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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

UFGS-21 13 26.00 40 (November 2023)

Preparing Activity: NASA

Superseding
UFGS-21 13 26.00 40 (August 2016)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2023

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DIVISION 21 - FIRE SUPPRESSION

SECTION 21 13 26.00 40

DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS

11/23

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SECTION 21 13 26.00 40

DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS
11/23

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NOTE: This guide specification covers the requirements for the preparation of installation drawings and performance calculations, and the fabrication and installation of an automatic, heat-activated, open-head deluge type sprinkler system.

Materials and installation should be in strict accordance with NFPA requirements.

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 item(s) or insert appropriate information.

Remove information and requirements not required in the 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: If Section 23 30 00 HVAC AIR DISTRIBUTION is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.
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Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this

Section.

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 Reference Identifier (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 MECHANICAL ENGINEERS (ASME)

ASME B36.10M	(2022) Welded and Seamless Wrought Steel Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(2014) Standard for Disinfecting Water Mains

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A135/A135M	(2021) Standard Specification for Electric-Resistance-Welded Steel Pipe

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment

(1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2022; ERTA 3 2022) Standard for the Installation of Sprinkler Systems
NFPA 24	(2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(2023; ERTA 4 2023) National Electrical Code
NFPA 409	(2022) Standard on Aircraft Hangars

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2012) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders

UNDERWRITERS LABORATORIES (UL)

UL 262	(2004; Reprint Jul 2023) Gate Valves for Fire-Protection Service

1.2 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.]

Shop drawings (SD-02), product data (SD-03) and design data (SD-05) must be prepared by the designer and combined and submitted as one complete package. The QFPE must review the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. The QFPE must provide a Letter of Confirmation that they have reviewed the submittal package for compliance with the contract provisions. This letter must include their professional engineer stamp and signature. Partial submittals and submittals not reviewed by the QFPE must be returned disapproved without review.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists; G[, [____]]

Record of Existing Conditions; G[, [____]]

Qualified Fire Protection Engineer (Qfpe)

Sprinkler System Designer

Sprinkler System Installer

SD-02 Shop Drawings

Connection Diagrams; G[, [____]]Control Diagrams; G[, [____]]
Installation Drawings; G[, [____]]

SD-03 Product Data

Equipment and Performance Data; G[, [____]]

Equipment Foundation Data; G[, [_____]]

Piping Materials; G[, [_____]]Aboveground Piping Systems; G[, [_____]]

Valves; G[, [_____]]

Detection Systems; G[, [_____]]

Alarms; G[, [_____]]

Sprinkler Heads; G[, [_____]]

Supporting Elements; G[, [_____]]

Manual Activation Stations

Flame Detection Units; G

SD-04 Samples

Manufacturer's Standard Color Charts; G[, [_____]]

SD-05 Design Data

Design Analysis and Calculations; G[, [_____]]

Battery Power Calculations

Flame Detectors Fov

SD-06 Test Reports

Pressure Tests; G[, [_____]]

System Tests; G[, [_____]]

Operating Tests; G[, [_____]]

SD-07 Certificates

Product Installations

Piping Materials

Aboveground Piping Systems

Valves

Detection Systems

Alarms

Air Compressor

Sprinkler Heads

Supporting Elements

Request for Formal Inspection

Water Disposal Plan; G[, [____]]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.3 QUALITY CONTROL

Ensure all electrical work and fire detection equipment associated with the sprinkler system meet the requirements in the appropriate sections of DIVISION 26 ELECTRICAL and DIVISION 28 ELECTRONIC SAFETY AND SECURITY.

Provide UL listed or FM approved devices and equipment from a single manufacturer.

1.3.1 Qualifications

1.3.1.1 Sprinkler System Designer

The sprinkler system designer must be certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Water-Based Systems Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7

1.3.1.2 Sprinkler System Installer

The sprinkler system installer must be regularly engaged in the installation of the type and complexity of system specified in the contract documents, and must 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.

1.3.2 Previous Product Installations

Submit the names, locations, and client contact information of five successful previous projects of similar size and scope that the installer has constructed using the manufacturer's submitted products for this project.

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NOTE: Select wording to suit project.
****

Provide materials and work in accordance with the required and advisory provisions of NFPA 13 and NFPA 24, unless otherwise specified. In each of the NFPA standards referred to herein, the advisory provisions are mandatory, as though the word "shall" is substituted for the word "should" wherever it appears.

1.3.3 Predictive Testing and Inspection Technology Requirements

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NOTE: The Predictive Testing and Inspection (PT&I) tests prescribed in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS are MANDATORY for all [NASA] [_____] assets

and systems identified as Critical, Configured, or Mission Essential. If the system is noncritical, nonconfigured, and not mission essential, use sound engineering discretion to assess the value of adding these additional test and acceptance requirements. See Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS for additional information regarding cost feasibility of PT&I.

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This section contains systems and equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with the RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

1.4 PROJECT/SITE CONDITIONS

Submit installation drawings for deluge automatic sprinkler systems showing locations and elevations of existing obstructions and utilities. Show coordination of work between different trades and with the structural and architectural elements of work on the drawings. Ensure drawings are of sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate where conflicts or clearance problems exist between various trades. Also submit details of the equipment room layout and arrangement.

Conduct a survey and submit a record of existing conditions showing the work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Starting work constitutes acceptance of existing conditions.

1.5 SYSTEM DESCRIPTION

Design and [provide new] [modify existing] automatic [open-head] fire extinguishing sprinkler systems for [[_____] hazard occupancy] [uniform distribution of water] to afford complete fire protection coverage throughout Room [_____], Building [_____]. Ensure the design, equipment, materials, installation, and workmanship is in strict accordance with the required and advisory provisions of NFPA 13, except where modified as noted herein.

Submit connection diagrams indicating the relations and connections for piping materials, supporting elements, air compressor, sprinkler heads, valves, existing water systems and alarms. Indicate on the drawings the general physical layout of all controls, internal tubing, and wiring details.Submit control diagrams for deluge automatic sprinkler systems showing the physical and functional relationship of equipment. Show size, type, and capacity of the systems on the controls diagrams.

1.5.1 Qualified Fire Protection Engineer (QFPE)

An individual who is a licensed professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveying (NCEES) and has relevant fire protection engineering experience. Services of the QFPE must include:

a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. Working (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations, and material data sheets, indicating approval prior to submitting the shop drawings to the Designated Fire Protection Engineer (DFPE).

b. Provide a letter documenting that the SD-02, SD-03, and SD-05 submittal package has been reviewed and noting all outstanding comments.

c. Performing in-progress construction surveillance prior to installation of ceilings (rough-in inspection).

d. Witnessing pre-Government and final Government functional performance testing and performing a final installation review.

e. Signing applicable certificates under SD-07.

1.5.2 Design Requirements

Submit design analysis and calculations for deluge automatic sprinkler systems including information on spray areas, hazard by class, temperature setting of heads, and hydraulic calculations.

Design of deluge fire extinguishing sprinkler systems is by [hydraulic calculations for uniform distribution of water over the design area] [pipe schedules for [_____] hazard occupancy] and conforms to NFPA 13 and the requirements specified herein.

****
NOTE: Select design.
****

Design each system to withstand [earthquakes] [hurricanes].

Ensure the deluge sprinkler system meets the requirements for an extra-hazard system as defined in NFPA 13.

****
NOTE: Specify type(s) of sensing.
****

Consider each deluge valve used to supply water as a separate sprinkler system and provide each with: an individual automatic heat-responsive system that senses a predetermined fixed temperature, the rate of rise of temperature, a combination of predetermined fixed temperature and rate of rise of temperature, infrared (6,500 to 8,500 angstroms) heat sources, or ultraviolet (1,700 to 2,900 angstroms) heat sources, as specified. Ensure

each deluge valve contains an approved manual release located at the valve.

Size pipes based on hydraulic calculations to give an even distribution of water throughout the protected area.

1.5.2.1 Density of Water Application

Size pipes to provide the specified density when the system is discharging the specified maximum required flow. Application to horizontal surfaces below the sprinklers is [____] lpm [_____] gallons per minute (gpm) per square foot with outside hose stream requirements of [____] lpm [_____] gpm.

1.5.2.2 Sprinkler Design

Design area is the hydraulically most remote [_____]-square meter foot area as defined in NFPA 13.

Design area is as indicated based on the [_____] meter [_____] foot radius rule and conforms to NFPA 409 for aircraft hangars.

The spacing of sprinkler heads cannot exceed that permitted by NFPA 13 for ordinary hazard occupancy; except that for a discharge density of more than 8.1 liter per minute per square meter 0.20 gpm per square foot, the spacing of the sprinkler heads cannot exceed that for extra hazard occupancy. Ensure the spacing of sprinklers on the branch lines is essentially uniform.

PART 2 PRODUCTS

Provide material, equipment, and fixture lists indicating the following: manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information.

2.1 EQUIPMENT

Submit equipment and performance data for deluge automatic sprinkler systems including graphs and tables showing system pressures.

[Note some appropriate components for Type I, II, and III systems may not have UL listing or FM approval. In these instances, the components are not required to be UL listed or FM approved. Coordinate with the project Contracting Officer if additional information or guidance is required.]

2.1.1 Sprinkler Heads

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NOTE: Select required orifice size.
****

Provide open heads with a nominal [12.7 millimeter] [13.5 millimeter] [0.50 inch] [0.53 inch] orifice. For suspended ceilings, provide chrome-plated escutcheons and pendant sprinklers below the ceiling. Provide nickel-Teflon-coated corrosion-resistant sprinkler heads in exterior systems and systems exposed to corrosive environments. Provide sprinkler-head guards in areas subject to mechanical damage.

2.1.2 Cabinet

Provide extra sprinkler heads and a sprinkler-head wrench in a metal

cabinet adjacent to the deluge valve within each building. The number and type of extra sprinkler heads available is as specified in NFPA 13.

2.1.3 Valves

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NOTE: Select wording to suit project.
****

Operate valves using an independent detection system. Incorporate a mechanical latching mechanism for deluge valve clappers that is not affected by changes of pressure in the water system. If 150 millimeter 6inch valves are used in 200 millimeter 8inch risers, provide smoothly tapered connections. In addition to automatic operation, arrange each valve for manual release at the valve. Provide gages at the valves. Provide a test detection device for each actuation circuit adjacent to each valve that the device controls, as required by NFPA 13. Provide remote manual releases at [_____].

2.1.4 Water Supply

Ensure distribution is essentially uniform throughout the sprinkled area. Variation in discharge from individual heads in the hydraulically most remote area is between 100 and 120 percent of the specified density.

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NOTE: Select wording to suit project.
****

Base the hydraulic calculations on a static pressure of [_____] kilopascal, gage pounds per square inch, gage (psig) with [_____] lpm [_____] gpm being available at a residual pressure of [_____] kilopascal [_____] psig at the [point indicated] [junction with the distribution system].

2.1.5 Detection Systems

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NOTE: Select wording to suit project.
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Provide a [flame] [pneumatic] [hydraulic] [electric] [heat] [smoke] detection system. Ensure the nondetecting connecting [piping] [tubing] [wiring] have supervised circuits. Install tubing and wiring in protective [material] [metal] conduit or tubing.

2.1.5.1 Flame Detection Units

Detectors must be sensitive to the micron range best suited for their intended use. Detectors must operate over electrically supervised wiring circuits and the loss of power to the detector must result in a trouble signal. A self-test feature must be provided for each detector to be individually tested.

[Show validation and replication of actual flame detectors FOV (field of views), consisting of left and right horizontal axis and vertical axis on each drawing for each detector. Map and use FOV drawn to scale. Indicate detector's sensitivity setting, fuel type selection, size of flame, and distance range on drawing. Show detector's location, angle alignment,

mounting height, and aiming point/mark with clear dimensions from fixed and readily identifiable structural references on drawing.]

2.1.5.1.1 Infrared (IR) Single Frequency Flame Detector

The detector must be sensitive in the range of [_____] to [_____] micrometers only.

2.1.5.1.2 Infrared (IR) Multi Frequency Flame Detector

The IR detector must consist of three or more IR sensors, each selected for a different IR frequency. The primary sensor must be sensitive in the range of [_____] to [_____] micrometers only. Secondary sensors are tuned to different IR wavelengths to null out the effect of black body radiation to the primary sensor.

2.1.5.1.3 Ultraviolet (UV) Flame Detectors

UV flame detector must be of the narrow band response type which operates on radiated ultraviolet energy and must be sensitive in the range of [_____] to [_____] micrometers only. The cone of vision must be 80 degrees or greater. Each detector must be completely insensitive to light sources in the visible frequency range.

2.1.5.1.4 Combination UV/IR Flame Detector

The UV/IR detector must provide discrimination against false alarms by requiring both UV and IR flame detection before an alarm is sent. The UV sensor must be sensitive in the range of 0.185 to 0.265 micrometers only. The IR sensor must be sensitive in the range of [_____] to [_____] micrometers only. Detectors must be completely insensitive to light sources in the visible frequency range.

2.1.5.2 Spot Heat Detection Units

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NOTE: Select wording to suit project.
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Provide units for [surface] [flush] outlet box mounting. Support units independently of conduit, tubing, or wiring connections. Provide completely enclosed metal units and [combination fixed temperature and rate-of-rise] [fixed temperature and rate-compensated] [infrared] [ultraviolet] [_____] type units. Provide self-resetting contacts after [response to rate-of-rise] actuation. Operation under fixed temperature actuation results in an indication that may be noted by external visual inspection of the unit, or the unit may be of the self-resetting type. Provide at least two units in spaces over 55.7 square meter 600 square feet [or as required per unit UL/FM listed spacing.]. Provide fixed-temperature-type units in areas subject to abnormal temperature changes, such as showers and boiler rooms. In areas subject to moisture or exterior atmospheric conditions, select unit types approved for such locations. Removal of any unit from the system results in the actuation of a trouble signal. Provide not less than two extra detection devices of each type for each system. Furnish a portable electric device suitable for testing the detectors.

2.1.5.3 Smoke Detection Units

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NOTE: Select wording to suit project.
****

Provide detection of abnormal smoke densities by the [ionization principle] [photoelectric principle] [cloud-chamber principle]. Provide required control and power panels, either as individual units or integral with the main control panel. Provide detectors and associated panels that are compatible with the main control panel and suitable for use in a supervised circuit. If a malfunction of the electrical circuitry to the detector or its control or power units occurs, the result is the operation of the system trouble devices. Each detector contains a visible indicator lamp that shows when the unit is activated. Each detector is the plug-in type in which the detector base contains screw terminals for making wiring connections. Ensure detector spacing and location is in accordance with the manufacturer's recommendation. Provide a remote indicator lamp for each detector that is located above suspended ceilings, beneath raised floors, or otherwise concealed from view.

[Provide multiple chamber-type ionization detectors responsive to both invisible and visible products of combustion. Ensure detectors are not susceptible to operation due to changes in relative humidity. Ensure the sensitivity of each detector is field-adjustable to compensate for the conditions under which it is to operate. Use two-wire-type detectors.

][Ensure detectors operate on a multiple-cell concept using a light-emitting diode (LED) light source. Failure of the LED does not cause an alarm condition, but operates the detector indicating lamp.

][Provide a UL-listed FM-approved detector measuring particles in the 0.0025 to 0.01 micrometer range through a sampling mechanism. Failure of the sampling mechanism causes a trouble signal.

]2.1.5.4 Control Panel

****
NOTE: Select wording to suit project.
****

Provide a modular-type control panel for electrically operated detection systems. Install the panel in a surface-mounted steel cabinet with hinged doors and a cylinder lock. Ensure the control panel is a neat, compact, factory-wired assembly containing all parts and equipment required to provide all specified operating and supervisory functions of the system.

Provide a cabinet, enamel-finished on the inside and the outside, with prominent rigid plastic or metal identification plates attached.

Locate trouble lights on the doors of cabinets and locate a trouble alarm above the top of the cabinet.

Provide system power for 120-volt, 60-hertz service. Ensure electric detection system is electrically supervised against opens on all circuits. A ground fault condition that prevents the required operation of the system or a single break in any of the actuation system circuits results in the activation of a system trouble bell. Loss of ac power results in operation of the system trouble alarm. Trouble alarm sounds

continuously until the system has been restored to normal or trouble silencing switch has been operated.

Provide a silencing switch that transfers trouble signals to an indicating lamp so that correcting the trouble condition automatically transfers the trouble signal from the indicating lamp back to the trouble alarm until the silencing switch is restored to the normal position. Locate the electrical control panels, batteries, and battery charger in areas not subject to water damage or provide the weatherproof type.

2.1.5.5 Secondary Power Supply

Provide a battery charger and the specified quantity of nickel-cadmium, lead-calcium, or sealed lead-acid, rechargeable storage batteries.

Locate batteries in a steel lockable cabinet.

Provide a charger with a completely automatic high and low charging rate and that is capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge. If a high-rate switch is provided, provide a red pilot light as part of the unit assembly to indicate when batteries are manually placed on a high rate of charge.

Provide batteries of the proper ampere-hour rating to operate the system and provide supervision for up to [60][_____] hours. Submit battery power calculations that substantiate the battery capacity. Provide reliable separation between cells to prevent contact between the terminals of adjacent cells and between battery terminals and other metal parts.

2.1.5.6 Wiring

Obtain alternating current (ac) operating power for the control panel, battery charger, and air compressor, [ahead][downstream] of all building services, from the [line][load] side of the incoming facility power source. Provide independent, properly fused safety switches, with provisions for locking the covers and operating handles in the POWER ON position for these connections. Locate switches adjacent to the main distribution panel. Paint the switch boxes red and identify them with a permanent lettered designation. Provide wiring with color code in accordance with NFPA 70. Ensure wire for 120-volt circuits is No. 12 AWG minimum. Ensure wire for low-voltage dc circuits is No. 14 AWG, minimum. Provide wiring in a rigid metal conduit, intermediate metal conduit, or electrical metallic tubing, as specified on drawings.

2.1.5.7 Conductor Identification

Identify circuit conductors within each enclosure where a tap, splice, or termination is made. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink-type sleeves. Attach the markers, in a manner that will preclude accidental detachment. Identify the control circuit terminations.

2.1.5.8 Supervision

****
NOTE: Select wording to suit project.
****

Provide a supervised [deluge sprinkler piping] [pneumatic detection system] system. [If a break in the piping or tubing systems resulting in loss of pneumatic pressure occurs, the result is the activation of a supervisory alarm.]Ensure that a silencing switch is provided. Arrange the switch to transfer supervisory signals to an indicating lamp and ensure that correction of the supervisory condition automatically transfers the supervisory signal from the indicating lamp back to the supervisory alarm until the silencing switch is restored to the normal position.

2.1.6 Alarms

2.1.6.1 Water Motor Alarm

Provide alarms of the approved weatherproof and guarded type. Ensure each alarm sounds locally upon flow of water in the sprinkler system to which it is connected. Mount alarms on the outside of the outer walls of each building at a location as directed.

2.1.6.2 Local Alarm

For either an electric alarm horn or bell, as specified, provide the alarm to sound locally on operation of any detection system; regardless of whether water flows or not. Ensure the current for these alarms is taken from the facility service where connection is made ahead of all other services.

2.1.6.3 Fire Alarm

Provide and arrange equipment so an alarm is automatically transmitted over the facility fire alarm system when actuated by the detection system and by the flow of water in each sprinkler system. Provide Class A supervision of detection and actuation circuits.

2.1.6.4 Trouble Alarm

****
NOTE: Select wording to suit project.
****

Provide a local [100 millimeter] [4-inch] electric alarm [bell] [horn] [_____] to indicate trouble or failure of the detection system air compressor.

2.1.7 Aboveground Piping Systems

Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through standard tapered reducing pipe fittings; the use of bushings is not permitted. Use polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or graphite and oil, applied only on male threads to join pipe threads. Use Schedule 80 steel pipe for pipe nipples 150 millimeter 6-inches-long and shorter. Conceal piping in areas with suspended ceilings.

2.1.7.1 Water Pipe

Ensure pipes are carbon steel. Ensure all piping is suitable for a working pressure of not less than 1207 kilopascal gage, 175 psig, in

accordance with ASME B36.10M or ASTM A135/A135M.

2.1.7.2 Sprinkler Pipe and Fittings

Ensure sprinkler pipe and fittings meet NFPA 13, except Piping 2 inches and less must be minimum Schedule 40.Piping larger than 2 inches must be minimum Schedule 10. Galvanized piping is only permitted for deluge sprinkler systems. Use zinc-coated steel pipe and fittings for water motor alarm piping. Rubber-gasketed grooved-end pipe and fittings with mechanical couplings are permitted only in pipe sizes 100 millimeter 4 inches and larger. Ensure rubber gaskets for use in dry pipe sprinkler system are UL listed. Do not use restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings that use steel gripping devices to bite into the pipe when pressure is applied.

2.1.7.3 Double Basket Strainers

When specified on drawings, provide double basket strainers with removable screens having standard perforations 3 millimeter 0.125 inch in diameter in the riser beneath the deluge valves.

2.1.7.4 Pipe Hangers and Supports

Provide pipe hangers and supports in accordance with NFPA 13 and constructed from black iron.Where seismic bracing is required, install hangers and supports to allow controlled seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

2.1.7.5 Valves

****
NOTE: Select valve type.
****

Provide valves as required by NFPA 13 and of types approved for fire service. Ensure gate valves open by counterclockwise rotation.

Use check valves that are flanged, clear opening, swing-check-type with flanged inspection and access cover plates for pipe sizes 100 millimeter 4 inches or larger. Provide an outside screw and yoke (OS&Y) valve beneath each [deluge] valve in each riser when more than one valve is supplied from the same water supply pipe.

Equip sprinkler system valves with electrical supervision devices connected to the building fire alarm system indicating the open or closed position of the valve or any supervisory condition.

2.1.7.6 Identification Signs

Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix design data identification plates to the riser of each system.

2.1.7.7 Main Drains

Provide drain piping that discharges at safe points outside the building or to sight cones attached to drains of adequate size to readily receive

the full flow from the drain under maximum pressure. Provide auxiliary drains as required by NFPA 13.

2.1.7.8 Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through the entire thickness of walls, floors, roofs, and partitions. Provide not less than a 6.0 millimeter 0.25-inch space between the exterior of piping or pipe insulation and the interior of the sleeve. Firmly pack the space with insulation and caulk at both ends of the sleeve with plastic waterproof cement.

Provide ASTM A53/A53M, Schedule 40 or standard weight, zinc-coated steel pipe sleeves in masonry and concrete walls, floors, and roofs as required. Extend sleeves in floor slabs 50 millimeter 2 inches above the finished floor.

Provide zinc-coated steel-sheet sleeves having a nominal weight of not less than 0.633 gram per square millimeter 0.90 pound per square inch in other than masonry and concrete partitions and walls, floors, and roofs.

2.1.7.9 Escutcheons

Provide approved one-piece or split-hinge-type escutcheons for piping passing through floors, walls, and ceilings in both exposed and concealed areas. Provide chrome-plated metal escutcheons where pipe passes through finished ceilings. Provide other escutcheons of steel or cast iron with aluminum paint finish where indicated. Securely anchor escutcheons in place with setscrews or other approved positive means.

2.1.7.10 Fire Department Inlet Connections

Provide inlet connections, about [_____] 915 millimeter 3[_____] feet above grade, of the approved two-way type with 65 millimeter 2.5 inch National Standard female hose threads with plug and chain.

2.1.7.11 Joints

Use threaded or flanged joints; do not use welded joints.

2.1.8 Underground Piping Systems

2.1.8.1 Pipe and Fittings

****
NOTE: Select cover depth.
****

Provide outside-coated cement-lined 150 [_____] millimeter 6 [_____] inches ductile iron pipe and fittings conforming to NFPA 24 for piping under the building and within 1525 millimeter 5 feet of the outside the building walls. Anchor joints in accordance with NFPA 24, using pipe clamps and steel rods. Minimum depth of cover is [_____] [915] millimeter [_____] [3] feet.

2.1.8.2 Valves

Provide valves as required by NFPA 24 for fire service. Ensure gate valves conform to AWWA C500 or UL 262 with cast iron body and bronze trim, and open by counterclockwise rotation.

2.1.8.3 Post Indicator Valve Assembly (PIV)

Provide a standard FM-approved or UL-listed inside-screw gate valve, rated at 1207 kilopascal 175 psi, with an above-grade post indicator or a completely factory-assembled FM-approved quarter-turn valve and above-grade post indicator-operator. Direction to open is counterclockwise.

Ensure post has a fail-safe feature to keep the valve intact in case of breaking off above grade. Operator is a worm-gear-type with permanently oil-lubricated watertight gear case complete with a handle.

Ensure surfaces below grade receive a coating of bitumen not less than 0.51 millimeter 20-mils thick. Fill, prime, and finish above-grade surfaces with multiple coats of high-gloss, weather-resistant, red enamel.

Fit post indicator valves to accommodate electrical supervisory switches.

Provide electrical supervisory switches for interconnection to the building fire alarm system. Ensure switches and connections meet the requirements of Section 28 31 70 INTERIOR FIRE ALARM SYSTEM, ADDRESSABLE

2.1.8.4 Valve Boxes

Except where indicator posts are installed, provide each gate valve in buried piping with an adjustable cast-iron valve box of a size suitable for the valve on which it is used. Boxes installed outside of paved areas may be of acrylonitrile-butadiene-styrene (ABS) plastic or of inorganic fiber-reinforced black polyolefin plastic. The head is round and the lid has the word WATER cast in it. The least diameter of the shaft of the box is 133 millimeter 5.25 inches. Apply a heavy coat of bituminous paint to each cast-iron box.

2.1.9 Valve Signs

Attach approved, properly lettered metal signs to each control valve.

2.1.10 Modifications to Existing Post Indicator Valves

****
NOTE: Delete or modify this part as required.
****

Modify the existing post indicator valves by furnishing and installing a double-pole double-throw limit switch on each valve. Enclose the limit switch in a NEMA 250, Type 4, enclosure and rated for 15 amperes at 115 volts ac. Install the limit switch to actuate when the valve starts to close and when the valve is fully open.

Extend wiring for these switches to the existing fire-alarm panel. Install wiring in conduit.

2.1.11 Equipment Foundation

Submit equipment foundation data for deluge automatic sprinkler systems consisting of the following items:

a. Equipment weight and operating loads.

b. Horizontal and vertical loads.

c. Size, location, and projection of anchor bolts.

d. Horizontal and vertical clearances for installation, operation and maintenance.

e. Plan dimensions of foundations and relative elevations.

f. Installation requirements such as noise abatement, vibration isolation, and utility service.

2.2 Deluge Riser Types and Functionality

Provide valves to control the release of water that are of a type of deluge riser configuration suitable for the hazards and sensitivity of operations encountered.

Deluge risers consist of, but are not limited to, deluge valve(s), two-step arm and activate release stations, solenoid valve(s), manual release valve(s), with all associated piping and trim, including gauges, pressure switches, solenoid control cabinet,[pneumatic actuators,] and fixed spray nozzles and/or open sprinkler heads for the system. Include all materials, accessories, and equipment to provide an operationally compliant system.

Provide deluge valve(s) capable of actuation by local arm and activate release stations[, and detection devices] Provide arm and activate releasing stations that interface through the fire alarm system for control of solenoids that operate the deluge valves.

Systems discharge water from open, fixed spray nozzles or heads after the deluge valves are opened. Once activated, systems continue to operate until each deluge valve is commanded to close or an upstream manually operated control valve is closed. Refer to plans for quantity and location of valves.

2.2.1 Standard Deluge Riser

The Standard deluge riser has either one (1) UL-listed standard deluge valve or two (2) standard deluge valves in parallel when parallel redundancy is required against failure. Provide pressure gauges and other appurtenances at the deluge valves as required by NFPA 13 and manufacturer's instructions to meet UL Listing requirements. Provide full standard manufacturer's trim, including an alarm test line, unless otherwise modified by plan notes or details.

Provide deluge valves capable of actuation by electronic solenoid or manual release valve, protected by a metal box, that relieves pressure in the deluge valve priming line. Actuation of normally closed solenoids will be by arm and activate release stations[and detection device, depending on facility requirements]. When the valve is set for service, the

diaphragm chamber is hydraulically pressurized through the trim connections from an outlet upstream of the water supply control valve. The operation of the solenoid or manual release valve releases water from the diaphragm chamber through an outlet faster than it can be replenished through the restricted control valve in the diaphragm chamber supply connection. This release results in a rapid pressure drop in the chamber, so the water supply pressure forces the diaphragm to open. Water discharges from open, fixed spray nozzles and/or open sprinkler heads after the deluge valve trips. Closing of the solenoid valve permits the diaphragm chamber to pressurize again. This closes the deluge valve and stops the flow of water into the system piping.

Provide separate circuits from the control panel to each zone of initiating devices. Transmission of signals from more than one zone over a common circuit is prohibited.

[2.2.2 Type I Deluge Riser

The Type I deluge riser has either one (1) pneumatically actuated, normally closed butterfly valve or two (2) butterfly valves in parallel to control supply of water to the system piping and nozzles downstream. Use parallel vales when programmatic requirements dictate the elimination of single failure points. The farthest downstream butterfly valve to the water supply opens on an arm command to prevent water hammer. The closest downstream valve to the water supply opens on an activate command.

The pneumatic actuator is supplied compressed air or GN2 from a solenoid cabinet from which the butterfly valve's actuator is controlled by its own 4-way, 2-position solenoid. The two ports on each pneumatic actuator are connected to the two outlet ports of a four-way, two-position solenoid valve with dual coils. The four-way, two-position solenoid valve has four ports: supply, vent, side one outlet, and side two outlet. Upon activation of the water spray system, power is supplied to the coil of the solenoid outlet connected to the pneumatic actuator port that opens the butterfly valve. When this coil is energized, compressed air or GN2 travels from the solenoid supply port to the corresponding outlet and pressurizes the chamber that opens the butterfly valve. Simultaneously, the other chamber that closes the butterfly valve is vented through the other solenoid outlet which is connected to the solenoid vent. The pneumatic line from the solenoid to the port of the actuator that opens the butterfly valve has a bidirectional flow control valve that allows full pneumatic flow from the solenoid to the actuator and has an adjustable capability to restrict the flow from the actuator to the solenoid.

When the valve closure signal is received, power is supplied to the coil of the solenoid outlet connected to the pneumatic actuator port that closes the butterfly valve. When this coil is energized, compressed air or GN2 travels from the solenoid supply port to the corresponding outlet and pressurizes the chamber that closes the butterfly valve. Simultaneously, the other chamber that opens the butterfly valve is vented through the other solenoid outlet connected to the solenoid vent. The bidirectional flow control valve in the pneumatic line from the side of the actuator that opens the butterfly valve is used to control venting to set the closure time of each valve.

][2.2.3 Type II Deluge Riser

The Type II deluge riser has four (4) pneumatically actuated, normally closed butterfly valves, configured in two parallel sets in series, to

control supply of water to the system piping and nozzles downstream. The riser splits into two branches downstream of the supply control valve, supplying each series of butterfly valves separately for system redundancy. The two riser branches have a connection pipe between the parallel sets of butterfly valves. The two branches of the riser flow back together after the farthest downstream set of valves to supply open nozzles and/or heads with water.

The set of valves farthest downstream of the water supply opens on an arm command to prevent water hammer. No water will move when the system is armed. The closest downstream set of valves to the water supply (closest to shutoff valve, water immediately upstream) opens on an activate command which causes water to enter the system piping.

The pneumatic actuator is supplied compressed air or GN2 from a solenoid cabinet from which the butterfly valve's actuator is controlled by its own 4-way, 2-position solenoid. The two ports on each pneumatic actuator are connected to the two outlet ports of a four-way, two-position solenoid valve with dual coils. The four-way, two-position solenoid valve has four ports: supply, vent, side one outlet, and side two outlet. Upon activation of the water spray system, power is supplied to the coil of the solenoid outlet connected to the pneumatic actuator port that opens the butterfly valve. When this coil is energized, compressed air or GN2 travels from the solenoid supply port to the corresponding outlet and pressurizes the chamber that opens the butterfly valve. Simultaneously, the other chamber that closes the butterfly valve is vented through the other solenoid outlet which is connected to the solenoid vent. The pneumatic line from the solenoid to the port of the actuator that opens the butterfly valve has a bidirectional flow control valve that allows full pneumatic flow from the solenoid to the actuator and has an adjustable capability to restrict the flow from the actuator to the solenoid.

When the valve closure signal is received, power is supplied to the coil of the solenoid outlet connected to the pneumatic actuator port that closes the butterfly valve. When this coil is energized, compressed air or GN2 travels from the solenoid supply port to the corresponding outlet and pressurizes the chamber that closes the butterfly valve. Simultaneously, the other chamber that opens the butterfly valve is vented through the other solenoid outlet connected to the solenoid vent. The bidirectional flow control valve in the pneumatic line from the side of the actuator that opens the butterfly valve is used to control venting to set the closure time of each valve.

]2.2.4 Type III Deluge Riser

The Type III deluge riser has one (1) manually operated butterfly valve with quarter turn handle geared for quick operation by hand, not requiring excessive force. A pressure switch is required at each riser.

The use of a Type III riser requires AHJ approval and must satisfy operational and safety requirements. The Type III deluge riser must be located remotely enough from the hazard so the system protects a person on standby either in a space considered sufficient shelter for the hazards or remote enough to allow for egress after the valve is operated.

2.3 MANUAL ACTIVATION STATIONS

Provide two-step arm and activate release stations at each location shown. Each release station will have two electronic pull stations or push

buttons, one for "arm" and the other for "activate." Initiating both an arm and activate push button/pull station will cause the water spray valve to operate.

Provide devices that meet the requirements specified for manual alarm stations in Division 28 ELECTRONIC SAFETY AND SECURITY except as modified herein. Provide devices that are not spring loaded or constructed of plastics or composite materials. Provide stations that are of a type not subject to operation by jarring or vibration. Provide stations that have a dual action release configuration to prevent accidental system discharge, the activation station, which includes lifting/opening a cover and then operating the arm and activate pull levers. Provide stations that are yellow in color.

[For push button release stations, utilize Crouse-Hinds Class I-Div II Cat.No. EDSC2155 GB explosion-proof push-button control stations or approved equal, and a set of Crouse-Hinds Class I-Div II Cat. No. EFSC21561J1J3 LED S300 explosion-proof pilot-light control stations or approved equal.]

[Provide permanently affixed (using fasteners) plastic signage above each pair of manual activation stations to identify that these are manual water spray activation stations, that both stations must be activated for system operation,][Provide permanently affixed (using paint) painted labels onto manual activation station covers,] as per fire protection design drawings. Provide stations that have a positive visible indication of operation. Provide a type of station where restoration to normal position requires use of a key or special tool. Where a building fire alarm pull station is also mounted in the vicinity of a manual water spray station, separate the stations by at least [152][_____] millimeters [36][_____] inches horizontally.

PART 3 EXECUTION

Provide the deluge sprinkler system with complete drainage facilities in accordance with the applicable requirements of NFPA 13.

3.1 INSTALLATION

3.1.1 Connections to Existing Water Supply Systems

Use tapping or drilling machine valve and mechanical joint-type sleeves for connections made under pressure. Bolt the sleeves around the mains and the valve in conformance to AWWA C500. Open the valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of potable service. Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Receive approval before any service is interrupted. Furnish material required to make connections into the existing water supply system. Perform excavating, backfilling, and other incidental labor for connections as required.

****
NOTE: Add any government-furnished assistance.
****

[Furnish][The Government will furnish only]the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.1.2 Disinfection

Disinfect new water piping and existing water piping affected by the work in accordance with AWWA C651. The Government will supply the water, but the Contractor is responsible for approved disposal of contaminated water.

3.1.3 Painting

****
NOTE: Coordinate with painting Section 09 90 00 PAINTS AND COATINGS.
****

Submit the manufacturer's standard color charts showing the recommended colors and finishes.

For manufacturer's standard-finish equipment, bring surfaces damaged during construction to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replace the damaged equipment with new undamaged equipment at no additional cost to the Government.

Protect all sprinkler heads from painting operations.Thoroughly clean and paint pipe, pipe hangers, supports, and other iron work in concealed spaces with one coat of primer paint.

Ensure all exposed piping, valves, and appurtenances, including hose racks and reels, but excluding hoses, hose nozzles, and siamese connections, receive one coat of enamel, Color No. 11105 (red), in accordance with MIL-STD-101 and SAE AMS-STD-595A.

3.1.4 Electrical Work

Electrical work is specified in Division 26 ELECTRICAL and DIVISION 28 ELECTRONIC SAFETY AND SECURITY, except as noted.

Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Ensure motors, controllers, contactors, and disconnects conform to and have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

3.2 FIELD QUALITY CONTROL

****
NOTE: If the specified system is identified as critical, configured, or mission essential, use Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS to establish predictive and acceptance testing criteria, above and beyond that listed below.
****

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Perform pressure tests, system tests, and operating tests required for new work. Notify the Contracting Officer 48 hours in advance of the start of testing.

Submit test reports for pressure tests, system tests, and operating tests.

3.2.1 Preliminary Tests

****
NOTE: Select water pressure.
****

Hydrostatically test each system at [_____] [1380] kilopascal [_____] [200] psig for a period of 2 hours and flush in accordance with NFPA 13. Inspect, test, and approve piping above suspended ceilings before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests have been completed and all corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for formal inspection and tests.

3.2.2 Formal Inspection and Tests

The Contracting Officer [,Owner's Representative (i.e. O&M System Engineer), and the AHJ or their designee(s)] will witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 calendar days prior to the date the inspection is to take place. Ensure an experienced technician regularly employed by the Contractor is present during the inspection. At this inspection, repeat any or all of the required tests as directed. Test each detection device and its connection to each valve by the application of heat. Test each deluge system by full flow from the individual system or any combination of systems. Correct defects in the work, and make additional tests until it has been demonstrated that the systems comply with all contract requirements. Furnish appliances, equipment, electricity, instruments, connecting devices, and personnel for the tests. The Government will furnish the water for the tests.

3.2.2.1 Systems and Device Testing

Operate the entire initiating, alarm, and actuation systems. As a minimum, demonstrate operation and supervision of the following functions and devices:

a. All operational and supervisory functions of the control and annunciator panels.

b. Activation of each water control valve by its respective solenoid valve as specified herein and per manufacturer's instructions.

c. Each manual discharge station and associated circuit(s) with system discharge through test header or open heads/nozzles at least once.

d. All actuator circuits and system control valve(s).

e. All detectors and associated circuits.

f. All alarms and associated circuits.

g. Activation of the Base fire alarm system (receipt of fire alarm at alarm office).

h. Repeat all of the above tests with the system on battery power only.

[For water spray systems, record pressure readings at the system actuation valve and compared to the design criteria to determine that the system is operating as designed.]

3.2.2.1.1 Operating Tests

Perform a full operational flow test for each riser. Perform the flow test until flow reaches a steady-state or until approved by a representative of the AHJ, and then command the riser to close to test shut-off operation or close the supply control valve and reset the valve as applicable.

When possible, activate the system and observe the water discharge patterns from all the open spray nozzles and/or sprinkler heads to verify:

a. Patterns are not impeded by plugging of the nozzles and/or sprinkler heads.

b. Nozzles and/or sprinkler heads are properly positioned.

c. Nozzle and/or sprinkler head discharge patterns are not obstructed from wetting surfaces to be protected as designed.

Record pressure readings after the riser's control valve(s) per meter manufacturer's requirements and compare to the design criteria to determine that the system is operating as designed.

In areas where periodic flow testing of the deluge system cannot be accomplished through its open heads or nozzles due to facility operations, provide a test header that will properly model the flow characteristics of the system. Isolate the system by closing the valve to the nozzles/heads and open the test header valve. Provide a flow meter or ports for the connection of a portable flow meter to monitor the flow in the discharge piping.

3.2.3 Disposition of Test Water

Dispose of test water in accordance with the approved water disposal plan to avoid property damage.

3.2.4 Test Point

Measure the hydrostatic test pressure at the low point of the individual system or zone being tested.

3.2.5 Leakage

Install the inside sprinkler piping so that there is no leakage when the system is subjected to the hydrostatic pressure tests.

3.2.6 Piping Test

Test the piping between the check valve in the fire department inlet piping and the outside connection in the same manner as the balance of the systems.

3.2.7 Test Blanks

Provide test blanks, of the self-indicating type. Ensure test blanks have red painted lugs protruding beyond the flange in a way to clearly indicate their presence. Number test blanks to enable tracking their use and location and to ensure their removal after the test is completed.

3.3 ADJUSTING AND CLEANING

3.3.1 Flushing of Underground Connections

Flush underground mains and lead-in connections to the system riser before connection is made to the sprinkler piping to remove foreign materials that may have entered the underground piping during the course of the installation. Continue the flushing operation until water is clear.

Flush underground mains and lead-in connections at a flow rate not less than indicated below or at the hydraulically calculated water demand rate of the system, whichever is greater.

Pipe Size millimeters	100	125	150	200	250	300
Flow Rate liters per minute	1512	2268	2835	3780	5670	7560

Pipe Size Inches	4	5	6	8	10	12
Flow Rate gpm	400	600	750	1000	1500	2000

3.4 CLOSEOUT ACTIVITIES

3.4.1 Operation and Maintenance

Submit [6] [_____] copies of the operation and maintenance manuals 30 calendar days prior to testing the deluge automatic sprinkler systems. Update after testing and resubmit data for final approval no later than 30 calendar days prior to contract completion.

Furnish operation and maintenance manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Ensure test data is legible and of good quality. Light-sensitive reproduction techniques are acceptable, provided finished pages are clear, legible, and not subject to fading. Provide pages for vendor data and manuals with 10 millimeter 3/8 inch holes, bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets in a loose-leaf binder. Ensure the binder can lie flat with printed sheets that are easy to read. Ensure caution and warning indications are clearly labeled.

Provide classroom and field instructions in operation and maintenance of systems equipment where required by the technical provisions. These services are directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representative. Give the Contracting Officer seven days written notice of scheduled instructional

services. Make instructional materials belonging to the manufacturer or vendor available to the Contracting Officer.

-- End of Section --