SECTION 21 13 13

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

All Fire Protection System design, modification, and installations shall be in accordance with UFC 3-600-01: Fire Protection Engineering for Facilities.

The UFC 3-600-01 required Fire Protection Designer shall provide a performance designed system or a fully designed system as applicable.

This section is primarily intended for performance designed systems, i.e., systems where the size, layout, and support of branch lines and cross mains, and the layout of sprinkler heads will be designed by the Fire Protection Designer.

The Fire Protection Designer shall provide the following information in the contract documents for performance designed systems.

(1) Show the layout and size of all piping and equipment from the point of connection to the water supply, to the sprinkler cross mains. The contract drawings must include a detailed sprinkler riser diagram. Water velocity in the piping should not exceed 6 m/s (20 ft/s).

(2) Show location and size of service mains, interior feed mains, control valves, sprinkler risers, drain lines, sectional valves, and inspector's test valves and switches on the drawings.

(3) Specify water flow data including hydrant flow results, including the location where the hydrant flow test was conducted, the location and size of existing mains and new water supply lines that will serve the sprinkler system (including all supervisory valves), and the location and size of all risers.

(4) Highlight or clearly indicate the area(s) to be protected by sprinklers on the drawings.

(5) Specify water flow requirements including the design density, design area, the hose stream demand (including location of the hose stream demand), the duration of supply, and sprinkler spacing and area of coverage in this section.

(6) Show the location of the backflow preventer (including provisions for a drain and access for maintenance) where the potable water supply system is at risk of contamination by the sprinkler system on the drawings.

(7) Show all provisions necessary for forward flow testing of the backflow preventer at system demand, as required by NFPA 13 on the drawings. Indicate location of all components and required items, including test ports, for pressure measurements both upstream and downstream of the backflow preventer, a drain to the building exterior, and appropriate, permanent means of disposing of the large quantity of

water that will be involved in the initial test and subsequent annual tests.

(8) Highlight all concealed spaces on the drawings that require sprinkler protection, such as spaces above suspended ceilings that are built of combustible material or that can contain combustible materials, such as storage, and communication cabling that is not fire-rated.

(9) Provide details on the drawings of pipe restraints for underground piping. This includes details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

When connecting to an existing water distribution system, water flow tests will be conducted to determine available water supply for the sprinkler system. The Designer will either perform or witness the water flow test. The water flow test results (including date test is performed) should be included in the Project Development Brochure; however it is critical that the water flow test results be included in the design documents no later than the concept submission. Note that the availability of the Designer to participate or witness the water flow test will be necessary. The need for fire pumps or a water tank can in many instances have a significant impact on the amount programmed for design and construction of a facility.

A fully designed system will include the items listed above and all additional information required that is required by UFC 3-600-01 and NFPA 13 for a fully operational system.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Current editions of references at time of delivery order shall be used.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies - (ANSI approved 2010)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	Grooved and Shouldered Joints
AWWA C651	Standard for Disinfecting Water Mains
AWWA C652	Disinfection of Water-Storage Facilities

ASME INTERNATIONAL (ASME)

ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A135/A135M	Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A449	Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated,

	120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A795/A795M	Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75	Standard Specification for Seamless Copper Tube
ASTM B88	Standard Specification for Seamless Copper Water Tube
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM F436	Hardened Steel Washers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	Standard for the Installation of Sprinkler Systems
NFPA 1963	Standard for Fire Hose Connections
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 668	Hose Valves for Fire-Protection Service
UL Bld Mat Dir	Building Materials Directory
UL Fire Prot Dir	Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage. Provide wet pipe sprinkler system in areas indicated on the drawings. Except as modified herein, the system shall be designed and installed in accordance with UFC 3-600-01 and NFPA 13 . Rack sprinklers shall be in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. Design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

Systems covering 140 square meters (1500 square feet) or greater shall be hydraulically designed. Only systems less than 140 square meters (1500 square feet) and located in buildings which were designed using the pipe schedule system may be designed using the pipe schedule method of NFPA 13.

Hydraulically design the system to discharge a minimum density of UFC required gpm/square foot over the hydraulically most demanding square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s. Applications requiring multiple densities/design areas must be referred to and shown on the drawings.

1.2.1.1 Hose Demand

Add an allowance for exterior hose streams of as required by UFC 3-600-01.

1.2.1.2 Basis for Calculations

The design must include an adequate water supply to meet the sprinkler water demand. The designer must provide water flow test results and hydraulic calculations to ensure that the system demand will be met.

Design Calculations: The designer will provide detailed hydraulic calculations that clearly demonstrate that the water supply will meet the demand of the sprinkler system and hose streams. Calculations will be submitted with the concept design submission.

Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping. Where applicable, hydraulic calculations may be based on operation of fire pump(s).

1.2.1.3 Hydraulic Calculations

Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments and as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings to substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with UFC 3-600-01 and NFPA 13, but shall not exceed 225 square feet for light hazard occupancies, 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies, and 225 square feet for light hazard occupancies.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

All submittals related to system configuration, hydraulic calculations, and equipment selection, including manufacturer's catalog data, working

drawings, connection drawings, control diagrams and certificates shall be submitted concurrently as a complete package.

SD-02 Shop Drawings

Shop Drawings

The Sprinkler System Shop Drawings shall conform to requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building.

As-Built Drawings

As-built shop drawings, at least 10 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size paper.

SD-03 Product Data

Fire Protection Related Submittals

Materials and Equipment

Components and Equipment Data

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided. Data shall be adequate to demonstrate compliance with contract requirements for the following:

a. Pipe

b. Fittings, flanges and gaskets

c. Pipe hanger

d. Gate valve

e. Check valve

f. Alarm check valve

g. Fire department connection

h. Sprinkler water flow indicator switch

i. Sprinkler pressure alarm switch

j. Water motor alarm assembly

k. Control valve supervisory (tamper) switch

l. Sprinkler

m. Hose reel assembly

Spare Parts

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Preliminary Tests

Final Acceptance Test

Onsite Training

Fire Protection Specialist

Sprinkler System Installer Qualifications

A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project.

SD-05 Design Data

Sway Bracing

Hydraulic Calculations

SD-06 Test Reports

Preliminary Test Report

A schedule of preliminary tests, at least 14 days prior to the proposed start of the tests.

Final Acceptance Test Report

Upon successful completion of all tests specified under PRELIMINARY TESTS, written notification shall be given to the Contracting Officer of the date for the final acceptance test. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

SD-07 Certificates

Contractor's Material and Test Certificates

Certificates, as specified in NFPA 13, shall be completed and signed by the Contractor's Representative performing all required tests for both underground and aboveground piping.

Inspection by Fire Protection Specialist

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals

Manuals shall be in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures, possible breakdowns, and repairs, and troubleshooting guide. This shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

1.4 QUALITY ASSURANCE

Compliance with referenced UFC 3-600-01 and NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.4.1 Fire Protection Specialist

Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is an individual registered professional engineer who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES) or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations. The Fire Protection Specialist shall prepare and submit a list of the fire protection related submittals, no later than 7 days after the approval of the Fire Protection Specialist, from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.2 Sprinkler System Installer

Work specified in this section shall be performed by the Sprinkler System Installer who is regularly engaged in the installation of the type and complexity of system specified in the contract documents, and who has served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

1.4.3 Shop Drawings

Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Submit 3 copies of the Sprinkler System shop drawings, no later than 21 days prior to the start of sprinkler system installation. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. Submit load calculations for sizing of sway bracing, for systems that are required to be protected against damage from earthquakes.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Provide Materials and Equipment that have been tested by Underwriters Laboratories, Inc. and are listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE. Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity. The mere omission of such terms under the description of any item of equipment described shall not be construed as waiving this requirement.

2.4 UNDERGROUND PIPING COMPONENTS

Where applicable, drawings must show the service connection details and the underground water mains for the sprinkler system. Drawings must show details of the water service point-of-entry into the building and through the floor slab, and underground piping restraints, including the number and size of restraining rods and thrust blocks.

2.4.1 Pipe

Piping from a point 6 inches above the floor to the point of connection to the existing water mains shall be ductile iron with a rated working pressure of 150 psi conforming to AWWA C151/A21.51, with cement mortar lining conforming to AWWA C104/A21.4. Piping more than 5 feet outside the building walls shall comply with Section 33 11 00 WATER DISTRIBUTION.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110/A21.10. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

2.4.3 Gate Valve and Indicator Posts

This paragraph may be disregarded if underground valves are either not required or are specified elsewhere.

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM APP GUIDE.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel or copper unless otherwise indicated.

2.5.1 Steel Piping Components

Steel piping exposed to the weather or corrosive atmospheres shall be galvanized or properly protected against corrosive effects.

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black or galvanized as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A795/A795M, ASTM A53/A53M, or ASTM A135/A135M. Pipe in which threads or grooves are cut or rolled formed shall be Schedule 40. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. [Steel press fittings shall be approved for fire protection systems.] Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

2.5.1.5 Bolts, Nut, and Washers

Bolts shall be conform to ASTM A449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type conforming to ASME B18.2.2 or ASTM A193/A193M, Grade 5 . Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Copper Tube Components

2.5.2.1 Copper Tube

Copper tube shall conform to ASTM B88, Types L and M.

2.5.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A183.

2.5.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.4 Valves

2.5.4.1 Control Valve and Gate Valve

A control valve is required for control of each individual sprinkler riser. The type of such valves should be either the OS&Y or wall type indicator post. Where multiple risers are supplied from a single water service, riser control valves of the OS&Y type should be located in a valve room with exterior access. For more guidance on arrangement of sprinkler control valves, refer to NFPA 13, Appendix A.

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM APP GUIDE.

2.5.4.2 Check Valve

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.4.3 Hose Valve

Hose valves shall be all bronze, straight or angle type, 2-1/2 inch American National Standard Fire Hose Screw Thread (NH) male outlet conforming to NFPA

1963 requirements. Hose valve shall be provided with 2-1/2 inch to 1-1/2 inch reducer, cap and chain.

Valve shall comply with UL 668 and shall have a minimum rating of 300 psi. Valve shall be non-rising stem, all bronze, 90 degree angle type, with 2-1/2 inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 2-1/2 to 1-1/2 inch reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain.

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

NOTE: In lieu of an alarm check valve, the designer may show a back flow preventer and an accompanying two inch drain on the sprinkler system side, along with a vane type water flow switch.

2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, water flow alarm bell shall be provided and installed in accordance with NFPA 13. Water flow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel(FACP). Electric water flow alarms are preferred. Coordinate type and location of water flow alarm with the electrical designer.

Water motor alarm assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 3/4 inch galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 1 inch galvanized and shall be arranged to drain to the outside of the building.

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

Water motor alarms and pressure alarm switches can be used only with an alarm check valve. Vane type water flow indicators can be used with or without an alarm check valve and are often used for zoning of the fire suppression system, e.g., building wings or floors.

To permit testing of each alarm device, the designer shall design and provide a separate inspector's test connection for each device. Coordinate selections and delete inapplicable devices.

2.8.1 Sprinkler Water Flow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the

housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Sprinkler Pressure (Water flow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 1/2 inch NPT male pipe thread. The switch shall have a maximum service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

The designer will coordinate the desired location of the fire department connection with and verify the type of threads used by the fire department serving the building where the sprinkler system is being installed. If conflicting, fire department requirements shall supersede the following.

Fire department connection shall be projecting or flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass or chromium plated finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.10 SPRINKLERS

Areas that are classified as light hazard will be equipped with quick response sprinklers.

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be as required for the application. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

2.10.1 Concealed Sprinkler

Concealed sprinkler shall be chrome-plated or stainless steel quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.2 Recessed Sprinkler

Recessed sprinkler shall be chrome-plated or stainless steel quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.3 Flush Sprinkler

Flush sprinkler shall be chrome-plated or stainless steel quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.4 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, quick-response type with nominal 1/2 inch or 17/32 inch orifice. Pendent sprinklers shall have a polished chrome or stainless steel finish.

2.10.5 Upright Sprinkler

Upright sprinkler shall be brass, chrome-plated, or stainless steel quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.6 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a brass, polished chrome, or stainless steel finish. Sidewall sprinkler shall be the quick-response type.

2.10.7 Residential Sprinkler

Residential sprinkler shall be the pendent or sidewall type with nominal 1/2 inch orifice. Residential sprinkler shall have a polished chrome finish.

2.10.8 Intermediate Level Rack Sprinkler

Intermediate level rack sprinkler shall be of the upright or pendent type with nominal 1/2 inch orifice and minimum "K" factor of 5.5. The sprinkler shall be equipped with a deflector plate to shield the fusible element from water discharged above it.

2.10.9 Corrosion Resistant Sprinkler

NOTE: The use of corrosion resistant sprinklers is generally limited to industrial type occupancies such as those involving electroplating, steam rooms, salt storage, and piers and wharves.

Corrosion resistant sprinkler shall be listed in UL-04. Corrosion resistant sprinkler shall be the upright or pendent type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer. Temperature rating shall be as indicated.

2.10.10 Dry Sprinkler Assembly

Dry sprinkler assembly shall be of the pendent, upright, sidewall, or 45-degree type as required for each application. Assembly shall include an integral escutcheon. Maximum length shall not exceed maximum indicated in UL Fire Prot Dir. Sprinklers shall have a polished chrome finish.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers as required to protect sprinklers from damage.

2.12.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 FIRE HOSE REEL ASSEMBLY

Assembly shall include nozzle, fire hose, reel, 1-1/2 inch valve, and bracket suitable for wall mounting. The assembly shall be semi-automatic type complete with Underwriters clip which permits controlled one-man operation whereby control valve can be opened, hose unreeled and clip released by pulling on hose. Valve shall be non-rising stem, all bronze, angle type with 1-1/2 inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Reel shall be of steel

construction with red enamel finish and shall be equipped with 100 feet of 1-1/2 inch rubber lined fire hose. Nozzle shall be of the industrial combination fog-straight stream type with shutoff. Components of the assembly shall be listed in UL Fire Prot Dir.

2.14 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Indicate piping, type of connection and equipment, such as a test header with hose valves, required for flow testing of the backflow preventer at full system demand as required by NFPA 13. Arrangement of test assembly should be coordinated with the installation.

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 150 or 175 psi as applicable. The maximum pressure loss shall be 6 psi at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

Prior to ceiling installation and concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. The Fire Protection Specialist shall: 1) inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

Piping shall be installed straight and bear evenly on hangers and

supports. Piping system shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as specified in NFPA 13 for protection of piping against damage from earthquakes.

3.4.1 Protection of Piping Against Earthquake Damage

Protection of piping from earthquake damage is not required.

3.4.2 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches for steel pipe or 6 inches for copper tubing. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size.

Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line or at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located

outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

Designer will indicate location of the inspector's test connections and all associated valves on the contract drawings, and will provide details of drain piping, if drain piping is needed.

3.4.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building or at the location indicated. Auxiliary drains shall be provided as required by NFPA 13.

3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade adjacent to and on the sprinkler system side of the backflow preventer. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Velocity drip from fire department connection check valve shall drain to the outside or at the location indicated. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet unless specified otherwise or unless project involves replacement of an existing line. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than5 feet outside the building walls shall meet the requirements of Section 33 11 00 WATER DISTRIBUTION.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 31 00 00, EARTHWORK.

3.7 ELECTRICAL WORK

Coordinate power and alarm requirements with the contract drawings and other specification sections.

Except as modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP and Section 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. All wiring for supervisory and alarm circuits shall be solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

3.8 DISINFECTION

This section shall be used only for systems requiring disenfection.

After all system components are installed and hydrostatic test(s) are completed, the entire sprinkler system shall be disinfected. Flush all sprinkler system piping with potable water until any entrained dirt and other foreign materials have been removed before introducing chlorinating material. Remove the flushing fitting of each cross main and of each grid branch line and then back-flush through the sprinkler main drain.

a. The water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. Feed either a hypochlorite solution (using a hypochlorinator) or liquid chlorine (using a solution-fed chlorinator and booster pump) into the system at a constant rate of 50 parts per million (ppm) until the entire system is filled.

b. Monitor the chlorine residual level in the water at six hour intervals for a period of 24 hours. If the residual chlorine is below 25 ppm in any interval sampled, flush all piping and repeat the chlorination procedure. Open and close each valve in the system several times during this 24 hour period to ensure its proper disinfection. Following the 24-hour period, verify that no less than 25 ppm chlorine residual remains in the system. After the chlorine residual level is successfully maintained at or above 25 ppm for a 24 hour period, flush the system with water from the distribution system until the residual chlorine is reduced to less than one ppm.

c. From several points in the unit, take additional samples of water at locations specified by the Contracting Officer in disinfected containers for bacterial examination. Test these samples in an approved laboratory for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA Standard Method SM9223, Total Coliforms-PA Test.

d. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in two separate test samples taken 24 hours apart. The system will not be accepted until satisfactory bacteriological results have been obtained.

   The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests and proposed date and time to begin the preliminary tests. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, submit 3 copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

Following the installation of the sprinkler riser equipment, and prior to final acceptance test, a main drain test shall be made to verify the adequacy of the water supply.

3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. Provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5 inch diameter hoses, play pipe nozzles, calibrated pressure gauges, pitot tube gauge, plus all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. Provide a metal placard on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Begin the Final Acceptance Test only when the Preliminary Test Report has been approved. Submit proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests, and proposed date and time to begin the Test, submitted with the procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated water flow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Submit as-built shop drawings, at least 14 days after completion of the Final Tests, updated to reflect as-built conditions after all related work is completed. Drawings shall be on reproducible full-size paper. In addition, the representative shall have available copies. of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. Submit 3 copies of the completed Final Acceptance Test Report no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist as specified.

3.12 ONSITE TRAINING

The number of hours of instruction shall be determined based of the number and complexity of the systems specified.

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit proposed schedule, at least 14 days prior to the start of related training. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. Submit 6 Operating and Maintenance Manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis. The Onsite Training shall cover all of the items contained in the approved manuals.

-- End of Section --