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USACE / NAVFAC / AFCESA / NASA **UFGS-21 13 18.00 10 (May 2009)**
Change 1 - 02/13

Preparing Activity: USACE **Superseding**
UFGS-21 13 18.00 10 (November 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2013
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DIVISION 21 - FIRE SUPPRESSION

SECTION 21 13 18.00 10

PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION

05/09

-- End of Section Table of Contents --

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SECTION 21 13 18.00 10

PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION
05/09

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NOTE: This guide specification covers the requirements for preaction and deluge fire protection sprinkler systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

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NOTE: Because preaction systems are more costly, less reliable, and require more maintenance than wet-pipe systems, they should be used only where justified by occupancy conditions. Deluge systems are "open head" systems which discharge all sprinklers upon system actuation. The use of deluge systems should be limited to special hazard situations.

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 Contractor.

The Designer will provide the following information in the contract documents for performance designed systems. This information will be in accordance with Military Handbook 1008C.

(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 waterflow 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 waterflow 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 are intended for storing combustible materials.

(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, waterflow tests will be conducted to determine available water supply for the sprinkler system. The Designer will either perform or witness the waterflow test. The waterflow test results (including date test is performed) should be included in the Project Development Brochure; however it is critical that the waterflow 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 waterflow 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.

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1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the

extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(2009) 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 C104/A21.4	(2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2012) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

ASME INTERNATIONAL (ASME)

ASME B16.1	(2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.11	(2011) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.9	(2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	(2010) Standard for Square and Hex Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A135/A135M	(2009) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts

ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A449	(2010) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A795/A795M	(2008; R 2012) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM F436	(2011) Hardened Steel Washers
ASTM F436M	(2011) Hardened Steel Washers (Metric)

FM GLOBAL (FM)

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

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

MSS SP-71	(2011; Errata 2013) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2012; Amendment 1 2012) Life Safety Code
NFPA 13	(2013) Standard for the Installation of Sprinkler Systems
NFPA 13D	(2013) Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
NFPA 13R	(2013) Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
NFPA 1963	(2009; Errata 09-1) Standard for Fire Hose Connections
NFPA 24	(2013) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 72	(2013) National Fire Alarm and Signaling Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2012) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2012) Building Materials Directory
UL Fire Prot Dir	(2012) 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 [preaction] [deluge] sprinkler system(s) in [areas indicated on the drawings] [_____]. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified

herein, the system shall meet the requirements of NFPA 13 and NFPA 72. The sprinkler system shall be a single interlocked system that requires the actuation of an alarm initiating device to open the water control (deluge) valve.

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. Determine pipe sizes which are not indicated on the drawings by hydraulic calculations.

1.2.1 Hydraulic Design

****

NOTE: Applications requiring multiple densities/design areas must be referred to and shown on the drawings.

Systems covering 140 square meters (1500 square feet) or greater will be hydraulically designed. Only systems less than 140 square meters (1500 square feet) may be designed using the pipe schedule method of NFPA 13. This section must be edited if the system is to be designed using the pipe schedule method.

****

Hydraulically design the system to discharge a minimum density of [_____] L/min per square m gpm/square foot over the hydraulically most demanding [280] [_____] square m [3,000] [_____] square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 32 mm 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 6 m/s 20 ft/s.

1.2.1.1 Hose Demand

Add an allowance for exterior hose streams of [_____] L/min gpm to the sprinkler system demand [at the fire hydrant shown on the drawings closest to the point where the water service enters the building] [at the point of connection to the existing water system]. [An allowance for interior hose stations of [_____] L/min gpm shall also be added to the sprinkler system demand.]

1.2.1.2 Basis for Calculations

****

NOTE: 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.

****

Base the design of the system upon a water supply with a static pressure of [_____], and a flow of [_____] at a residual pressure of [_____]. Water supply shall be presumed available [at the point of connection to existing] [at the base of the riser] [_____]. 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] [on operation of the fire pump(s) provided in Section 21 30 00 FIRE PUMPS].

a. 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. Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments. 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.

c. 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, include a flow diagram indicating the quantity and direction of flows. 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

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 shall not exceed 9 square m 100 square feet for extra hazard occupancies, 12 square m 130 square feet for ordinary hazard occupancies, and 21 square m 225 square feet for light hazard occupancies. Exceptions are as follows:

a. Facilities that are designed in accordance with NFPA 13R and NFPA 13D.

b. Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.

1.2.3 Control System

****

NOTE: The drawings must show the following information relative to the control and detection system: preaction or deluge system control panel, source of power for control panel, fire protection valve actuation devices, detectors, manual actuation stations, waterflow pressure switches, supervisory switches; notification appliances; connection to the building fire alarm control panel or other remote monitoring systems, and all power, control, alarm, supervisory and interconnecting wiring. The designer will indicate the complete zoning of initiating devices and specify the descriptive zone labeling for each corresponding system annunciator.

All areas to be protected with preaction sprinklers must be equipped with the detectors necessary to activate the sprinkler system.

****

The control system shall meet the requirements of NFPA 72. The control panel shall be listed in UL Fire Prot Dir or FM APP GUIDE for "Releasing Device Service". The control panel and the solenoid valve that activates the water control valves shall be compatible with each other. Compatibility shall be in accordance with specific UL listing or FM approval of the control equipment.

1.2.3.1 Power Supply

Provide the primary operating power from two single-phase 120 VAC circuits. Transfer from normal to backup power and restoration from backup to normal power shall be fully automatic and shall not initiate a false alarm. Loss of primary power shall not prevent actuation of the respective automatic water control valve upon activation of any alarm initiating device. Provide backup power through use of rechargeable, sealed, lead calcium storage batteries.

1.2.3.2 Circuit Requirements

Connect alarm initiating devices to initiating device circuits (IDC), Style [D] [_____] or to signal line circuits (SLC), Style [6] [_____], in accordance with NFPA 72. Alarm notification or indicating appliances shall be connected to indicating appliance circuit (IAC), Style [W] [X] in accordance with NFPA 72. Provide a separate circuit for actuation of each individual automatic water control valve. Fully supervise the circuits that actuate the water control valves so that the occurrence of a single open or a single ground fault condition in the interconnecting conductors will be indicated at the control panel.

1.2.4 System Operational Features

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NOTE: Delete manual actuation stations when not required. For deluge systems, delete requirements for supervisory air pressure.

****

Include in the system a heat detection system, manual actuation stations, supervisory and alarm switches, alarm notification appliances, control panel and associated equipment. Provide preaction sprinkler system piping

with supervisory air pressure not to exceed 210 kPa 30 psig.

1.2.4.1 System Actuation

Activation of any [single heat detector] [2 heat detectors] or a single manual actuation station shall actuate alarm zone circuits of the control panel that, in turn, shall actuate the corresponding automatic water control valve. Actuation of the automatic water control valve shall cause water to [fill the preaction system piping and be discharged from fused sprinklers] [discharge from the open sprinklers of the deluge system].

1.2.4.2 Alarm Functions

****
NOTE: Drawings must indicate and detail the connection of the system control panel to the building alarm system and/or to the base-wide fire reporting system.
****

Activation of any heat detector or sprinkler pressure alarm switch or manual actuation station shall cause the illumination of the respective zone annunciator, and [activation of the building fire alarm system] [transmission of the alarm to the base-wide fire reporting system]. Valve tamper alarm shall be monitored by the system control panel and transmitted to the building fire alarm system as a trouble alarm.

1.2.4.3 Supervisory Functions

The reduction of supervisory air pressure within the sprinkler system piping to less than [70] [_____] kPa [10] [_____] psi or the occurrence of a single open or a single ground fault in any alarm initiating device circuit, in the automatic water control valve actuation circuit, in any alarm indicating appliance circuit or in other electrically supervised circuit shall cause the individually labelled control panel trouble light to be illuminated, the audible trouble alarm to be activated, and a trouble alarm to be transmitted [to the building fire alarm control panel] [and] [to base-wide fire reporting system].

1.3 SUBMITTALS

****
NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G"

designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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

SD-02 Shop Drawings

Shop Drawings[; G][; G, [_____]]
As-Built Drawings

SD-03 Product Data

Fire Protection Specialist[; G][; G, [_____]]
Installer Qualifications
List of Submittals
Materials and Equipment[; G][; G, [_____]]
Spare Parts
OnSite Training[; G][; G, [_____]]

SD-05 Design Data

Sway Bracing
Hydraulic Calculations[; G][; G, [_____]]
Storage Batteries[; G][; G, [_____]]

SD-06 Test Reports

Preliminary Tests[; G][; G, [_____]]
Final Acceptance Tests[; G][; G, [_____]]

SD-07 Certificates

Inspection by Fire Protection Specialist[; G][; G, [_____]]

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

1.4 QUALITY ASSURANCE

Compliance with referenced 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. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Incorporate all requirements that exceed the minimum requirements of NFPA 13 into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.4.1 Fire Protection Specialist

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NOTE: Level IV may be selected where warranted by system complexity.
****

Perform the work specified in this section under the supervision of and certified by the Fire Protection Specialist (FPS) who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level [III] [IV] 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 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 prepare and submit a list of submittals, related to fire protection, from the Contract Submittal Register that relate to 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 mylar film, 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 1:100 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; 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.

f. Complete point-to-point wiring diagram of the detection and control system. Indicate the detailed interconnection of control panel modules to the devices, the number and size of conductors in each conduit, and size of conduit. Connection points shall be indicated and coordinated with the terminal identification marked on the devices. Provide complete internal wiring schematic of the control panel and each electrical device. Detailed description of the functions of the control panel and each module shall be provided.

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 alist 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 SYSTEMS

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NOTE: The drawings must show the service connection details and 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 150 mm 6 inches above the floor to [a point 1500 mm 5 feet outside the building wall] [the point of connection to the existing water mains] shall be ductile iron with a rated working pressure of [1034] [1207] [_____] kPa [150] [175] [_____] psi conforming to AWWA C151/A21.51, with cement mortar lining conforming to AWWA C104/A21.4. Piping more than 1500 mm 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 with cement mortar lining conforming to AWWA C104/A21.4. 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

****

NOTE: This paragraph will be deleted 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 900 mm 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] 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 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut or rolled formed. 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 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.] 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.

2.5.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa 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, 1.6 mm 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. Bolts 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] [ASTM A193/A193M, Grade 5] [ASTM A563M ASTM A563, Grade [C3] [DH3]].

2.5.4.3 Washers

Washers shall meet the requirements of ASTM F436M 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

****
NOTE: 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 Valves

Check valve 50 mm 2 inches and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 100 mm 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 AUTOMATIC WATER CONTROL VALVE (DELUGE VALVE)

****
NOTE: "Automatic water control valve" is a generic term synonymous with "deluge valve" and is used for both preaction and deluge systems. "Automatic water control valve" is consistent with what is used in the UL Fire Protection Equipment Directory. Delete reset capability when not required.
****

Automatic water control valve (deluge valve) shall be electrically-actuated and rated for a working pressure of 1207 kPa 175 psi. Valve shall be capable of being reset without opening the valve. Electrical solenoid valve used to actuate the water control valve shall be an integral

component of the valve or shall be approved for use by the water control valve manufacturer. Solenoid valve shall be rated at 24 volts direct current, and shall be normally closed type that operates when energized. Solenoid valves shall be rated for a maximum pressure differential of 1207 kPa 175 psi. Water control valve shall be equipped with a means to prevent the valve from returning to the closed position until being manually reset. Assembly shall be complete with the valve manufacturer's standard trim piping, drain and test valves, pressure gauges, and other required appurtenances. Include with each assembly an emergency release device for manually tripping the water control valve in the event of a power or other system failure. Device shall be a standard accessory component of the valve manufacturer and shall be labeled as to its function and method of operation. Valves located in hazardous locations shall be approved for the hazard classification of the area where located.

2.7 SUPERVISORY AIR SYSTEM

****
NOTE: Supervisory air is not appropriate for deluge systems. Delete this section and reference to supervisory air for deluge systems and for unsupervised preaction systems.

Show the power supply to the air compressor and to the low air pressure alarm device on the drawings.
****

2.7.1 Air Compressor

Air compressor shall be single stage oil less type, air cooled, electric-motor driven, equipped with a check valve, centrifugal pressure and moisture unloader, pressure switch for automatic starting and stopping. Pressure switch shall be set to start the compressor at [140] [_____] kPa [20] [_____] psi and stop it at [200] [_____] kPa [30] [_____] psi. A safety relief valve, set to operate at [450] [_____] kPa [65] [_____] psi, shall be provided. The compressor shall be sized to pressurize the system to [200] [_____] kPa [30] [_____] psi within 30 minutes.

2.7.2 Air Pressure Maintenance Device

Device shall be a pressure regulator that automatically reduces supply air pressure to the minimum 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, 1.6 mm 1/16 inch restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing maximum inlet pressure of 680 kPa 100 psi to a fixed outlet pressure adjustable to [70] [_____] kPa [10] [_____] psi.

2.7.3 Air Supply Piping System

Each preaction system shall be equipped with a separate pressure maintenance device, 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 Switch

Each preaction system shall be provided with an air pressure switch connected to the control panel. Upon reduction of supervisory air pressure to approximately [70] [_____] kPa [10] [_____] psi, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light on the control panel annunciator.

2.8 WATER MOTOR ALARM ASSEMBLY

****
NOTE: Coordinate this paragraph with paragraph Waterflow Alarm; delete parts not used.
****

Assembly shall include a body housing, impeller wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum19 mm 3/4 inch galvanized piping shall be provided between the housing and the automatic water control valve. Drain piping from the body housing shall be minimum 25 mm 1 inch galvanized steel and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and on the outside surfaces.

2.9 FIRE DEPARTMENT CONNECTION

****
NOTE: 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 connection shall be [projecting] [flush] type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a [polished brass] [chromium plated] finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) in accordance with [NFPA 1963][_____].

2.10 SPRINKLERS

****
NOTE: The designer will indicate on the contract drawings the type of sprinkler heads for each area if more than one type of sprinklers is to be provided. Delete sprinkler types from this paragraph that are not intended for use in the system(s) used in the contract.

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

Sprinklers for preaction systems shall be automatic, fusible solder or glass bulb type; sprinklers for deluge systems shall be open type without the fusible element. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be [ordinary] [intermediate]

[_____] [as indicated]. 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 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, [recessed] [quick-response] type with nominal [13 mm 1/2 inch] [13.5 mm 17/32 inch] orifice. Pendent sprinklers shall have a [polished chrome] [stainless steel] [white polyester] [_____] finish.

2.10.2 Upright Sprinkler

Upright sprinkler shall be [brass] [chrome-plated] [stainless steel] [white polyester] [quick-response type] [_____] and shall have a nominal [13 mm 1/2 inch] [13.5 mm 17/32 inch] orifice.

2.10.3 Corrosion Resistant Sprinkler

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

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

2.11 ACCESSORIES

2.11.1 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.

2.11.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 19 mm 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.11.3 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.

2.11.4 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 located [_____] [as indicated].

2.11.5 Identification Sign

Valve identification sign shall be minimum 150 mm wide by 50 mm high 6 inches wide by 2 inches high with enamel baked finish on minimum 1.214 mm 18 gauge steel or 0.6 mm 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.

2.12 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

****

NOTE: 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 test gauge 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 [1034] [1207] [_____] kPa [150] [175] [_____] psi. The maximum pressure loss shall be 40 kPa 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.

2.13 CONTROL PANEL

Panel shall be UL listed or FM approved for "Releasing Device Service" or shall have modules approved for this purpose. Panel shall contain all components and equipment required to provide the specified operational and supervisory functions of the system. House components in a [surface] [flush]-mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly factory assembled and wired unit. Panel shall include integral "power on," "alarm," and "trouble" lamps with annunciation of each alarm, supervisory and trouble signal. The panel shall have prominent rigid plastic or metal identification plates for lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Control panel switches shall be within the locked cabinet. Provide a suitable means for testing the working condition and accuracy of the control panel visual indicating devices (meter and lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

2.13.1 Zone Annunciator

Provide a separate alarm and trouble lamp for each active and spare zone

located on exterior of cabinet door or visible through the cabinet door. A minimum of [two] [_____] spare alarm zones that are fully operational shall be provided. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic or metal sign with either raised or engraved letters. Zone identification shall consist of a unique zone number as well as a word description of the zone.

2.13.2 System Zoning

****
NOTE: As a minimum, the system will be zoned by type of device and by floor or by specific location.
****

The system shall be zoned as follows:

ZONE NO.	DESCRIPTION
[_____]	[_____]

2.13.3 Primary Power Supply

****
NOTE: The drawings will indicate a dedicated power supply circuit for each preaction and deluge sprinkler system control panel. The power circuit will be arranged so that power and lighting system can be shutdown for building modifications without shutting down primary power to the control panel.
****

Primary power and trouble alarm power to the Control Panel shall be supplied from two 120 VAC circuits. [Power to the control panel shall be as indicated.] [A [separate panel] [fused two-pole disconnect switch] connected ahead of [the main building panel] [indicated panel] shall be provided.] [Panel shall be equipped with [two] [_____] 20-amp circuit breakers for each control panel and with key lock. [Panel] [Disconnect switch] shall be permanently marked "[PREACTION] [DELUGE] SPRINKLER SYSTEM".]

2.13.4 Emergency Power Supply

Emergency power shall be provided for system operation in the event of failure of the primary power supply and shall consist of rechargeable storage battery system. Transfer from normal to emergency power or restoration from emergency to normal power shall be automatic and shall not cause transmission of a false alarm.

2.13.4.1 Storage Batteries

Storage Batteries shall be sealed, lead-calcium type requiring no additional water. Submit calculations to substantiate the total requirements for supervisory and alarm power. Include ampere-hour requirements for each system component and each control panel component or module, under both normal and alarm conditions. The battery recharging period shall be included with the calculations. The batteries shall have ample capacity, with primary power disconnected, to operate the system for a period of 90 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all alarm indicating

devices in the alarm mode for a minimum period of [15] [_____] minutes. Battery cabinet shall be a separate [compartment at the bottom of the control panel] [cabinet]. The battery cabinet shall have adequate space for spare duplicate storage batteries. Batteries shall be mounted on a noncorrosive and nonconductive base or pad.

2.13.4.2 Battery Charger

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within [12 hours] [_____] using the high charging rate. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly. The charger shall be located in control panel cabinet.

2.14 ALARM INITIATING DEVICES

2.14.1 Heat Detectors

****
NOTE: The location and type of heat detectors and alarm devices must be indicated on project drawings. Delete descriptive paragraphs of detectors types not used. Alarm indicator should be used only if necessary to meet project requirements.
****

Detectors located in areas subject to moisture, exterior atmospheric conditions or hazardous locations as defined in NFPA 70 shall be approved for such locations. Detectors shall be listed or approved for 15 m 50 foot spacing between detectors. The detector shall be equipped with an alarm indicating light in its base that lights when the detector is in an alarm condition. [Five] [_____] spare detectors of each type and temperature rating shall be provided.

2.14.1.1 Rate Compensation Detector

Detector shall be of the [vertical] [horizontal] spot type with a temperature classification rating of [ordinary] [intermediate] as defined by NFPA 72. Detectors listed or approved as "rate anticipation" type will be accepted. Detector shall automatically reset when temperature drops below detector temperature rating. Detector shall be hermetically sealed.

2.14.1.2 Fixed-Temperature and Rate-of-Rise Heat Detector

Detector shall consist of two independently operated thermal elements. The rate-of-rise portion of the detector shall consist of an air chamber, flexible metal diaphragm and a moisture-proof calibrated vent which will respond to a temperature rise exceeding 8 degrees C 15 degrees F per minute. This portion of the detector shall be self-restoring after actuation. The fixed temperature portion of the detector shall consist of a fusible alloy that will melt and cause an alarm when the surrounding air rises above the temperature rating of the detector. The detector shall provide an external indication when the fixed temperature portion of the detector actuates. Detector shall have a temperature classification rating of [ordinary] [intermediate] as defined by NFPA 72.

2.14.1.3 Fixed-Temperature Heat Detector

Detector shall have a fusible alloy that will melt and cause an alarm when the surrounding air rises above the temperature rating of the detector. The detector shall provide an external indication upon actuation of the detector. Detector shall provide a temperature classification rating of [ordinary] [intermediate] as defined by NFPA 72.

2.14.2 Manual Actuation Station

****
NOTE: Manual actuation stations are needed for deluge systems only. Delete this paragraph for preaction systems.
****

Station shall be mounted at 1000 mm 42 inches above the floor, unless otherwise shown. Station shall be arranged to activate the deluge system. Station shall be dual-action type requiring two separate operations in order to cause system discharge. Station shall be colored [lime yellow] [_____] [a unique color dissimilar to color used for manual fire alarm system]. Station shall be provided with a positive visible indication of operation of the station. Station shall be weatherproof type and shall be provided with an engraved label indicating DELUGE SYSTEM.

2.14.3 Sprinkler Pressure Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches. The switch shall have a service pressure rating of 1200 kPa 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 30 to 60 kPa 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.

2.14.4 Waterflow Alarm

****
NOTE: Electric waterflow alarm bells are preferred. Coordinate type and location of waterflow alarm with the electrical designer.
****

[Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow 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] [28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE]]. [Mechanically operated, exterior mounted, water motor alarm assembly shall be provided 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 19 mm 3/4 inch galvanized piping from the body housing shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 25 mm 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.]

2.14.5 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.

2.15 NOTIFICATION APPLIANCES

****
NOTE: The notification appliances are for providing local notification of a sprinkler system operation. These devices are not intended to provide general building fire alarm evacuation. Fire alarm evacuation systems are addressed in Section 27 51 23.10 INTERCOMMUNICATION SYSTEM.
****

Notification appliances shall be suitable for connection to supervised alarm indicating circuits. Appliance shall have a separate screw terminal for each conductor. The surface of the appliance shall be red in color.

2.15.1 Alarm Bell

Bell shall be 250 mm 10 inch diameter, surface-mounted vibrating type with matching back box. Sound output shall be a minimum of [85] [_____] DBA at 3000 mm 10 feet. Bell shall operate on nominal 24 VDC. Bells shall have screw terminals for in-out wiring connection. Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.15.2 Alarm Horn

Horn shall be surface mounted, with the matching mounting back box [surface mounted] [recessed] [[single] [double] projector,] [grill and] vibrating type suitable for use in an electrically supervised circuit. Horns shall operate on nominal 24 VDC and have screw terminals for in-out wiring connection. Sound output shall be a minimum of [85] [_____] DBA at 3000 mm 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

2.16 WIRING

Wiring for alternating current (AC) circuits shall be 12 AWG minimum. Wiring for low voltage direct current (DC) circuits shall be No. [16] [14] AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in electrical metallic tubing or in metallic conduit, except rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same function shall be similarly color coded. Wiring color code shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, alarm indicating, supervisory, and actuation circuits are prohibited.

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 publications referenced herein.

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, including signed approval of the Preliminary, Detection and Control Systems, and Final Acceptance Test Reports. 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.

3.5 ABOVEGROUND PIPING INSTALLATION

3.5.1 Protection of Piping Against Earthquake Damage

Seismically protect the system piping against damage from earthquakes. This requirement is not subject to determination under NFPA 13. Install the seismic protection of the system piping, including sway bracing as required, in accordance with UFC 3-310-04, 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 300 mm 12 inches for steel pipe or 150 mm6 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 150 mm 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 750 mm 30 inches in length shall be individually supported.

3.5.6 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 exceeding 300 mm 12 inches in length. 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 150 mm 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.

3.5.7 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.

3.5.8 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 13 mm 1/2 inch.

3.5.9 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.

3.5.10 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.

3.5.11 Inspector's Test Connection

****

NOTE: 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.

****

Unless otherwise indicated, test connection shall consist of 25 mm 1 inch pipe connected [to the remote branch line] [at the riser as a combination test and drain valve]; a test valve located approximately 2 m 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.

3.5.12 Drains

Provide main drain piping to discharge [at a safe point outside the building] [at the location indicated]. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 11 L 3 gallons, the auxiliary drain shall consist of a valve not smaller than 13 mm 1/2 inch and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 11 L 3 gallons, the auxiliary drain shall consist of two 25 mm 1 inch valves and one 50 x 300 mm 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 25 mm 1 inch in diameter. Tie-in drain lines shall be pitched a minimum of13 mm per 3 m 1/2 inch per 10 feet.

3.5.13 Installation of Fire Department Connection

Connection shall be mounted [on the exterior wall approximately 900 mm 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 and arranged to drain to the outside.

3.5.14 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

****
NOTE: Restraint of the underground piping must be detailed on the drawings.
****

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be [900] [_____] mm [3] [_____] feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm 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 1500 mm 5 feet outside the building walls shall meet the requirements of Section 33 11 00 WATER DISTRIBUTION.

3.7 ELECTRICAL WORK

Unless otherwise specified herein, power supply equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.7.1 Overcurrent and Surge Protection

All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1, IEEE C62.41.2 and NFPA 70. Cables and conductors that serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.7.2 Grounding

Grounding shall be provided to building ground.

3.7.3 Wiring

System field wiring shall be installed in 19 mm 3/4 inch minimum diameter electrical metallic tubing or metallic conduit. Wiring for the sprinkler

system fire detection and control system shall be installed in tubing or conduits dedicated for that use only and not installed in conduit, outlet boxes or junction boxes which contain lighting and power wiring or equipment. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked and labeled in accordance with the wiring diagram. No more than one conductor shall be installed under any screw terminal. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors is not permitted. Wiring within any control equipment shall be readily accessible without removing any component parts. Conductors shall be color-coded and shall be identified within each enclosure where a connection or termination is made. Conductor identification shall be by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Circuits shall be wired to maintain electrical supervision so that removal of any single wire from any device shall cause a "trouble" condition on the control panel.

3.7.4 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 600 mm 24 inches and not more than 2000 mm 78 inches above the finished floor.

3.7.5 Detectors

Detectors shall be ceiling-mounted in accordance with NFPA 72 and shall be at least 300 mm 12 inches from any part of any lighting fixture. Detectors shall be located at least 900 mm 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location.

3.7.6 Manual Actuation Stations

Manual actuation stations shall be mounted readily accessible and 1060 mm 42 inches above the finished floor.

3.7.7 Notification Appliances

Notification appliances shall be mounted a minimum of 2400 mm 8 feet above the finished floor unless limited by ceiling height.

3.8 PIPE COLOR CODE MARKING

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NOTE: Designer will coordinate color code marking with Seciton 09 90 00 PAINTS AND COATINGS. Color code marking for piping which are not listed in Table I of Paragraph 3.5 Pipe Color Code Marking of UFGS Section 09 90 00 will be added to the table.
****

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

3.9 PRELIMINARY TESTS

The system, including the underground water mains, the aboveground piping, detectors and control system 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, proposed date and time to begin the tests, submitted with the 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, complete and submit 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 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.

3.9.1 Underground Piping

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.

3.9.2 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 L 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

3.9.3 Aboveground Piping

3.9.3.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa 200 psi or 350 kPa 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.

3.9.3.2 Air Pressure Test

****
NOTE: Delete this paragraph for deluge system applications and preaction systems not requiring supervisory air.
****

As specified in NFPA 13, an air pressure leakage test at 350 kPa 50 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 10 kPa 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

3.9.3.3 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 65 mm 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.

3.9.4 Detection and Control System Tests

Upon completion of the installation, the detection and control system shall be subjected to functional and operational performance tests including tests of each installed initiating device, system actuation device and notification appliance. The control system tests specified in paragraph FINAL ACCEPTANCE TESTS shall be conducted to ensure that the system is completely functional and that wiring has been properly connected. If deficiencies are found, corrections shall be made and the system shall be retested to assure that the systems have no deficiencies.

3.9.5 Automatic Water Control Valve Test

Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector and a manual actuation station connected to the control panel and a manual actuation device that is part of the valve trim. A full-flow main drain test shall be made. For preaction systems with supervisory air, the air pressure shall be reduced to verify proper operation of the air supply system and associated supervisory alarm devices.

3.10 FINAL ACCEPTANCE TESTS

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test; submit the proposed procedures for Final Acceptance Tests, no later than [14] [_____] days prior to the proposed start of the tests, the proposed date and time to begin Final Acceptance Tests, submitted 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.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 waterflow 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. 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. Submit [3] [_____] copies of the completed Final Acceptance Tests Reports, no later that [7] [_____] days after the completion of the Final Acceptance Tests. All items in the Report shall be signed by the Fire Protection Specialist In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of tests previously conducted. Submit as-built 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.

3.10.1 Control System Test

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NOTE: Listed tests are minimum required. If additional tests are required, such tests must be added to the list.
****

Testing shall be in accordance with NFPA 72. The test shall include the following:

a. Visual inspection of wiring connections.

b. Opening the circuit at each alarm initiating device, solenoid valve, and notification appliance to test the wiring and supervisory features.

c. Test of each function of the control panel.

d. Test of each circuit in the normal, open and ground fault modes.

e. Test of each initiating device in both normal and trouble conditions.

f. Test of each control circuit and device.

g. Test of each alarm notification appliance.

h. Test of the battery charger and batteries.

i. Operational tests under emergency power supply, including activation of connected alarm notification appliances for the specified time period.

3.10.2 Trip-tests of Automatic Water Control Valves

Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector, a manual actuation station connected to the system control panel and the manual release which is part of the valve trim. Each valve shall be returned to normal condition after each test. Prior to trip testing sprinkler deluge system, precautionary steps shall be taken to prevent water damage to the building and equipment from sprinkler discharge. [Control valves on deluge systems shall [be shut off immediately after automatic water control valve trips] [remain open until open sprinklers have discharged for a minimum of [10] [_____] seconds].] [Control valves on preaction systems shall remain open until piping is filled with water.]

3.10.3 Tests of Supervisory Air System

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NOTE: Delete this paragraph for deluge system applications and preaction systems not requiring supervisory air.
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Preaction system supervisory air pressure shall be reduced from the normal

system pressure to the point at which a low-pressure alarm is sounded. Air pressure shall be restored to verify trouble signal restoration. Automatic start/stop features of air compressor shall be tested.

3.11 ONSITE TRAINING

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NOTE: The number of hours of instruction should be determined based of the number and complexity of the systems specified.
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The Fire Protection Specialist 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 [_____] 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 onsite response to a service call on an emergency basis.]

-- End of Section --