or the most current edition and the Denver Building and Fire Code Amendments.
2. As required by AHJ, add elevator recall including necessary elevator modifications per latest Denver Codes. Upgrade the elevator to be capable of Phase II operation.

G. Protection For Mechanical Shafts:

1. Sprinklers shall be required in all shafts where the shaft construction or contents are combustible or where the shaft is accessible by personnel.

EXCEPTION: For shafts housing a single duct which occupies the entire area of the shaft, sprinklers are not required.

2. Where sprinklers are provided in shafts, they shall be accessible for inspection, maintenance, or repair and replacement.
3. Sprinkler heads shall be placed at the top of all shafts requiring protection. If the shafts have offsets, additional protection may be required as determined by the DSP Project Manager based on project and code requirements.
4. The coverage and spacing limitation from NFPA-13 shall be complied with.
5. Protection for shafts housing a hazardous exhaust system.

1.07 QUALITY ASSURANCE

- A. Design of fire suppression systems shall be performed by or under the direction and control of a designer with certifications approved by the AHJ.

B. System Design Engineer and/or Contractor qualifications:

1. System Design Engineer and/or Contractor shall have five (5) years minimum experience on projects equal to or greater in size to the subject project.
2. Shall have an established office within 100 miles of the District, which maintains a full complement of spare parts, tools and equipment for the specific project and type of system.
3. The entire fire suppression system project including design, calculation, installation, and testing, excluding prefabrication, shall be bid by a single source that has the capability to perform all of the work required under this section. No installation work shall be sub-contracted without prior permission from DPS.
4. Contractor shall have the capability of providing full service maintenance, testing and inspection program in accordance with NFPA standards and where applicable, be certified to perform these services.

- C. Code Compliance Products, General: Comply with local and state governing regulations, which require the products used for fire suppression work to be selected from lists in certain published latest editions of standards or codes as indicated therein.

- D. Manufacturer: Except for products required to comply with recognized product listings, provide fire suppression system products and accessories produced by a fire suppression manufacturer with not less than five (5) years experience in manufacturing similar products.

- E. Installer: A firm with at least three (3) years of successful installation experience on projects with fire

suppression piping work similar to that required for the project.

- F. NFPA Code: Comply with NFPA-13, entitled, "Standard for the Installation of Sprinkler Systems".
- G. NFPA Compliance: Comply with NFPA-14 entitled, "Standard for the Installation of Standpipe and Hose Systems".

Fire suppression pumps shall comply with applicable section of NFPA-20, entitled, "Standard for the Installation of Centrifugal Fire Pumps". Comply with requirements of UL's Standard for Safety No. 1478, entitled, "Fire Pump Relief Valves", and No. 448, "Pumps for Fire suppression Service".

- H. NFPA Code: Comply with NFPA-24, entitled, "Standard for Outside Protection", pertaining to hydrants.
- I. NFPA Code: Comply with NFPA-10, entitled, "Portable Fire Extinguishers", pertaining to portable extinguishers.
- J. Screw Thread Connections: Comply with NFPA-194, entitled, "Standard for Screw Threads and Gaskets for Fire Hose Connections", pertaining to standpipe threaded connections. Comply with local fire department marshal regulations for sizes, threading and arrangement of connections for Denver Fire Department equipment to standpipe systems.
- K. FM Compliance: Comply with Factory Mutual, "Approval Guide".
- L. FM Approval Marks: Provide units bearing FM approval marks.
- M. UL Labels: Provide units which have been approved and listed by Underwriters Laboratories.
- N. Requirements: Entire fire suppression system shall be designed, furnished, and installed in strict conformance to NFPA Chapter 13 and all related regulations and requirements:
 - 1. Sprinklers shall be provided for protection of all shafts serving a special hazard exhaust system.
 - a) EXCEPTION: Coverage is not required if the shaft is dedicated to special hazard exhaust system(s), the shaft is not accessible by personnel, is of fire resistive non-combustible construction, and duct work is completely non-combustible.
 - 2. Correspondence with the AHJ shall be in writing, distributed to DPS and maintained with the project records.
 - 3. For special hazard exhaust systems, such as paint spray operations or cooking exhaust, refer to the appropriate NFPA Standards for the design of sprinkler protection.

1.08 SUBMITTALS

A. General Requirements:

- 1. All submittals shall comply with DPS Design and Construction Standards.
- 2. The Owner reserves the right to charge the Fire Suppression Contractor for multiple reviews by DPS if more than two (2) submittals (either for shop drawings or record drawings) are made by the Fire suppression Contractor. The Owner reserves the right to charge the Contractor for multiple reviews of the same submittal (or of a rejected submittal) if more than two (2) submittals are made by the Contractor.
- 3. Initial submission shall be no later than thirty (30) days after the Notice to Proceed. Before work commences, the Contractor shall provide DPS and the DPS fire suppression technician with copies of all shop drawings and in progress changes to those drawings.

4. Equipment submittals shall contain annotated descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Catalog cut sheets shall be submitted in a suitable folder or binder and indexed referencing the applicable specification sections. Unclear or partial reproductions of manufacturer's original catalog cuts or descriptive data shall not be accepted. Each item supplied shall be clearly identified on each sheet. Where the submittal material describes items, in addition to the items being submitted, the additional items shall be crossed out and the submittal item shall be identified.
5. Submit proof of compatibility for equipment components required to be approved as a system.
6. The System Design Engineer and/or Contractor shall acquire all necessary drawings from DPS Space Management Office to develop complete submittals.
7. The Systems Design Engineer and/or Contractor shall provide full submittals, including hydraulic calculations, product data, riser diagrams, designer certification, installer qualifications, employee certifications, test certificates, and shop drawings. Partial and incomplete submittals shall not be acceptable.
8. Review by DPS shall not relieve the System Design Engineer and/or Contractor from full compliance with requirements of the contract documents, codes, and standards.
9. The System Design Engineer and/or Contractor shall field verify all existing conditions:
 - a) Note: Electronic documents provided by DPS are obtained from reliable sources. Although it is deemed to be valid, neither the Facility Management Department nor any other school department or official can warrant the accuracy of the material. System Design Engineer and/or Contractor are required to field verify all existing conditions and information.
 - b) Should any discrepancies arise, DPS shall be notified in writing before or during the bid period.

B. Shop Drawings:

1. Submit detailed shop drawings including a riser diagram, hydraulic calculations, equipment data sheet submittals, and employee certification in accordance with NFPA-13.
2. Submit anchoring details and calculations in accordance with DPS Design & Construction Standards.
3. Drawings shall be minimum size of 24"x36" and a maximum size of 30"x42", with a minimum scale of 1/8"=1'0". Shop drawings, hydraulic calculations, and equipment data sheets shall be submitted for review.
4. Drawings shall include a site plan, floor plan/layout drawings, riser diagram(s) and hydraulic calculations based upon the general arrangement drawings provided and other drawings that may be available from the Owner. Drawings shall include column line designations where provided on the contract documents. The site plan drawing shall clearly indicate the required water supply information from NFPA-13.
5. Drawings shall be in strict compliance with NFPA-13 and drawn in a Computer Aided Drafting (CAD) to a commercial or architectural/engineering drawing standard and in Auto CAD 2007 unless waived in writing by DPS.
6. An up-dated set of shop drawings approved by DPS that incorporates all field changes shall be maintained at the job site, in good condition, from the start of construction until all inspections are completed.

C. Product Data:

1. Annotated descriptive data to show the specific model, type and size of each item the System Design Engineer and/or Contractor proposes to furnish.
2. Catalog cut sheets shall be submitted in a suitable folder or binder, and indexed.

3. Unclear or partial reproductions of manufacturer's original catalog cuts or descriptive data will not be accepted.
4. Each item proposed to be supplied for the project shall be clearly identified.
5. Where the submittal material describes other items, in addition to the items being submitted for the project, the items that are not proposed for the project shall be crossed out and the proposed item shall be identified.

D. Test And Inspection Matrix:

1. The Contractor shall be responsible for submitting a testing and inspection matrix prior to beginning construction.
2. The matrix shall include, at a minimum:
 - a) All required tests per DPS Design and Construction Standards, especially those included in the This Standard.
 - b) All required tests and inspections by the AHJ, i.e. Building Department, Fire Department, etc.
 - c) Parties responsible for attending each test/inspection
 - d) Dates of test/inspection
 - e) Date of notification and parties that will be notified of test/inspection, five (5) business days prior to date of test/inspection

E. Record Drawings:

1. The Contractor shall submit two (2) sets of record drawings (same paper size as Shop Drawings) to DPS for review and approval. After review and approval, submit the final as-built Drawings in accordance with DPS Design and Construction Standards. The as-built drawings shall include all the information required under shop drawings and the following:
 - a) The drawings shall show the system as installed, including all deviations from the approved shop drawings.
 - b) When a fire suppression system employs electronic fire detection and alarm devices to activate system, detailed fire suppression and alarm as-built drawings, complying with DPS Design and Construction Standards shall accompany the fire suppression as-built drawing submittal by the appropriate Contractor.
 - c) Dependent upon the extent of filed changes required to the original approved shop drawings submitted to the AHJ, DPS reserves the right to require a supplemental set of hydraulic calculations, at no additional cost to the Owner, to verify the adequacy of the system in the as-built condition.
 - d) Submittal of preliminary record drawings shall follow the job schedule and shall be submitted ten (10) days prior to Substantial Completion. The final record drawings must be submitted prior to Final Completion date.
 - e) Drawings shall readily reflect all Auxiliary drain locations.

F. Test Certificates:

1. Test certificate(s) showing that pneumatic, hydrostatic, and final tests were conducted in accordance with the applicable NFPA standards, shall be submitted to the AHJ and DPS.

G. Operating And Maintenance Manual:

1. The Contractor shall submit two (2) preliminary O&M Manuals to DPS for review and approval ten (10) days prior to the contract Substantial Completion date. After review and approval, submit the final O&M Manuals in accordance with DPS Design and Construction Standards.
2. Final manual shall be approved by DPS prior to conducting training session.
3. Final manual shall contain a complete training session outline (agenda). Including but not limited to DPS sprinkler maintenance personnel.
4. Final manual shall include all system test certificates.

1.09 QUALIFICATIONS

A. General Requirements:

1. All variance requests and AHJ responses shall be in writing.
2. The system design and installation shall conform to these standards. When variances are granted by the AHJ, they will be documented in writing by the AHJ and a copy shall be maintained in all project files and at the job site.
3. The Contractor shall be ultimately responsible to guarantee the system against freezing for reasons other than that of the building Owner's negligence.
4. Systems shall be designed in strict accordance with applicable codes and standards, the manufacturer's recommended practice, and the requirements from the AHJ.

B. Contractor's Designer Qualifications:

1. The design of the fire suppression systems shall be performed by or under the direction and control of a Colorado registered P.E. designer or certification NICET III or higher. Said professional shall be experienced in fire suppression, thoroughly familiar with and experienced in this type of installation.
2. The Owner's representative and DPS reserve the right to request proof of qualifications.
3. Design related work shall NOT be subcontracted unless pre-approved by DPS in writing.

C. Installer/Contractor Qualifications:

1. Contractor shall have five (5) years minimum experience on projects equal to or greater in size to the subject project. DPS shall verify the qualifications of the Contractor.
2. The entire fire suppression system project including design, calculation, and installation and testing, excluding prefabrication shall be bid by a single firm which has the capabilities to perform all of the work required under this standard. No installation work shall be sub-contracted without prior permission in writing for DPS.
3. Shall be registered for the design and installation for fire suppression systems in the AHJ.
4. Shall have the capability of providing a full service maintenance, testing, and inspection program in accordance with NFPA standards and, where applicable, be certified to perform these services.

D. Installation Qualifications:

1. Welders shall comply with the requirements of AWS D10.9, “Specifications of Qualifications of Welding Procedures and Welders for Piping and Tubing Level AR-3”:
 - a) Anyone welding within the school building must obtain a “Hot Work Permit” from Denver Fire Department prior to any work.
2. Job foremen shall be trained for the installation and operation of each type of system and possess documentation of qualifications and training. Job foremen shall have a minimum of three (3) years of successful installation experience on projects with fire suppression systems similar in scope and nature to that required for the project.

1.10 WARRANTY

- A. All workmanship and materials shall be warranted in accordance with DPS Design and Construction Standards.

1.11 EMERGENCY SERVICES

- A. During the installation and warranty period, the Contractor shall provide emergency repair service for the sprinkler system within four (4) hours of a request by the District
- B. Service shall be available twenty-four (24) hours per day, seven (7) days per week.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

- A. Equipment used shall bear the UL listing and FM approval for the use intended and be permitted by applicable referenced standards. See the following list of preferred manufacturers from DPS Facilities Management. Also refer to Specification DPS Design and Construction Standards 15100 Valves for Acceptable Manufacturers.
- B. Incidental items, which are essential, but which may not be described by this specification, shall also be provided and installed in the commercial/industry standard or better method and quality.

2.02 MATERIALS

- A. General Piping:
 1. All piping shall be USA manufactured Schedule 10 steel piping for 2-inch and larger, and Schedule 40 steel for all piping 1-1/2-inch and smaller.
 2. Pipe joining: Fittings shall comply with NFPA-13 requirements. Grooved couplings, fittings, and gaskets used throughout a system shall be supplied from the same manufacturer and be designed for the specific installation.
 3. Threaded fittings are preferred in architecturally exposed or sensitive areas.
 4. Design, hydraulic data, and fabrication documentation shall be submitted on the use of segmentally welded fitting.
 5. Threaded and roll grooved pipes are subject to the limitations of NFPA-13.
 - a) Exclude cut grooved pipes
 6. In all cases, face bushings shall not be permitted. Except where specifically approved by DPS, hexagonal bushings shall not be permitted. Hexagonal bushings shall not be used where a reducing fitting is normally available.

7. The use of toggle bolts for suspension shall not be permitted. All piping shall be substantially supported from the building structure.
8. CPVC piping is NOT permitted.

B. Steel Piping And Fittings:

1. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where applicable and with factory- or field-formed threaded ends:
 - a) Cast-Iron Threaded fittings: ASME 16.1, Class 125.
 - b) 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. Include ends matching joining method.
 - c) Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe.
2. Grooved-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized and with factory- or field-formed, roll-grooved ends:
 - a) Grooved-Joint piping systems:
 - i) Grooved-End Fittings: UL-listed, ASTM A 536, ductile iron casting with OD matching steel-pipe OD.
 - ii) Grooved-End 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, greaseless rubber gasket listed for use with housing, and steel bolts and nuts.
3. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 2 ½ to NPS 5; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory-or field-formed, roll-grooved ends.
 - a) Grooved-Joint piping systems:
 - i) Grooved-End Fittings: UL-listed, ASTM A 536, ductile iron casting with OD matching steel-pipe OD.
 - ii) Grooved-End 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, pre-lubricated rubber gasket listed for use with housing, and steel bolts and nuts.
4. Other steel pipes from domestic manufacturers are not acceptable alternates to Schedule 10 and 40 pipes.
5. Schedule 5 included in Schedule 8 pipe shall not be allowed.
6. The Corrosion Resistance Ratio of all pipes shall be 1.00 or greater. Documentation shall be presented with product submittal.

C. Valves

1. General Requirements:
 - a) Refer to DPS Design and Construction Standards Section for Valves.
 - b) Suitable for a minimum of one hundred seventy-five (175) psi working pressure, unless the project

requirements demand higher pressures, i.e., fifty (50) psi above the anticipated system pressure.

- c) Riser and sectional control valves: Indicating types sized to match the supply pipe and approved for use in automatic sprinkler and standpipe systems.
 - d) Control valves: Provide with adequate means for mounting an electrical supervisory contact switch, which shall be specified in this section.
2. Check Valves:
- a) 1-1/2" and smaller: all bronze with screwed ends.
 - b) 2" and larger: iron or brass body
3. Miscellaneous Valves:
- a) Ball drip valves: brass with 1/2" NPT rated for one hundred seventy-five (175) psi or higher where necessary.
 - b) Inspector's test valves: Minimum 1" brass ball valves.
 - c) Approved combination test/drain valves may be installed.
 - d) The valves used for the gauge assemblies shall be 1/4" globe or angle 3-way valves, with a working pressure of not less than one hundred seventy-five (175) psi. They shall have a screwed bonnet and renewable composition disc.

D. Gauges

1. Water Pressure:
- a) Brass bourdon tube with 3-1/2" diameter case rated for three hundred (300) psi water pressure.
 - b) Gauge dial: from zero to three hundred (0-300) psi in five (5) pound increments.
 - c) Equip gauges with a 1/4" stem with a 1/4" shut-off valve.
2. Air Pressure:
- a) Brass bourdon tube with 3-1/2" diameter case rated for two hundred fifty (250) psi air pressure.
 - b) Gauge dial: from zero to one hundred (0-100) psi in one (1) psi increments.
 - c) Equipped gauges with a 1/4" stem with a 1/4" shut-off valve.

E. Fire Department Connections:

- 1. The System Design Engineer shall coordinate the location of all new Fire Department Connections with the AHJ and DPS.
- 2. New Fire Department Connections: Double 2-1/2" Siamese connection with (NH) threads, compatible with Denver Fire Department threads.
- 3. Single 2-1/2", with NH threads; Fire Department Connections may be used/reused if the riser is less than 3"
- 4. Labels and signs shall be provided per NFPA-13 and 14. See section 3.02-H.

F. Miscellaneous Valves:

1. Swing Check Valve: Provide iron swing check valves, one hundred seventy five (175) lb. rated working pressure, of size and end type indicated.
2. Automatic Drain Device: Cast brass angle or straight connection, male connection both ends. Seals automatically under pressure.

G. Backflow Preventers:

1. Mainline valve bodies and covers shall be manufactured of ductile iron ASTM A536, Grade 65-45-12 and shall be designed to withstand a 10-1 safety factor over rated MWWP.
2. Ductile iron bodies shall be flanged ANSI B16.1, Class 125, epoxy coated internally 10-20 mils and prime coated externally.
3. Head losses through the assembly shall not exceed eight (8) psi (4" through 8") and ten (10) psi (10") at velocities from zero to and including seven and one half (7.5) FPS. Flow curves shall be documented by independent laboratory testing.
4. The by-pass meter assembly shall consist primarily of a bronze water meter in series with a bronze double check valve. The meter shall be the total registration type with accurate registration between one and twenty (1 and 20) GPM flow rates. The by-pass double check shall consist of independent modular center stem guided check assemblies with guiding surfaces located in the threaded-on-body bronze caps. The by-pass double check shut-off valves and test-cocks shall be resilient seated ball valves with full flow characteristics. The static pressure drop across the by-pass double check assembly shall be approximately two (2) psi less than the mainline check valves to assure proper operation.
5. Mainline shut-off valves shall be resilient wedge, OS&Y, UL/FM for fireline service and are considered integral to the assembly along with full port ball valve test-cocks. Assemblies must be factory assembled and backflow tested. Double check detector assemblies shall be rated one hundred seventy five (175) psi MWWP (32°F - 140°F), factory assembled and tested to assure proper mainline/by-pass balance and crossover performance.

H. Fire Horn And Strobe:

1. Fire Horn and Strobe: Provide per AHJ and current DPS Fire Alarm Standards.
 - a) Mount above each Fire Department Connection at a height of ten feet (10') to fifteen feet (15') above adjacent grade

I. Hangers And Supports:

1. Provide pipe hangers of the design required for the specific installation and location.
2. Install retaining clips/clamps in locations where vibration may be a concern.
3. The use of toggle bolts for suspension shall not be permitted.
4. Piping shall be suspended from structural members only. No piping is to be supported from floor or roof slab construction.
5. In exposed areas, cut ends of hangers/supports shall be protected with end caps.
6. In finished ceiling areas, provide plastic buttons/escutcheons where pipe hanger penetrates finished ceiling.
7. No powder-actuated supports.

J. Automatic Sprinklers:

1. Orifice size: ½” diameter. The same model, manufacturer and orifice size shall be used throughout the project. Other orifice sizes are acceptable when so determined and specified by the System Design Engineer and/or Contractor.
2. Sprinkler Heads:
 - a) Temperature rating classification: Ordinary, unless required otherwise, based on ambient conditions.
 - b) Heads in ceilings in finished spaces shall be flush mounted “concealed” style (not “recessed” or “exposed” style).
 - c) Heads in Corridor and Hallways shall be flush mount “concealed” style (not “recessed” or “exposed” style), unless approved by DPS.
 - d) Quick response sprinklers shall be utilized for all heads where allowed by NFPA-13 and suitable for the specific project. (k factor of 5.6 or 8.0 and/or AHJ).
 - e) Provide concealed heads for all rooms in School provided with lay-in type ceilings.
 - f) In all finished ceilings with acoustical ceiling tiles, the fire sprinkler heads shall be located in the center of the ceiling tile. In 2-foot x 4-foot acoustical ceiling tiles, quarter-points are acceptable.
 - g) Whenever possible in areas where the pipe is exposed, such as in classrooms, and installed at the perimeter of the room, consider the use of extended coverage sidewall heads to minimize the use of branch piping through the center of the room.
 - h) Provide dry sidewall heads for all Loading Docks, canopies, or areas requiring freeze-proof heads.
 - i) Provide upright or pendant heads for all unfinished areas.
 - j) Corrosive atmospheres: coated to prevent deterioration.
 - k) Other areas (non-finished): brass finish, ordinary temperature rating.
 - l) Mechanical rooms/attics: brass finish, intermediate temperature rating.
 - m) Localized areas with potential for freezing: dry pendant or dry sidewall sprinklers.
 - n) Use of flexible pipe drops at sprinkler heads is prohibited.
 - o) Fire sprinkler basis-of-design models included below are for reference. Similar models by approved manufacturers may also be acceptable. All sprinkler types may not be represented below, and all sprinklers must meet the guidelines of the DPS Design and Construction Standards:
 - i) Concealed sprinkler – Reliable G4A
 - ii) Concealed extended coverage sprinkler – Reliable G4 XLO QREC/EC
 - iii) Concealed horizontal sidewall sprinkler – Viking VK408 without conical cover adaptor
3. Metal Cabinet and spare sprinklers. Spare sprinklers, spare escussions, and wrenches located where the temperature will not exceed 100°F. The number of spare sprinklers shall be based on the requirements of NFPA-13; all interpretations will be by the AHJ. Location to be approved by the AHJ.

4. Sprinklers subject to damage in all areas / rooms / closets, other than the classrooms, shall be provided with guards. Classrooms having sprinklers below 10'-0" shall be provided with guards unless requirement waived by DPS.
 - a) Gymnasiums shall be provided with guards.

K. Drain And Test Lines;

1. The 2" main drain, sub-system drains, and inspector's test connection drains shall be provided with the appropriate size valve per applicable NFPA standards or manufacturer's recommendation. Drain line shall be extended to outside of building to a pervious surface.
2. Some schools have existing systems with 2" main drain located in the basement below grade and terminated by a floor drain; the 2" main drain must be revised and extended outside of building to a pervious surface.
3. Provide a concrete splash block at exterior drain terminations and drain to a pervious surface. Refer to additional requirements in this Standard.
4. A minimum 2" main drain for the entire system.

L. Electrical Equipment (Must Be Compatible With The Fire Alarm System):

1. Provide modules for flow and tamper switches. Include all necessary zones for the new fire sprinkler system:
 - a) If the building currently has a partial sprinkler system, provide modules for the existing system, the flow and tamper switches for each floor, and modules for the main flow and tamper switches.
 - b) Connect all flow and tamper switches to the fire alarm system.
2. Supervisory Switches:
 - a) Compatible with the type of valve used, activated by turning the valve actuator.
 - b) Shall have automatic reset capabilities.
 - c) Capable of being wired in normally open/closed position.
 - d) Cover shall have tamper resistant screws.
 - e) Minimum contact ratings:
 - i) 10 A @ 125 VAC
 - ii) 0.25 A @ 24 VDC
 - f) Tamper Supervisory switches shall initiate a distinct supervisory signal at the Fire Alarm Control Panel (FACP) by zone and/or sub-zone.
3. Automatic Water Flow Detectors:
 - a) Electronic vane type or pressure activated.
 - b) Compatible with the type of pipe and equipment used.
 - c) Built-in retard device, field adjustable from zero to seventy (0-70) seconds. Set for a time delay of thirty (30) seconds. Exception: pressure switches.

- d) Automatic self reset capabilities.
- e) Capable of being wired in normally open position.
- f) Tamper proof.
- g) Minimum contact ratings:
 - i) 5 @ 125 VAC
 - ii) 0.235 A Q 24 VDC
- h) All parts in contact with water shall be corrosion resistant.
- i) Shall initiate a distinct water flow alarm signal at the Fire Alarm Control Panel (FACP) by zone and/or sub-zone.

PART 3 EXECUTION

3.01 PREPARATION:

- A. Any system piping or components which are installed, purchased, or fabricated prior to the Contractor receiving a set of approved shop drawings shall be the responsibility of the Contractor.
- B. System installation shall not commence until the Contractor has obtained required approval of shop drawings.
- C. Contract drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.
- D. Contract drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. The most restrictive requirements shall be applied.
- E. Contract drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for those purposes, or have to be made from field measurements, Contractor shall take necessary measurements and prepare the drawings.
- F. Before any work is installed, determine that equipment will properly fit the space that required piping grades can be maintained without interferences between systems, with structural elements, or with the work of other trades.
- G. Coordinate the installation of fire suppression materials and equipment above and below ceilings with suspension system, light fixtures, and other building components:
 - 1. Coordinate ceiling space carefully with all trades. In the event of conflict, install fire suppression and electric systems within the cavity space allocation in the following order:
 - a) Fire sprinkler mains and cross-mains.
 - b) Electrical conduit.
 - c) Fire sprinkler branch line piping.
- H. Verify all dimensions by field measurements.
- I. Arrange for chases, slots, and openings in other building components to allow for the fire suppression installations.

- J. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the work.
- K. Coordinate the cutting and patching of building components to accommodate the installation of fire suppression equipment and materials.
- L. Where mounting heights are not detailed or dimensioned, install overhead fire suppression services and equipment to provide the maximum headroom possible. Notify System Design Engineer and/or Contractor and DPS of any conditions where headroom of less than 7' - 4" will result.
- M. Install fire suppression equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnection and to allow minimum interference with other installations.
- N. Coordinate connection of fire suppression systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

3.02 INSTALLATION OF COMPONENTS

A. General:

1. The Contractor shall be responsible during the design, installation, testing, and guarantee periods for any damage caused by Contractor s or by defective work, materials, or equipment.
2. Any damages resulting from the failure of any new system components shall be repaired at no cost to the Owner.
3. System shall be installed in a workmanlike manner.
4. Prior to completing building tie-in, the following must be completed:
 - a) Existing supply lines shall be thoroughly flushed to remove potential sediment and debris.
 - b) Inspect existing piping for cracking, damage, and remove corrosion from existing piping.
5. Contractors shall include all construction permits and fees (including inspection fees).
6. Contractor shall include all fees to expedite City, State and Fire Department plan reviews to meet the final completion date.
7. Contractor shall include in his proposal all "Fire Watch" costs borne by the Contractor, DPS, and AHJ as a result of this project.
8. System Design Engineer and/or Contractor shall comply with all Confined Space areas using the proper safety equipment required by the AHJ, DPS, and OSHA standards.
9. Contractor shall include cleanup (removing existing corrosion) and repair and/or replacement of existing Fire Service and existing fire suppression piping within the building footprint.
10. If applicable, System Design Engineer and/or Contractor shall NOT modify the existing Deluge System without consulting the Denver Fire Department and DPS. Where the existing deluge system employs manual valves, the Contractor must replace manual valves with automated deluge valves per DPS Design & Construction Standards.
11. Contractor shall keep their work area clean and dispose of construction debris, as required, on a DAILY basis, in order to facilitate a safe and efficient construction operation. Contractor shall provide dumpsters for Contractor use; DPS dumpsters shall not be used.

12. For all required core and hammer drilling, Contractors are not allowed to use water and must use vacuums with HEPA filters to eliminate/ minimize debris and dust while coring. The Owner reserves the right to fine/charge a fee to the contractor for cleaning services not performed by Contractor.
13. Contractor shall include final cleaning of all disturbed areas within the building.
14. Patch any holes or surface damage to adjacent surfaces caused by contractors work shall be repaired in accordance with the DPS Design and Construction Standards. Paint all patches shall match existing colors according to DPS Design and Construction Standards.
15. Contractor shall utilize professional forces to accomplish all painting, cutting, patching and sealing of all surfaces needing to be penetrated to complete Contractor work. Fire rated assemblies shall be fire safed/caulked as required.
16. Contractor to provide and install all necessary blocking/backing required for Contractor's work.
17. Contractor to clean adjacent surfaces as necessary to receive Contractor's work.
18. The System Design Engineer and Contractor shall include the design and all necessary components for the complete installation and tie-in of the existing Elevator(s) and/or Dumbwaiter(s). If the existing building is missing or does not have a code compliant Shunt Trip(s) for the Elevator(s) and/or Dumbwaiter(s); the Contractor shall be responsible for all necessary components (including electrical equipment, and tie-ins to a dedicated electrical circuit) for the complete installation of the required Shunt Trip(s), which meet or exceed current codes established by the AHJ and Denver Fire Department:
 - a) If the existing building elevator(s) is missing or does not have recall functions and/or Fire Hat Operation in accordance with the AHJ and Denver Fire Department; the Contractor shall be responsible for all necessary components (including electrical equipment, elevator equipment and circuitry upgrades) for the complete upgrade of the elevator in accordance with the AHJ and Denver Fire Department.
19. Where applicable, the existing fire suppression system served by the domestic water service shall be disconnected from the domestic water service. The Contractor shall repair domestic water service piping, etc and work shall be performed by licensed plumbing contractor.

B. Piping Requirements:

1. In dry-pipe systems and pre-action systems, all piping shall be sloped to facilitate drainage toward the point of the supply. All trapped sections of piping in both dry and wet systems shall be equipped with auxiliary drains located at a readily accessible point.
2. Piping shall be cleaned and kept clean and free of foreign matter before and during erection, including careful removal of dirt, scale, welding icicle or beads, cutting, burrs, and similar items
3. Install unions in pipe 2" or smaller adjacent to each valve:
 - a) Unions are not necessary on flanged devices or in piping installations using grooved mechanical couplings.
4. Pipelines with screwed fittings shall be made up with as few joints as possible:
 - a) Screwed joints shall have clean machine-cut threads and shall be made up with a piping compound or Teflon pipe thread tape. The threads for opened joints shall be cleaned and new piping compound or Teflon pipe thread tape applied before remaking the joint.
5. Flange bolts shall be evenly tightened with wrenches only:

- a) Flanged joints that have been made up and broken shall be made with new, unused gaskets, supplied with no cost added to the contract amount.
6. The end of each cross main shall be equipped with a minimum of 1-1/4" threaded/capped connections in order to facilitate flushing. See NFPA-13 for complete requirements
7. In cases where pipe sections are cut and removed on the job site for the installation of sprinklers, branch lines, cross mains, etc., the circular pipe sections shall be removed from the pipe and available for inspection at the time of hydrostatic testing.
8. Pipe outlets shall be reamed to remove burrs and sharp edges as required in NFPA-13 and UPC, i.e., remove burrs to the full interior diameter of the pipe.
9. The system riser shall not be attached to the supply connection until the underground piping is flushed, tested, and accepted by DPS. The two (2) week notice requirements and rescheduling conditions, as stated in these Specifications, is applicable.
10. Attachment of hangers and supports:
 - a) Hangers shall be attached to the supporting structure by means of approved beam clamps, mounting plates, brackets, clips, bolts, or concrete anchors. The use of toggle bolts is not permitted.
 - b) Drilling, cutting or burning of, or welding to structural members, for attachment of hangers and supports shall be subject to prior approval by DPS.
 - c) Hanger components shall be installed straight and true.
 - d) **Wall assemblies shall not be considered as an acceptable replacement for hangers.**
11. Piping shall be concealed to the maximum extent practical.

NOTE: Systems Design Engineer to discuss with the Owner's representative and determine the locations where the piping may be exposed Contract documents shall give clear directions to the Contractor.
12. Field changes in the piping layout or pipe sizes shall not be made without the prior approval of DPS.
13. Pipe penetrations through walls and ceilings shall have escutcheons at penetration of wall/ceiling surface. The annular space between the pipe and wall shall be filled with fire caulk and sealed.
14. Pipe penetrations through floors shall have the annular space between the pipe(s) and floor filled with fire caulk and sealed.

C. Valve Requirements:

1. Riser Control Valve:
 - a) Rooms or enclosures housing sprinkler system control valves shall be equipped with adequate heating, lighting, and adequate clearance.
 - b) System control valves shall be made accessible and operable from the floor, unless otherwise determined by the System Design Engineer and/or Contractor, and agreed upon by DPS in writing.
2. Drain and Test Valves:
 - a) NOTE: All main drains shall be discharge to the building exterior through a properly sized drained riser. System Design Engineer and/or Contractor to determine and specify means and routing of drain

discharge. The drain discharge shall be in a proper location inside the building, System Design Engineer and/or Contractor will identify the location of drain discharge and indicate on drawings.

- b) If the fire suppression piping is located at a lower elevation than the adjoining building grade, an outside drain installed to conduct main drain tests and a system auxiliary drain piped to a floor drain is desirable. An extra valve installed on the system drain piping may be necessary in order to isolate the system drain during testing of the main drain.
- c) Auxiliary drains and valves shall be provided as required by NFPA-13.
- d) Sight glasses shall be provided on all inspectors' test connections where discharge cannot be seen while valves are operated.
- e) The inspector's test connection, where required, shall terminate at a forty-five (45) degree elbow with a sprinkler which has the frame and strut assembly removed; other restricted orifices listed for the same purpose are acceptable. These shall be piped to the building exterior at grade level. If installed on the building interior, it shall include a restricting orifice and discharge to the exterior of the building. The orifice size shall be the same as the smallest sprinkler installed on the system.
- f) All drains located inside the building shall be piped to the outside of the building at a point free from causing water damage, terminating with a forty-five (45) degree elbow. This includes the drain for the Fire Department Connections piping. (Exception: Auxiliary drains).
- g) Contractor shall supply and install a concrete splash block with a minimum length of 6'-0" to direct the drain to a pervious surface, unless otherwise approved by DPS.
- h) All shutoff, drain, and test valves, which are placed in concealed spaces, shall have the standard sign affixed in a visible location; See Section 3.02-H. For example, if a valve is located above a ceiling, a sign indicating the location and type of valve shall be located on the wall immediately below the ceiling.
- i) Drain valves shall be made accessible and operable from floor, unless otherwise proposed by the System Design Engineer and/or Contractor and accepted by DPS in writing.

D. Gauges:

- 1. Minimum of two (2) water pressure gauges shall be installed on the system riser; one (1) on the supply side and one (1) on the system side of the main control and backflow check valves.

E. Sprinklers:

- 1. Installations shall be in accordance with sprinkler listing and manufacturer's recommended practices.
- 2. Coordinate sprinkler piping and head installations with mechanical, electrical fixtures other components, and building structural elements.
- 3. Maintain the maximum height possible. Sprinkler heads installed below 7'-4" requires permission from DPS.
- 4. Replace sprinklers that are damaged or coated during the construction process by paint, sprayed fire proofing, or similar material.

F. Backflow Preventers:

- 1. Install backflow preventers of the same size as the line sizes in which installed.
- 2. Install according to applicable regulations, minimum 30 inches and maximum 60 inches above finished floor and minimum of 18 inches away from any wall.

G. Fire Department Connections:

1. Siamese connections serving the same building shall be interconnected so that each one charges all systems.
2. Fire Department Connections shall be located as required per NFPA-13, UFC, and AHJ.

H. Electrical Equipment:

NOTE: System Design Engineer and/or Contractor to coordinate with work in Division 16:

1. Tamper switch signals shall initiate a unique supervisory alarm signal at the building FACP.
2. Other system supervisory signals shall provide unique indications of system supervisory status.
3. An exterior electric horn with flashing strobe assembly shall be installed for each system at a minimum height of 10' or maximum 15' above adjacent grade, above the Fire Department Connection serving the sprinkler system; coordinate with Division 16.
4. If an existing exterior warning signal exists, replace with a new device.
5. Graphic Annunciator:
 - a) Systems shall have a back lit (LED point graphic) annunciation panel at the main entrance/fire department point of response.
 - b) Coordinate with the fire alarm system to determine the need for addressable modules.
 - c) Each alarm and supervisory device shall be annunciated in the following way:
 - i) Each alarm and supervisory initiating device shall be identified by a symbol and illuminated. The graphic representation of the building shall be divided into logical zones as described in DPS Design and Construction Standards above and as required by the AHJ. Each device shall light when that device is in alarm. A LEGEND shall be provided for each type of device used.
 - d) Provide additional graphic zone maps in multilevel buildings. The additional zone maps shall be located on the other levels from where the main zone map is located. These zone maps shall represent only the level on which they are located.
 - e) The annunciator shall be located at the first responder point of entry into the building in a location approved by the AHJ and DPS.
 - f) An additional LCD annunciator and map shall be provided in the maintenance office.

I. Identification Signs:

1. Signs shall be permanently marked and constructed of weatherproof metal or rigid plastic.
2. Signs shall be secured to a device or the building wall with substantial and corrosion-resistant chains or fasteners.
3. Where sprinkler or standpipe control valves, test locations, or dry-pipe auxiliary drains are located in a room, above the ceiling or in a concealed space, the location of the valve shall be indicated by as 2"x 6" sign. Signs shall be located as follows:
 - a) If a valve is located inside a room, a sign shall be placed above the door, tight to the doorjamb, directly above the door handle. Similar signs are required on all intermediate doors within rooms.
 - b) If a valve is located above the ceiling, a sign shall be placed directly under the access panel or proper

ceiling tile to access valve. Sign shall be tight to ceiling.

- c) In other locations, DPS shall be contacted for specific direction of sign placement.
 4. Signs used to identify the location of fire hose valves in a closet shall be a minimum of 1'x 2' and have letters with a 2" height and ¼" stroke.
 5. Where water supply fire pump is provided, a sign shall be located near the pump indicating the minimum pressure and flow required at the pump discharge flange to meet the system demands.
 6. Valves:
 - a) All control, drain, and test connection valves shall be identified in accordance with NFPA-13.
 - b) All main and sectional system control valves, including water supply control valves, shall have a sign indicating the portion of the system controlled by the valve.
 7. Where sprinkler piping is supplied by a system with more than one system riser, a sign shall be located at each dual or multiple feed connections to the combination system riser to identify that to isolate the sprinkler system served by the control valve; an additional control valve or valves at other locations shall be shut off. The sign shall identify the location of the additional control valves.
 8. Fire Department Connections:
 - a) Each Fire Department Connection shall be designated by a sign having raised letters at least 1 inch in height, cast on a plate or fitting, indicating service design, e.g., "AUTOSPKR", "AUTO SPKR"
 - b) Where a Fire Department Connection services only a portion of a system of building, a sign shall be attached indicating portions of the building served.
 9. Installing Contractor shall provide a sign identifying the design basis of a system as hydraulic calculations or pipe schedule. The sign shall be located at the water supply control valve for sprinkler systems.
 10. The installing Contractor shall provide a sign identifying the design basis of a system as hydraulic calculations or pipe schedule. The sign shall be located at the water supply control valve for sprinkler or standpipe systems per requirements of NFPA.
- J. Project Coordination:
1. Core Drilling & Hammer Drilling:
 - a) Provide necessary equipment for core drilling or other equipment to penetrate walls, floors, ceilings, and roofs. Provide pipe sleeves and patching to maintain the structural assemblies fire resistant rating where required. All cutting, notching, etc., of structural elements shall be approved in writing by DPS.
 - b) For all required core drilling and Hammer Drilling, the Contractor shall not use water and must use vacuums with HEPA filters to eliminate/ minimize debris and dust while coring.
 2. Interferences:
 - a) Layout the system to minimize interferences between the fire suppression piping and equipment designated and installed by others. Fire suppression system zoning shall be consistent with the fire alarm layout.
 3. Welding Cutting, and Other Hot Work:
 - a) Cutting of pipes using heat/ignition generating devices shall not be conducted inside any portion of

existing buildings without written approval from DPS and a “Hot Work” Permit issued by Denver Fire Department. Welding of pipes on site is prohibited by NFPA-13 and only shop welding shall be allowed.

3.03 TESTING REQUIREMENTS

A. General Requirements:

1. The Contractor must have adequate personnel on site to perform the required tests and have the Permit Set of drawings available on site at all times.
2. The Contractor shall supply all necessary equipment, such as ladders and special tools

B. DPS, DPS Fire Suppression Technician, and the AHJ shall witness acceptance tests and inspections:

1. A minimum of five (5) working days notice is required:
 - a) For cancellation of a test, at least forty eight (48) hours notice is required or it shall be considered as a re-inspection.
 - b) Prior to the time of inspection, the Contractor shall verify that all equipment involved in the test are functioning and installed as required by contract documents and shop drawings.
 - c) Perform final system testing in conjunction with the fire alarm detection system specified in DPS Design and Construction Standards.
2. Re-inspections:
 - a) The Contractor shall be responsible for all costs of re-inspection fees incurred by the AHJ.
 - b) If a system fails any of the above tests, the same scheduling procedure shall be followed.
 - c) If more than two tests are necessary, Contractor shall be responsible for all re-inspection costs or fees and DPS Staffing.

C. Acceptance Tests:

1. The Contractor shall conduct the following tests for acceptance of the system installation. This includes all existing equipment which was re-used in the system. Record the inspections on a copy of Material and Test Certificate, shown in NFPA #13 or similar approved forms. Test report information shall be completed by the Contractor prior to each inspection:
 - a) The Contractor shall perform all tests and inspections with the System Design Engineer and/or Contractor, DPS and the AHJ present. A fire alarm representative shall be present when necessary to test fire alarm devices connected to the sprinkler system.
 - b) Prior to any tests on sprinkler/standpipe systems, the piping shall be flushed, as required by NFPA-13, to remove any foreign matter which could have entered the system during installation.
 - c) Functional tests shall be performed on all valves and manual operating devices.

D. Specific System Test:

1. For retrofit installations, a pneumatic test with a maximum pressure of forty (40) psi shall be conducted prior to a hydrostatic test to avoid any water damage due to leaks. This test does not replace the hydrostatic test.

2. Hydrostatic Test:

- a) All piping, including all supply pipes to the Fire Department Connection, shall be hydrostatically tested at fifty (50) psi in excess of the maximum pressure, or two hundred (200) psi, whichever is greater. This test shall be conducted prior to concealing any piping. A complete installation inspection shall be conducted in conjunction with the hydrostatic test while all piping is exposed.
- b) If visible signs of leakage occur or the system loses pressure within the two (2) hour test period, the test shall be considered as failed and shall require re-testing after correction of the cause of leakage.

3. Final System Inspection:

- a) A final inspection shall be performed when the system installation is complete, which includes: a complete functional test of all system components and of all alarms via the inspector's test correction. (Manual tripping of alarm devices is not acceptable.)
- b) A complete installation inspection shall be conducted by the System Design Engineer and/or Contractor and DPS and the DPS Fire Suppression Technician at the time of the final inspection, which will be coordinated with the work under DPS Design and Construction Standards.
- c) A main drain test shall be conducted with the control valve wide open. The main drain valve shall be opened and remain open until the system pressure stabilizes.
- d) Provide O&M Manuals, Training, and Record Drawings per part one of this specification.

END SECTION 21 13 13

SECTION 21 31 13

FIRE PUMPS

PART 1 - GENERAL

1.01 RELATED

- A. "General Requirements", Division 1 and Mechanical and Plumbing Basic Materials and Methods Spec Sections 22 05 00 and 23 05 00 of the Project Manual, and Division 21 13 13 "Fire Protection" pertain to and are hereby made part of the work of the Spec Section.

1.02 DESCRIPTION OF WORK

- A. The work under this Section includes furnishing all fire protection fire pumps and all required auxiliary equipment, specialties and all labor necessary to make the installation of the Fire Protection Fire Pump System as indicated on the drawings and specified herein.

1.03 SYSTEM DESCRIPTION

- A. Provide a complete fire pump unit and required auxiliary equipment to provide the required pressure for the fire protection system as indicated on the drawings.

1.04 QUALITY ASSURANCE

- A. Code Compliance Products, General: Comply with local and state governing regulations which require the products used for fire protection fire pump systems to be selected from lists in certain published latest editions of standards or codes as indicated therein.
- B. Manufacturer: Except for products required to comply with recognized product listings, provide fire protection fire pump system products and accessories produced by a fire protection manufacturer with not less than 5 years experience in manufacturing similar products.
- C. Installer: A firm with at least 3 years of successful installation experience on project with fire protection piping work similar to that required for the project.
- D. NFPA Code: Comply with NFPA No. 13, entitled "Standard for the Installation of Sprinkler Systems".
- E. NFPA Compliance: Comply with NFPA No. 14 entitled, "Standard for the Installation of Standpipe and Hose Systems."
- F. Fire protection pumps shall comply with applicable section of NFPA No. 20, entitled, "Standard for the Installation of Centrifugal Fire Pumps." Comply with requirements of UL's Standard for Safety No. 1478, entitled, "Fire Pump Relief Valves", and No. 448, "Pumps for Fire Protection Service."
- G. FM Compliance: Comply with Factory Mutual "Approval Guide."
- H. FM Approval Marks: Provide units bearing FM approval marks.
- I. UL Labels: Provide units, which have been approved and listed by Underwriters Laboratories.
- J. Requirements: Entire fire protection system shall be designed, furnished, and installed in strict conformance to NFPA Chapter 13 and all related regulations and requirements.

1.05 SUBMITTALS

- A. Prior to submitting shop drawings to the Engineer for approval, shop drawings shall be submitted to the local building department and the local fire prevention bureau authorities for their review and approval of the fire pump size, capacity, pressure, and system interface. Only approved drawings shall be reviewed by the Engineer.
- B. Product Data: Submit manufacturer's data on all fire protection fire pump system piping material, accessories and products. Include all data on fire protection pumps including but not limited to pump characteristics, performance curves certified where indicated.
- C. Shop Drawings:
- D. Submit shop drawings for the fire protection fire pump systems showing the sizes, location, accessories, valves, gauges, equipment connections, wiring diagrams and typical details for unit installation.
- E. Certification of Installation; Fire Sprinkler Fire Pump: Submit certificate upon completion of fire pump installation which indicates that the work has been tested in accordance with NFPA 13, and also that system is operational, complete, and has no defects.
- F. Fire Pump test and procedures and certificate format are contained in NFPA No. 13.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Provide products produced by one of the following (for each type of accessories or system).
- B. Fire Pumps Equipment
 - 1. Allis-Chalmers Corp.
 - 2. Aurora Pump Div., General Signal Corp.
 - 3. Fairbanks Morse Pump Div., Colt Ind.
 - 4. Foster Pump Work, Inc.
 - 5. Marlow Div., ITT Corp.
 - 6. PACO-Pacific Pumping Co.
 - 7. Peabody Barnes Peabody International
 - 8. Peerless Pump Co.
 - 9. Seco

2.02 ELECTRIC DRIVEN FIRE PROTECTION PUMPS

- A. **FIRE PUMP:** The pumps shall be an Aurora model 6-481-15C horizontal split-case fire pumps. The pump shall be rated for the required flow and hydraulic head as calculated by the delegated-design fire protection contractor. The pump shall be listed by UL and be approved by FM. The pump shall deliver not less than 65% of rated pressure at 150% of rated flow. The shut off pressure shall not exceed 140% of rated pressure.

Electric Drivers: The motors shall be listed by Underwriters' Laboratories. It shall be open drip proof with a 1.15 service factor and shall comply with the provisions of NFPA 70, National Electric Code as described in NFPA 20. The motor shall be mounted on a bent steel frame.
- B. **Controller:** The motor controller shall be a METRON model MP430 listed by UL and approved by FM for fire pump service. It shall be compatible with the motor horsepower and voltage. It shall be of the ACROSS-THE-

LINE type with a withstand rating of 100Ka short circuit symmetrical amperes. The controller enclosure shall be of NEMA 2 type. The controller shall have pre-piped ½” brass pipe pressure sensing line run from the discharge piping to the pressure switch.

- C. Pressure Maintenance (Jockey or Make-Up) Pump: The jockey pump shall be an Aurora Pump model PVM2-60. The pump shall be rated for 2 GPM @ 117 PSI. The jockey pump will be close coupled to a 1.5 hp @ 3600 rpm ODP motor. The motor will operate on 3 phase, 60 hertz, and 208 volts.

Jockey Pump Controller: A METRON model MB15B jockey pump controller shall be supplied. The jockey pump controller shall come complete with a fusible disconnect, front mounted hand-off-auto selector switch, and overload relays. The controller enclosure shall be of NEMA 2 type. The controller shall have ½” brass pressure sensing line run from the discharge piping to the pressure switch. Provide jockey controller with disconnect, pressure switch and casing relief valve.

- D. All equipment shall be factory tested in accordance with the requirements of NFPA, UL, and FM. The entire package system shall be hydrostatically tested by the pump manufacturer at 100 psi.
- E. **Provide a Remote panel and no start switch.**

2.03 FIRE PROTECTION AUXILIARY EQUIPMENT

- A. Provide for the fire pump, a motor controller, which shall be listed by Underwriters Laboratories and/or approved by Factory Mutual for fire pump service. The controller shall be h the listed motor horsepower and voltage. The controller shall be across the line type. The controller shall be completely assembled and tested by the manufacturer. Unit installation shall conform to NFPA 20 and Division 16 of these specifications.
- B. The Jockey Pump controller shall be furnished with a fusible disconnect, pre-piped Mercoid pressure switch, front mounted HAND-OFF-AUTO selector switch, and overload relays, all mounted in a NEMA rated enclosure. Controls shall be compatible with jockey pump and main pump.
- C. Fire Protection Pump Fittings: Provide fire protection pump fittings, including UL listed, automatic release valve, suction and discharge gauges to be liquid filled (0 to 300 psig) 3-1/2" dial faces, isolating gate suction valve, an isolating butterfly discharge valve, a water check valve, and a main relief valve with and enclosed waste cone properly sized for rated flow. Provide concentric discharge increasers, hose valve caps, and eccentric suction reducers, as recommended by pump manufacturer for applications and working pressures, indicated.
- D. Provide a power distribution system to accept the incoming feeder and distribute power to the electric motor controller and the jockey pump in accordance with manufacturers' requirements.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Installer must examine the subs trades and conditions under which the fire protection fire pump system and accessories are to be installed, and notify the Contractor in writing of conditions, detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION

- A. The Contractor shall verify dimensions and conditions governing his work at the building. No extra compensation shall be claimed or allowed, due to failure to report unfavorable conditions affecting his work.

3.03 INSTALLATION OF FIRE PUMPS

- A. Install fire protection pumps where shown, in accordance with manufacturer's written instructions, complying with FM and NFPA No. 20, and with recognized industry practices, to ensure that fire protection pumps comply

with requirements and serve intended purposes. Comply with NEMA standards and installation requirements of NEC.

- B. Coordinate with other work, including plumbing, standpipe, and fire sprinkler piping as necessary to interface installation of fire protection pumps properly with other components of fire water protection system.
- C. Check alignment and where necessary (and possible), realign shafts of motors and pumps within tolerances recommended by Manufacturer.
- D. Install pumps and pump drives on vibration mounts as shown; comply with manufacturer's indicated installation method, if any, and with other Division 15 Sections. Provide motor controllers and coordinate requirements with Division 16 regarding connections and installation.
- E. Ensure that fire protection pump units are wired properly, with rotation in direction indicated and intended for proper pump performance.
- F. Provide pumps and motors with electrical equipment grounding.
- G. Upon completion of installation of fire protection pumps, perform field acceptance tests of pumps, complying with operating instructions and procedures of NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units, which cannot be satisfactorily corrected.

3.04 ADJUST AND CLEAN

- A. Prior to energizing fire pump, assure that unit is clean and adjusted to the proper requirements. Provide final checkout in accordance with NFPA 20.

3.05 DEMONSTRATION

- A. Start-Up Services: Provide the services of a factory-authorized service representative to start-up fire pump units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Operating and Maintenance Training: Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of fire pump units. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division One.

END OF SECTION 23 31 13