SECTION 21 13 17

DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

Because dry systems are slower in operation, are less reliable, and require considerable and critical maintenance, they should be limited in application and used only in areas subject to freezing. Areas that are not subject to freezing should be protected with wet pipe sprinkler systems.

The designer will edit this specification section for either a performance-designed system or a fully designed system as applicable.

This specification 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 Professional required by UFC3-600-01.

The Designer will provide the following information in the contract documents for performance designed systems. This information will be in accordance with UFC 3-600-01.

(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) Air compressors, including controls and complete installation details, including piping, control valves, mounting base.

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

(10) 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 and funding for 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 Military Handbook 1008C 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 -

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 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 B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	Standard for Square and Hex Nuts

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 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 Bld Mat Dir	Building Materials Directory
UL Fire Prot Dir	Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

a. Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

b. Provide dry pipe sprinkler system in areas subject to freezing only. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, design and install the system in accordance with NFPA 13. Pipe sizes, which are not indicated on the drawings, shall be determined by hydraulic calculation. Gridded systems shall not be used.

c. Design any portions of the sprinkler system that are not indicated on the drawings or are not specified herein, including locating sprinklers, piping, and equipment, and size piping and equipment. Base the design of the sprinkler system on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

Hydraulically design the system to discharge a minimum density of UFC 3-600-01 required gpm per square foot over the hydraulically most demanding square feet of floor area. Provide hydraulic calculations in accordance with the Area\Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s.

1.2.1.1 Hose Demand

Add an allowance for exterior hose streams of UFC 3-600-01 required gpm to the sprinkler system demand at the point of connection to the existing water system.

1.2.1.2 Basis for Calculations

Base the design of the system upon a n adequate water supply to meet the sprinkler water demand. Base hydraulic calculations upon the Hazen-Williams formula with a "C" value of 120 for galvanized steel piping, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping or on operation of the fire pump(s) provided in Section 21 30 00 FIRE PUMPS as applicable.

a. Submit Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments. Outline hydraulic calculations as 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 substantiate that the design area used in the calculations is the most demanding hydraulically.

b. Plot water supply curves and system requirements 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. Indicate elevations of hydraulic reference points (nodes). Documentation shall identify each pipe individually and the nodes connected thereto. Indicate for each pipe the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient.

1.2.2 Sprinkler Coverage

Uniformly space sprinklers on branch lines. In buildings protected by automatic sprinklers, 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 NFPA 13, but not exceeding 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies, and 225 square feet for light hazard occupancies.

1.2.3 System Volume Limitations

Designer must ensure by calculation that a sufficient number of systems is provided to limit piping volume to less than 2800 liters (750 gallons).

Where the volume of any individual system piping volume exceeds 500 gallons, provide the dry pipe valve with a quick-opening device. The maximum system capacity controlled by one dry pipe valve shall not exceed 750 gallons. Indicate the calculated volume of each system on the Sprinkler System Shop Drawings.

1.3 SUBMITTALS

Government approval is required for submittals. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Fire Protection/Detection System

Detail drawings for Fire Protection/Detection System shall be one integrated submittal and shall consist of illustrations, schedules, performance charts, instructions, brochures, diagrams and complete detail drawings of the sprinkler system and any other information required to illustrate the system has been coordinated and will function as a unit. Detail drawings shall be on full-size paper. Detail drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. The Contractor's submittal must be prepared and sealed by the Fire Protection Engineer or Level 2 NICET certified designer.

As-Built Drawings

The detail drawings shall be updated to reflect As-Built conditions after all associated work is completed and submitted as full-size paper.

SD-03 Product Data

List of Submittals

Materials and Equipment

Spare Parts Data

Spare parts data for each different item of material and equipment specified, after approval of the detail drawings. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

Fire Protection Specialist

Qualifications with verification or license number of the registered Fire Protection Engineer or Level 3 NICET certified designer with current experience in the design of fire protection and detection systems.

Installer Qualifications

Test Procedures

Detailed test procedures for the fire protection system. The test procedures must be signed by the Fire Protection Engineer.

Onsite Training

Framed Instructions

Proposed diagrams, instructions, and other sheets prior to posting. The framed instructions shall be posted at each alarm check, dry pipe, deluge, solenoid valve and/or fire pump. Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

SD-05 Design Data

Sway Bracing

Hydraulic Calculations

SD-06 Test Reports

Preliminary Tests

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

Final Acceptance Test

SD-07 Certificates

Inspection by Fire Protection Specialist

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Fire Protection/Detection System

Six complete copies of the operation manual outlining the step by step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, catalog cuts, diagrams, drawings, parts list, and descriptive data covering the proper operation and testing. Four complete copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The manual shall include simplified diagrams for the system as installed.

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 the work specified in this section under the supervision of and certified by the Fire Protection Specialist (FPS). Submit the name and documentation of certification of the proposed FPS, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system shop drawings and hydraulic calculations. The FPS shall be a registered professional engineer and a Full Member of the Society of Fire Protection Engineers 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. The FPS shall prepare and submit a list of submittals related to Fire Protection from the Contract Submittal Register that verify the successful installation of the sprinkler systems(s), no later than 7 days after the approval of the FPS. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the FPS when submitted to the Government. The FPS 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 Installer Qualifications

Work specified in this section shall be performed by the Sprinkler System Installer. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the FPS Qualifications. The Installer shall be regularly engaged in the 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.

1.4.3 Shop Drawings

Submit 3 copies of the Sprinkler System Drawings, on reproducible full-size paper, no later than 21 days prior to the start of sprinkler system installation. The drawings shall conform to the 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; update the shop drawings to reflect as-built conditions after all related work is completed. 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. Indicate each type of fitting used and the locations of bushings, reducing couplings, and welded joints..

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; air supply system and piping; 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.

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. Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. Highlight the data 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.

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.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and 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.

2.4 UNDERGROUND PIPING COMPONENTS

The drawings shall show the service connection details, the underground water mains for the sprinkler system and details of the water service point-of-entry into the building and through the floor slab, and underground piping restraints, including 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 or 175 psi as applicable 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 Post

This paragraph may be ignored 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

2.5.1 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.

2.5.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be galvanized steel conforming to ASME B16.9 or ASME B16.11. Fittings that sprinklers, drop nipples or riser nipples (sprigs) are screwed into 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.

2.5.3 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. Gaskets shall be of silicon compound and approved for dry fire protection systems. 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.

2.5.4 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.

2.5.4.1 Bolts

Bolts shall be ASTM A449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.5.4.2 Nuts

Nuts shall be hexagon type conforming to ASME B18.2.2 or ASTM A193/A193M, Grade 5.

2.5.4.3 Washers

Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.5 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 size to be supported.

2.5.6 Valves

2.5.6.1 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.

2.5.6.2 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.

2.6 DRY PIPE VALVE ASSEMBLY

The dry pipe valve shall be a latching differential type listed in UL Fire Prot Dir or FM APP GUIDE and shall be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation. The assembly shall include a quick-opening device by the same manufacturer as the dry pipe valve for systems over 500 gallons in capacity.

2.7 SUPERVISORY AIR SYSTEM

Provide an air supply system in accordance with NFPA 13. The connection pipe from the air compressor shall not be less than 1/2 inch in diameter and shall enter the system above the priming water level of the dry pipe valve. Install a check valve in the system supply air piping from the compressor. A shutoff valve of the renewable disc type shall be installed upstream of this check valve. The air supply system shall be sized to pressurize the sprinkler system to 40 psi within 20 minutes.

2.7.1 Air Compressor

Compressor shall be single stage oil-free type, air-cooled, electric-motor driven, equipped with a check valve, shutoff valve and pressure switch for automatic starting and stopping. Pressure switch shall be factory set to start the compressor at 30 psi and stop it at 40 psi. A safety relief valve, set to operate at 65 psi, shall be provided.

2.7.2 Air Pressure Maintenance Device

Device shall be a pressure regulator that automatically reduces supply air to provide the pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1/16 inch restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing an inlet pressure of up to 100 psig to a fixed outlet pressure adjustable to 10 psig.

2.7.3 Air Supply Piping System

System shall be configured so that each dry pipe system is equipped with a separate pressure maintenance device, air compressor, shutoff valve, bypass valve and pressure gauge. Piping shall be galvanized steel in accordance with ASTM A795/A795M or ASTM A53/A53M.

2.7.4 Low Air Pressure Alarm Device

Each dry pipe valve trim shall be provided with a local alarm device consisting of a metal enclosure containing an alarm horn or bell, silence switch, green power-on light, red low-air alarm light and amber trouble light. Activate the alarm device by the low air pressure switch. Upon reduction of sprinkler system pressure to approximately 10 psig above the dry valve trip point pressure, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light. Restoration of system pressure shall cause the low-air alarm light to be extinguished and the audible alarm to be silenced. An alarm silence switch shall be provided to silence the audible alarm. An amber trouble light shall be provided which will illuminate upon operation of the silence switch and shall be extinguished upon return to its normal position.

2.8 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) in accordance with Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP and 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE or mechanically operated, exterior-mounted, water motor alarm assembly shall be provided and installed in accordance with NFPA 13. 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 valve shall be provided. Drain piping from the body housing shall be minimum 1 inch galvanized and shall be arranged to drain to the outside of

the building. Piping shall be galvanized both on the inside and outside surfaces.

NOTE: Electric water flow alarms are preferred. Coordinate type and location of water flow alarm with the electrical designer.

2.9 ALARM INITIATING AND SUPERVISORY DEVICES

Drawings shall indicate and detail the connection of the water flow pressure switch, low air and valve tamper switch to the building fire alarm system or to the base-wide fire reporting system.

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

2.9.1 Sprinkler Pressure (Waterflow) 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 dry pipe valve.

2.9.2 Low Air Pressure Supervisory Switch

The pressure switch shall supervise the air pressure in system and shall be set to activate at 10 psi above the dry pipe valve trip point pressure. The switch shall have an adjustable range between 5 and 80 psi. The switch shall have screw terminal connection and shall be capable of being wired for normally open or normally closed circuit.

2.9.3 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.

2.10 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. Fire department requirements shall supercede the paragraph below as required.

Fire department connection shall be projecting 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) in accordance with NFPA 1963.

2.11 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Areas where sprinklers are connected to or are a part of the dry pipe system shall be considered unheated and subject to freezing. Temperature classification shall be as required. 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.

The designer shall indicate on the contract drawings the type of sprinkler heads for each area if more than one type of sprinklers is to be provided.

2.11.1 Pendent Sprinkler

Pendent sprinkler heads shall be the dry pendent type, unless otherwise indicated. 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. Assembly shall include an integral escutcheon. Maximum length shall not exceed the maximum length indicated in UL Fire Prot Dir.

2.11.2 Upright Sprinkler

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

2.11.3 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 corrosive environments.

Corrosion resistant sprinkler shall be upright or pendent type installed in locations as indicated. Corrosion resistant coatings shall be factory applied by the sprinkler manufacturer.

2.12 DISINFECTING MATERIALS

2.12.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.12.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.13 ACCESSORIES

2.13.1 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.

2.13.2 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.

2.13.3 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.

2.13.4 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 prevent damage.

2.13.5 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.

2.14 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

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.

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.

PART 3 EXECUTION

3.1 EXAMINATION

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 EARTHWORK

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

3.3 INSTALLATION REQUIREMENTS

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

3.4 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall 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. Submit, 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.

3.5 ABOVEGROUND PIPING INSTALLATION

3.5.1 Protection of Piping Against Earthquake Damage

Install the seismic protection of the system piping, including sway bracing as required, in accordance with UFC 3-13-04, NFPA 13 and Annex A. Submit load calculations for sizing of sway bracing, for systems that are required to be protected against damage from earthquakes. Include the required features identified therein that are applicable to the specific piping system.

3.5.2 Piping in Exposed Areas

Exposed piping shall be installed so as not diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.5.3 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.

3.5.4 Pendent Sprinklers Locations

Sprinklers installed in the pendent position shall be of the listed dry pendent type, unless otherwise indicated. Dry pendent sprinklers shall be of the required length to permit the sprinkler to be threaded directly into

a branch line tee. 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. Dry pendent sprinkler assemblies shall be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. 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.

3.5.5 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.

3.5.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. 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 and fittings shall be from the same manufacturer. 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.

3.5.7 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.

3.5.8 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 in accordance with 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.

3.5.9 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.

3.5.10 Inspector's Test Connection

Designer shall 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.

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.

3.5.11 Drains

Provide main drain piping to discharge at a safe point outside the building or at the nearest available suitable drain location. Auxiliary drains shall be provided as indicated and as required by NFPA 13. Contractor shall verify existing drain is adequate before selection and use. When the capacity of trapped sections of pipe is less than 3 gallons, the auxiliary drain shall consist of a valve not smaller than 1/2 inch and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 3 gallons, the auxiliary drain shall consist of two 1 inch valves and one 2 x 12 inch condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 1 inch in diameter. Tie-in drain lines shall be pitched a minimum of 1/2 inch per 10 feet.

3.5.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade or adjacent to and on the sprinkler system side of the backflow preventer as indicated by TAFB fire department. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.5.13 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.

3.6 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 if project scope is to replace 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 than 5 feet outside the building walls shall meet the requirements of Section 33 11 00 WATER DISTRIBUTION. Restraint of the underground piping shall be detailed on the drawings.

3.7 ELECTRICAL WORK

Coordinate power and alarm requirements with the 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 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

3.8 DISINFECTION

If sprinkler piping is isolated from the domestic water piping systems by means of a reduced pressure backflow prevention assembly or if sprinkler piping in not connected to the domestic water piping, this paragraph may be ignored for those projects.

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. 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.

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, also proposed date and time to begin the tests, with the Preliminary Tests Procedures. 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 complete certificates as specified and 3 copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests 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.

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 Air Pressure Test

As specified in NFPA 13, an air pressure leakage test at 50 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

3.10.2.3 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, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. Provide 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. A metal placard shall be provided 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 initiating device, including pressure alarm switch, low air pressure switch, valve supervisory switch, and electrically-operated switch shall be tested for proper operation. Water motor alarm shall be tested. The connecting circuit to the building fire alarm system and to the base-wide fire report system shall be inspected and tested.

3.10.4 Trip Tests of Dry Pipe Valves

Each dry pipe valve shall be trip-tested by reducing normal system air pressure through operation the inspector's test connection. Systems equipped with quick opening devices shall be first tested without the operation of the quick opening device and then with it in operation. Test results will be witnessed and recorded. Test results shall include the number of seconds elapsed between the time the test valve is opened and tripping of the dry valve; trip-point air pressure of the dry pipe valve; water pressure prior to valve tripping; and number of seconds elapsed

between time the inspector's test valve is opened and water reaches the orifice.

3.10.5 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

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. 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. 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 Final Acceptance Test, with the Final Acceptance Test 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. 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. Each system shall be completely drained after each trip test. The system air supply system shall be tested to verify that system pressure is restored in the specified time. In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of tests previously conducted. Submit as-built shop drawings, at least 14 days after completion of the Final Tests. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. After the system has been tested and drained, the system shall be drained periodically for at least 2 weeks until it can be assured that water from the system has been removed. Submit 3 copies of the completed Final Acceptance Tests Reports, 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.

3.12 ONSITE TRAINING

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

The Fire Protection Specialist and Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit Proposed Onsite Training 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. The Onsite Training shall cover all of the items contained in the approved Operating and Maintenance Instructions, submit 6 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.

-- End of Section --