Preparing Activity: USACE Superseding
UFGS-21 13 16.00 20 (April 2006)
UFGS-21 13 17.00 10 (May 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 21 - FIRE SUPPRESSION

SECTION 21 13 16

DRY PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

08/20

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USACE / NAVFAC / AFCEC / NASA	**UFGS-21 13 16 (August 2020)**

Preparing Activity: USACE	**Superseding** **UFGS-21 13 16.00 20 (April 2006)** **UFGS-21 13 17.00 10 (May 2009)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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****

SECTION 21 13 16

DRY PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
08/20

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NOTE: This guide specification covers the requirements for dry pipe 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. The designer is permitted to edit any and all of this section for the project. If the designer is modifying/deleting non-bracketed items and text, the Designated Fire Protection Engineer (DFPE) should be consulted prior to incorporating final changes.

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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NOTE: For OCONUS projects, this specification section should be edited for specific Host Nation requirements. Coordinate compliance with Host Nation requirements with the DFPE.
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****
NOTE: This specification section includes requirements from UFC 3-600-01 (change 4, 7 February 2020)

****

PART 1 GENERAL

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NOTE:

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

This section is primarily intended for performance designed systems, e.g. systems where the size, layout, and support of branch lines and cross mains, and the layout of sprinklers will be designed by the Contractor.

This section is not intended to be used for NFPA 13D systems.

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

(1) Show the layout and size of all piping and equipment from the point of connection to the water supply, to the sprinkler riser. The contract drawings must include a detailed sprinkler riser diagram.

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

(3) Specify waterflow data including hydrant flow test 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.

(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) 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.

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

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

(10) Nitrogen generators, including controls and complete installation details, including piping, control valves, mounting base.

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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 MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2021) Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe

	Flanges
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1015	(2021) Performance Requirements for Double Check Backflow Prevention Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2022) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2021) Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA M14	(2015) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
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
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM B62	(2017) Standard Specification for

	Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)

FM GLOBAL (FM)

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

INTELLIGENCE COMMUNITY STANDARD (ICS)

ICS 705-1	(2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities

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

MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends

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 101	(2021; TIA 21-1) Life Safety Code
NFPA 291	(2022) Recommended Practice for Fire Flow Testing and Marking of Hydrants
NFPA 1963	(2019) Standard for Fire Hose Connections

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

UNDERWRITERS LABORATORIES (UL)

UL 199	(2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service
UL 262	(2004; Reprint Oct 2011) Gate Valves for

	Fire-Protection Service
UL 312	(2022) UL Standard for Safety Check Valves for Fire-Protection Service
UL 405	(2013; Bul. 2020) UL Standard for Safety Fire Department Connection Devices
UL 668	(2004; Reprint Oct 2021) UL Standard for Safety Hose Valves for Fire-Protection Service
UL 789	(2004; Reprint May 2017) UL Standard for Safety Indicator Posts for Fire-Protection Service
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

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NOTE: Seismic protection/bracing is to be provided for seismic design categories C or greater only, unless specifically requested by the DFPE. Consideration should also be giving to utilizing seismic protection/bracing to limit pipe movement.

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Provide dry pipe [sprinkler] system(s) in [areas indicated on the drawings] [_____]. Except as modified herein, the system must meet the requirements of NFPA 13[and]. Dry pipe systems must utilize nitrogen.Pipe sizes which are not indicated on the Contract drawings must be determined by hydraulic calculations.

1.2.1 Hydraulic Design

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

Discharge density for non-storage occupancies must be in accordance with UFC 3-600-01. Specific densities must be listed on the drawings or noted in the specification when drawings are not provided. Stating "comply with UFC 3-600-01 is not acceptable.

Hazard classification of miscellaneous storage must be per NFPA 13. Discharge density for the hazard classification must be per UFC 3-600-01.

The paragraph below must be listed on the drawings. If this information is not listed on the drawings, provide the information in paragraph 1.1.1.3 (with brackets completed).

Hydraulically design the system to discharge a minimum density [of [_____] L/min per square meter gpm/square foot over the hydraulically most

demanding [280] [_____] square meters[_____] square feet of floor area][as indicated on the drawings]. Hydraulic calculations must be in accordance with the Area/Density Method of NFPA 13.

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NOTE: The addition, modification or relocation of no more than twenty sprinklers to an existing system or modifications to existing sprinkler systems fed from domestic supplies are permitted to be designed using the pipe schedule method in NFPA 13 based on the layout of the existing system.

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1.2.1.1 Basis for Calculations

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

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

****

A waterflow test was performed on (DATE) at (LOCATION) and resulted in a static pressure of [_____ kPapsi] with a residual pressure of [_____ kPapsi] while flowing [_____ L/mingpm]. Perform a fire hydrant flow test prior to shop drawing submittal in accordance with NFPA 291. Results must include hydrant elevations relative to the building and hydrant number/identifiers for the tested hydrants, including which were flowed, which had a gauge. This information must be presented in a tabular form if multiple hydrants were flowed. The results must be included with the hydraulic calculations. Hydraulic calculations must be based on flow test noted in this paragraph, unless [verified by the NAVFAC[_____] Fire Protection Engineer and] approved by Contracting Officer. Hydraulic calculations must be based upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping, [and [_____] for existing underground piping]. A "C" value of 120 is permitted to be used in hydraulic calculations when nitrogen is utilized.[Hydraulic calculations must be based on operation of the fire pump(s) provided in Section 21 30 00 FIRE PUMPS.] [The minimum residual pressure in a service lateral (lead-in) at the [design flow rate][150% of the fire pump rated flow] must be 138 kPa20 psi at [the inlet to the backflow preventer][the suction side of the fire pump]].

1.2.1.2 Hydraulic Calculations

a. Water supply curves and system requirements must be plotted on semi-logarithmic graph (N^1.85) paper so as to present a summary of the complete hydraulic calculation.

b. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, minimum discharge pressures and minimum flows. Elevations of hydraulic reference points (nodes) must be indicated.

c. Documentation must identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe.

d. Where the sprinkler system is supplied by interconnected risers, the sprinkler system must be hydraulically calculated using the hydraulically most demanding single riser. The calculations must not assume the simultaneous use of more than one riser.

e. All calculations must include the backflow preventer manufacturer's stated friction loss at the design flow or [83 kPa12 psi for reduced pressure][55 kPa8 psi for double check] backflow preventer, whichever is greater.

f. All calculations must be performed back to the actual location of the flow test, taking into account the direction of flow in the service main at the test location.

1.2.1.3 Design Criteria

Hydraulically design the system to discharge a minimum density [of [_____] L/min per square metergpm/square foot over the hydraulically most demanding [_____] square metersquare feet of floor area][as indicated on the drawings]. Hydraulic calculations must be in accordance with the Area/Density Method of NFPA 13. 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 must be added to the sprinkler system demand.]

1.2.2 Sprinkler Coverage

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NOTE: The exception in NFPA 13 to eliminate sprinklers in electrical rooms is not applicable per UFC 3-600-01.
****

Sprinklers must be uniformly spaced on branch lines. Provide coverage throughout 100 percent of the [building][area noted on the Contract drawings]. This includes, but is not limited to, telephone rooms, electrical equipment rooms (regardless of the fire resistance rating of the enclosure), boiler rooms, switchgear rooms, transformer rooms, attached electrical vaults and other electrical and mechanical spaces. Coverage per sprinkler must be in accordance with NFPA 13. Provide sprinklers below all obstructions in accordance with NFPA 13. Exceptions are as follows:

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

[1.2.3 System Volume Limitations

Where the volume of an individual system piping exceeds 1890 liters500 gallons, provide the dry pipe valve with a quick-opening device. The maximum system capacity controlled by one dry pipe valve must not exceed 2800 liters750 gallons, unless it complies with the dry pipe system water delivery calculations noted in NFPA 13.

]1.2.4 Qualified Fire Protection Engineer (QFPE)

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NOTE: UFC 3-600-01 requires that shop drawings must bear the Review Stamp and professional engineering stamp of the QFPE prior to submission to the Government for approval.

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NOTE: The term Qualified Fire Protection Engineer (QFPE) should be considered interchangeable with the terms "Fire Protection Designer of Record (FPDOR)" and/or "Fire Protection QC Specialist" where referred to in other applicable contract documents. The intent of defining the QFPE roles and responsibilities here is NOT to require personnel in addition to the QFPE, FPDOR, and/or FPQC specialist referenced elsewhere in the applicable contract documents.

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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 DFPE.

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

1.3 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.

NOTE: When 20 or less sprinklers are added, modified or relocated, shop drawings, hydraulic calculations and product data are not required to be submitted. Edit this section accordingly.
****

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.] Partial submittals and submittals not fully complying with NFPA 13 and this specification section must be returned disapproved without review. SD-02, SD-03 and SD-05 must be submitted simultaneously.

Shop drawings (SD-02), product data (SD-03) and calculations (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

Qualified Fire Protection Engineer (QFPE); G[, [_____]]

Sprinkler System Designer; G[, [_____]]

Sprinkler System Installer; G[, [_____]]

Nitrogen Generation System Commissioning Technician ; G[, [_____]]

SD-02 Shop Drawings

Shop Drawing; G[, [_____]]

SD-03 Product Data

Pipe; G[, [_____]]

Fittings; G[, [_____]]

Valves, including gate, check, butterfly, and globe; G[, [_____]]

Relief Valves; G[, [_____]]

Sprinklers ; G[, [_____]]

Pipe Hangers and Supports ; G[, [_____]]

Sprinkler Alarm Switch; G[, [_____]]

Valve Supervisory (Tamper) Switch; G[, [_____]]

Fire Department Connection; G[, [_____]]

Backflow Prevention Assembly; G[, [_____]]

Hose Valve; G[, [_____]]

[Seismic Bracing; G[, [_____]]

][High/Low-Nitrogen Pressure Supervisory Switch; G[, [_____]]

][Nitrogen Generation System; G[, [_____]]

] Nameplates; G[, [_____]]

Dry Pipe Valve; G[, [_____]]

SD-05 Design Data

[Seismic Bracing; G[, [_____]]

Load calculations for sizing of seismic bracing

] Hydraulic Calculations; G[, [_____]]

SD-06 Test Reports

Test Procedures; G[, [_____]]

SD-07 Certificates

Verification of Compliant Installation; G[, [_____]]

Request for Government Final Test; G[, [_____]]

SD-10 Operation and Maintenance Data

Operating and Maintenance (O&M) Instructions; G[, [_____]]

Spare Parts Data; G[, [_____]]

SD-11 Closeout Submittals

As-built drawings

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

Within 36 days of contract award but no less than [14 days][_____] prior to commencing work on site, the prime Contractor must submit the following for review and approval. SD-02, SD-03 and SD-05 submittals received prior to the review and approval of the qualifications must be returned Disapproved Without Review. All resultant delays are the sole responsibility of the prime Contractor.

1.4.1.1 Shop Drawing

[_____] copies of the shop drawings, no later than 28 days prior to the start of system installation. Working drawings conforming to the requirements prescribed in NFPA 13 and must be no smaller than [ISO A1][ANSI D][the Contract Drawings]. Each set of drawings must include the following:

1. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

2. Floor plans drawn to a scale not less than 1:100 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, electrical power connections and other details required to clearly describe the proposed arrangement.

3. 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 must show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

4. Longitudinal and transverse building sections showing typical branch line and cross main pipe routing, elevation of each typical sprinkler above finished floor and elevation of "cloud" or false ceilings in relation to the building ceilings.

5. Plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.

6. Riser layout drawings drawn to a scale of not less than 1:25 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.

7. 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. The dimension from the edge of vertical piping to the nearest adjacent wall(s) must be indicated on the drawings when vertical piping is located in stairs or other portions of the means of egress.

8. Details of each type of pipe hanger[, seismic bracing/restraint] and related components.

[9. Include fire pump curve with shop drawings and hydraulic calculations.]

10. The calculated volume of each system.

1.4.1.2 Product Data

[_____] copies of annotated catalog data to show the specific model, type, and size of each item. Catalog cuts must also indicate the NRTL listing. The data must be highlighted to show model, size, options, and other pertinent information, that are intended for consideration. Data must be adequate to demonstrate compliance with all contract requirements. Product data for all equipment must be combined into a single submittal.

1.4.1.3 Hydraulic Calculations

****
NOTE: Include the first bracketed item for Army Corps projects.
****

Calculations must be as outlined in NFPA 13 except that calculations must be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings.[Calculations must include isometric diagram indicating hydraulic nodes and pipe segments.][Include fire pump curve with submittal.]

1.4.1.4 Operating and Maintenance (O&M) Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modified by this specification section.

Provide [six][_____] manuals[and one pdf version on electronic media]. The manuals must 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, 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 must be capable of providing [4][_____]-hour on-site response to a service call on an emergency basis.]

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

1.4.2 Qualifications

****
NOTE: NICET (National Institute for Certification in Engineering Technologies) establishes the qualifications of an individual as an Engineering Technologist with verification of experience by having a current NICET certification.
****

1.4.2.1 Sprinkler System Designer

The sprinkler system designer must be certified as a Level [III][IV] 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.

1.4.2.2 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.

1.4.2.3 Nitrogen Generation System Commissioning Technician

Commissioning technician of nitrogen generation system(s) must have one of the following qualifications. Qualifications must be provided prior to preliminary inspection and tests.

a. Commissioning of nitrogen generation system must be carried out by technician employed by and certified by the nitrogen generation system manufacturer.

b. In lieu of manufacturer's commissioning technician, the fire sprinkler contractor must provide proof their commissioning technician has manufacturer's certified training for the equipment being installed and proof of at least five previous installations of manufacturer's equipment where the contractor's commissioning technician has successfully conducted commissioning under the direct supervision of the manufacturer's commissioning representative. Contractor must provide proof the five supervised commissioning occurred AFTER contractor's commissioning agent has obtained the certified training. Commissioning carried out prior to factory training, or without supervision of manufacturer's technician or commissioning of other manufacturer's equipment does not qualify as applicable experience. Conduct preliminary inspections and testing does not qualify as applicable experience.

1.4.3 Regulatory Requirements

Equipment and material must be listed or approved. Listed or approved, as used in this Section, means listed, labeled or approved by a Nationally Recognized Testing Laboratory (NRTL) such as UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of an item of equipment described must not be construed as waiving this requirement. All listings or approvals by testing laboratories must be from an existing ANSI or UL published standard. The recommended practices stated in the manufacturer's literature or documentation are mandatory requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. All pipes must be either capped or plugged until installed.

1.6 EXTRA MATERIALS

Spare sprinklers and wrench(es) must be provided as spare parts in accordance with NFPA 13.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials, equipment, and devices listed for fire protection service when so required by NFPA 13 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for a particular classification of materials. Material and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least [2][_____] years prior to bid.

2.1.2 Nameplates

Major components of equipment must have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new name plate permanently affixed to the item or equipment. Nameplates must be etched metal or plastic, permanently attached by screws to control units, panels or adjacent walls.

2.1.3 Identification and Marking

Pipe and fitting markings must include name or identifying symbol of manufacturer and nominal size. Pipe must be marked with ASTM designation. Valves and equipment markings must have name or identifying symbol of manufacturer, specific model number, nominal size, name of device, arrow indicating direction of flow, and position of installation (horizontal or vertical), except if valve can be installed in either position. Markings must be included on the body casting or on an etched or stamped metal nameplate permanently on the valve or cover plate.

2.1.4 Pressure Ratings

Valves, fittings, couplings, alarm switches, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than [1207][1724] kPa[175][250] psi.

2.2 UNDERGROUND PIPING COMPONENTS

****

NOTE: The design drawings must show the service connection details and the underground service lateral for the sprinkler system. The drawings must show 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. 4-inch piping is the minimum permitted for service laterals serving NFPA 13R systems. 6-inch piping is the minimum permitted for NFPA 13 systems.

****

2.2.1 Pipe

Pipe must comply with NFPA 24. Minimum pipe size is [100 mm4 inches][150 mm6 inches]. Piping more than 1.50 meters5 feet outside the building walls must comply with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. A continuous section of welded stainless steel fire water service piping from a point outside the building perimeter to a flanged fitting at least 304 mm1-foot above the finished floor within the building is acceptable.

2.2.2 Fittings and Gaskets

Fittings must be ductile-iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets must be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile-iron pipe joints must conform to AWWA C111/A21.11.

2.2.3 Gate Valve[and Indicator Posts]

****

NOTE: This paragraph will be deleted if underground valves are either not required or are specified elsewhere.

****

Installation must comply with NFPA 24. Gate valves for use with indicator post must conform to UL 262.[Indicator posts must conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.]

[2.2.4 Valve Boxes

Except where indicator posts are provided, for each buried valve, provide a cast-iron, ductile-iron, or plastic valve box of a suitable size. Plastic boxes must be constructed of acrylonitrile-butadiene-styrene (ABS) or inorganic fiber-reinforced black polyolefin. Provide cast-iron, ductile-iron, or plastic cover for valve box with the word "WATER" cast on the cover. The minimum box shaft diameter must be 133 mm5.25 inches.

Coat cast-iron and ductile-iron boxes with bituminous paint applied to a minimum dry-film thickness of 0.254 mm10 mils.

]2.2.5 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape, 80 mm3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification must read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.3 ABOVEGROUND PIPING COMPONENTS

****

NOTE: Specify steel piping exposed to the weather or corrosive atmospheres to properly protect against corrosive effects.

NOTE: GALVANIZED PIPING IS ONLY PERMITTED FOR DELUGE SYSTEMS, VALVE TRIM PIPING AND DRAIN PIPING WHEN EXPOSED TO THE EXTERIOR.

****

2.3.1 Steel Piping Components

2.3.1.1 Steel Pipe

****

NOTE: For DLA, use Schedule 40 steel pipe only.

NOTE: Grooved pipe must be cut grooved for WHS projects.

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Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53/A53M, ASTM A135/A135M or ASTM A153/A153M.

[Steel pipe must be minimum Schedule 40 for sizes 50 mm2 inches and less; and minimum Schedule 10 for sizes larger than 50 mm2 inches.][Steel pipe must be Schedule 40 only.] Steel piping with wall thickness less than Schedule 40 must not be threaded. [Grooved pipe must be cut-grooved.]

2.3.1.2 Fittings

Fittings must be welded, threaded, or grooved-end type. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable-iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe, steel press fittings and field welded fittings are not permitted. Fittings, mechanical couplings, and rubber gaskets must be supplied by the same manufacturer. Threaded fittings must use Teflon tape or manufacturer's approved joint compound.[Saddle tees using rubber gasketed fittings are permitted only when connecting to existing piping

for additions or modifications. Saddle tees must use a connection method that completely wraps around the pipe.] Reducing couplings are not permitted except as allowed by NFPA 13.

2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 1200 kPa175 psi service and the product of the same manufacturer. Field welded fittings must not be used. Fitting and coupling housing must be malleable-iron conforming to ASTM A47/A47M, Grade 32510; ductile-iron conforming to ASTM A536, Grade 65-45-12. Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 50 mm2 inches and larger. Gasket must be of silicon compound and listed for dry fire protection systems. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium-plated or zinc-electroplated.

2.3.1.4 Flanges

Flanges must conform to NFPA 13 and ASME B16.1. Gaskets must 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.

[2.3.2 Copper Tube Components

2.3.2.1 Copper Tube

Copper tube must conform to ASTM B88MASTM B88, Types L and M.

2.3.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings must conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings must conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy fittings for flared copper tube must conform to ASME B16.26 and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

]2.3.3 Pipe Hangers and Supports

****

NOTE: Seismic parameters must follow UFC 3-301-01 Structural Engineering. The writer of this section must coordinate with the Structural Engineer or Government to determine the proper seismic design category for the project, in accordance with the IBC or ASCE guidelines. See UFC 3-310-04 for more information.

****

Provide galvanized pipe hangers[, supports and seismic bracing][and supports] in accordance with NFPA 13.[Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes for Seismic Design Category ["C"]["D"]["_____"]].

2.3.4 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

2.3.4.1 Control Valve

Manually operated sprinkler control/gate valve must be [outside stem and yoke (OS&Y) type][or][butterfly type][as indicated on the drawings] and must be listed.

2.3.4.2 Check Valves

Check valves must comply with UL 312. Check valves 100 mm4 inches and larger must be of the swing type, have a clear waterway and meet the requirements of MSS SP-71, for Type 3 or 4. Inspection plate must be provided on valves larger than 150 mm6 inches.

2.3.4.3 Hose Valve

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NOTE: Hose valves are required as part of the backflow prevention test header.
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Valve must comply with UL 668.

2.4 DRY PIPE VALVE ASSEMBLY

The dry pipe valve must be a listed, latching differential type be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation. The assembly must include a quick-opening device by the same manufacturer as the dry pipe valve for systems over 1890 liters500 gallons in capacity and in all cases when needed to achieve the timed test requirements in part 3 of this specification section.

2.5 SUPERVISORY NITROGEN SYSTEM

Provide a nitrogen supply system in accordance with NFPA 13. The connection pipe from the nitrogen generator must not be less than 13 mm 1/2-inch in diameter and must enter the system above the priming water level of the dry pipe valve. Install a check valve in the system supply nitrogen piping from the generator. A shutoff valve of the renewable disc type must be installed upstream of this check valve. The nitrogen supply system must be sized to pressurize the sprinkler system to [275][_____] kPa [40][_____] psi within 20 minutes.

2.5.1 Nitrogen Generation System

The nitrogen generation system (NGS) must be installed with a compressor sized appropriately for the application and capable of achieving system pressure within 30 minutes in accordance with the requirements of NFPA 13. The nitrogen generation system must be designed to achieve a nitrogen concentration of 98% or greater and maintain that concentration within the fire sprinkler system continuously. The output nitrogen quality must be confirmed by using a gas stream analyzer. Where multiple dry pipe sprinkler risers are present, provide a manifold adjacent to the dry pipe

sprinkler risers. Manifold system must include automatic vent and air maintenance devices for each sprinkler system riser. Nitrogen generation system requires a dedicated, hardwired 120V AC power supply.

2.5.1.1 Design of Nitrogen Generation System

Design the system so all equipment is installed within the confines of the riser room with the exception of a connection for a manual or automatic gas analyzer. Provide a system that is capable of delivering a minimum of 98 percent nitrogen composition throughout all of the system piping within 14 days from the commencement of the inerting process. Provide membrane type nitrogen generators that provide "instant on-instant off" nitrogen gas production without the need for nitrogen storage tanks. The complete nitrogen generator system must be self-contained and skid mounted with "drop-in" operability with a simple one step direct connection of the nitrogen gas supply line to each zone/riser. Provide an automatic "fill and purge" breathing process. This must be done while the sprinkler system is fully functional and must not alter the design performance of the sprinkler system. A process that involves continuous venting of the piping network is not permitted. Air maintenance devices used in conjunction with the nitrogen generation system must be listed for use on sprinkler systems. At the riser and at the end of each zone, provide a connection for a [manual][automatic] gas analyzer.

2.5.1.2 Nitrogen Air Compressor

Air compressors to be used in conjunction with the nitrogen generator must be capable of the following:

a. Capable of producing a continuous stream of compressed air at 100+ psig.

b. Capable of automatic cut in and cut out.

c. Equipped with an on-board after-cooler.

d. Equipped with an on-board automatic water blow down system.

e. Equipped with vibration dampening system.

f. Equipped with an air storage tank to provide continuous delivery of compressed air to the nitrogen generator.

g. Rated for continuous duty service.

h. Compressors less than 3.0 hp must be an oil-less design.

i. Oil-less compressors must be such that the manufacturer has designed the oil-less compressor to provide 5000 hours of continuous duty service before requiring a gasket and seal rebuild.

2.5.1.3 Nitrogen Venting Device

The functional component of the nitrogen venting device for use in the "fill and purge" breathing process must:

a. Be NRTL listed for use on sprinkler systems.

b. Not require plumbing to drain.

c. Close automatically at the completion of the nitrogen inerting process without manual intervention.

d. Be installed on each zone in the riser room.

2.5.1.4 Supervision of Nitrogen Generator

Nitrogen generator must be able to provide the following monitoring options:

a. Power supply "on" for nitrogen generators.

b. Power supply "on" for compressor.

c. Amp draw for compressor.

d. Line pressure (psig).

e. Nitrogen purity at discharge (sample port for use with [manual][automatic] gas analyzer).

2.5.2 Nitrogen Pressure Maintenance Device

Device must be a pressure regulator that automatically reduces supply air pressure to the minimum pressure required to be maintained in the piping system. The device must have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1.6-mm1/16-inch restriction to prevent rapid pressurization of the system, and adjustment screw. The device must be capable of reducing maximum inlet pressure of 680 kPa100 psi to a fixed outlet pressure adjustable to [70][_____] kPa[10][_____] psi.

2.6 ALARM INITIATING AND SUPERVISORY DEVICES

2.6.1 Sprinkler Alarm Switch

pressure-type flow switch(es). [Connection of switch must be by the fire alarm installer].

2.6.2 High/Low-Nitrogen Pressure Supervisory Switch

Each dry pipe valve must be provided with a nitrogen pressure switch connected to the control unit. The pressure switch must supervise the nitrogen pressure in the system and set to activate at 70 kPa10 psi above the dry pipe valve trip point pressure (low) and 70 kPa10 psi above normal nitrogen pressure (high). The switch must have an adjustable range between 35 and 500 kPa5 and 80 psi. The switch must have screw terminal connection and capable of being wired for normally open or normally closed circuit.

2.6.3 Valve Supervisory (Tamper) Switch

Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open. The switch must be tamper resistant and contain 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.

[2.7 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.

****

[Reduced-pressure principle][Double-check] valve assembly backflow preventer complying with ASSE 1013, ASSE 1015 and AWWA M14. Each check valve must have a drain. Backflow prevention assemblies must have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List" and be listed for fire protection use. Listing of the specific make, model, design, and size in the FCCCHR List is acceptable as the required documentation.

2.7.1 Backflow Preventer Test Connection

Test connection must consist of a series of listed hose valves with 65-mm2 1/2-inch National Standard male hose threads with cap and chain.

]2.8 FIRE DEPARTMENT CONNECTION

****

NOTE: The designer will coordinate the desired location and thread type for the fire department connection with the responding fire department.

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Fire department connection must be [freestanding][projecting][flush] type with cast-brass body, matching [wall] escutcheon lettered "Auto Spkr" with a [polished-brass][chromium-plated] finish. [The connection must have individual self-closing clappers, caps with drip drains and chains.] Female inlets must have [65-mm2 1/2-inch][100 mm4-inch][125 mm5-inch][_____] diameter [American National Fire Hose Connection Screw Threads (NH) per NFPA 1963] [Storz][_____]. Comply with UL 405.

2.9 SPRINKLERS

****

NOTE: The designer will indicate on the contract drawings the type of sprinklers for each area if more than one type of sprinkler 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 must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled

storage applications only.

2.9.1 Pendent Sprinkler

Pendent sprinkler must be[recessed][quick-response][dry pendent] type with nominal K-factor of [80][115][160][_____][5.6][8.0][11.2][_____]. Pendent sprinklers must have a [polished chrome][stainless steel][white polyester][_____] finish. Assembly must include an integral escutcheon.

2.9.2 Upright Sprinkler

Upright sprinkler must be [brass][chrome-plated][stainless steel][white polyester] [quick-response type][_____] with a nominal K-factor of [80][115][160][_____][5.6][8.0][11.2][_____].

2.9.3 Sidewall Sprinkler

Sidewall sprinkler must be the [quick-response][standard-response] [recessed][dry sidewall] type. Sidewall sprinkler must have a nominal K-factor of [80][115][160][_____][5.6][8.0][11.2][_____]. Sidewall sprinkler must have a [brass][polished-chrome][stainless steel][white polyester][_____] finish.

[2.9.4 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.

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

]2.10 ACCESSORIES

2.10.1 Sprinkler Cabinet

Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.

2.10.2 Pendent Sprinkler Escutcheon

Escutcheon must 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 must have a factory finish that matches the pendent sprinkler.

2.10.3 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.10.4 Sprinkler Guard

Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located [_____][within 2.1 meters7 feet of the floor][as indicated].

2.10.5 Relief Valve

Relief valves must be listed and installed at there riser in accordance with NFPA 13.

2.10.6 Identification Sign

Valve identification sign must be minimum 150 mm wide by 50 mm high6 inches wide by 2 inches high with enamel baked finish on minimum 1.214-mm 18 gage steel or 0.6-mm0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must 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. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative a condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.[Installation of in-rack sprinklers must comply with applicable provisions of NFPA 13.] Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

a. Piping offsets, fittings, and other accessories required must be furnished to provide a complete installation and to eliminate interference with other construction.

b. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to insure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers and similar equipment) concealed above hung ceilings by permanent color coded pins/tabs in the ceiling directly below the item.

c. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.

3.2.1 Waste Removal

At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 UNDERGROUND PIPING INSTALLATION

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

****

The fire protection water main must be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover must be [900][_____] mm [3][_____] feet or the frost line, whichever is deeper. The supply line must terminate inside the building with a flanged piece, the bottom of which must be set not less than 304 mm1-foot above the finished floor. A blind flange must be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block must be provided at the elbow where the pipe turns up toward the floor. In addition, joints must be anchored in accordance with NFPA 24. Buried steel components must be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm5 feet outside the building walls must meet the requirements of Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

3.4 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping must fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.4.1 Protection of Piping Against Earthquake Damage

****

NOTE: The writer of this section must coordinate with the Structural Engineer or Government to determine the proper seismic design category for the project, in accordance with the IBC or ASCE guidelines. See UFC 3-310-04 for more information.

****

Seismic restraint is [not]required.

3.4.2 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors

or equipment access. Exposed horizontal piping, including drain piping, must be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

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

3.4.4 Pendent Sprinklers

****

NOTE: Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 6.9 bar100 psi and a branch line above the ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop must not exceed 300 mm12 inches for steel pipe and 1500 mm6 inches for copper tube.

****

a. Drop nipples to pendent sprinklers must consist of minimum 25-mm1-inch pipe with a reducing coupling into which the sprinkler must be threaded.

b. Where sprinklers are installed below suspended or dropped ceilings, drop nipples must be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling must not extend below the underside of the ceiling.

c. Recessed pendent sprinklers must be installed such that the distance from the sprinkler deflector to the underside of the ceiling must not exceed the manufacturer's listed range and must be of uniform depth throughout the finished area.

d. Pendent sprinklers in suspended ceilings must be located in the center of the tile (+/- 2 inches).[

e. Dry pendent sprinkler assemblies must be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space.][

f. Dry pendent sprinklers must be of the required length to permit the sprinkler to be threaded directly into a branch line tee.][

g. Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 6.9 bar100 psi and a branch line above the ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop must not exceed 300 mm12 inches for steel pipe and 1500 mm6 inches for copper tube.]

h. Sprinklers installed in the pendent position must be of the listed dry

pendent type or on return bends, unless otherwise indicated.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers must contain no fittings between the branch line tee and the reducing coupling at the sprinkler.

3.4.6 Pipe Joints

Pipe joints must conform to NFPA 13, except as modified herein. Not more than four threads must 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 must be provided where indicated or required by NFPA 13. Grooved pipe and fittings must be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools must be products of the same manufacturer. For copper tubing, pipe and groove dimensions must comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field must be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe must be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

3.4.7 Reducers

Reductions in pipe sizes cannot be made with one-piece tapered reducing fittings. When standard fittings of the required size are not manufactured, single bushings of the face or hex type will be permitted. Where used, face bushings must be installed with the outer face flush with the face of the fitting opening being reduced. Bushings must 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.

3.4.8 Pipe Penetrations

a. 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 must be core-drilled and provided with pipe sleeves. Each sleeve must be Schedule 40 galvanized steel, ductile-iron or cast-iron pipe and extend through its respective wall or floor and be cut flush with each wall surface. Sleeves must provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.

b. Where pipes and sleeves penetrate fire walls, fire partitions, or floors, pipes/sleeves must be firestopped in accordance with Section 07 84 00 FIRESTOPPING.

c. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must 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.

d. All penetrations through the boundary of rooms/areas identified as secure space area must meet ICS 705-1.

3.4.9 Escutcheons

Escutcheons must be provided for pipe penetration in finished areas of ceilings, floors and walls. Escutcheons must be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

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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.

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Unless otherwise indicated, the test connection must consist of 25-mm1-inch pipe connected to the remote branch line; a test valve located approximately 2 meters7 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". All test connection piping must be inside of the building and penetrate the exterior wall at the location of the discharge orifice only. The discharge orifice must be located outside the building wall no more than 0.6 meters2 feet above finished grade, directed so as not to cause damage to adjacent construction or landscaping during full flow discharge, or to the sanitary sewer. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building. Do not discharge to the roof. Discharge to floor drains, janitor sinks or similar fixtures is not permitted.

Provide concrete splash blocks at all drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

3.4.11 Backflow Preventer

Locate within the building or in a heated enclosure in locations subject to freezing. For heated enclosures, provide a low temperature supervisory alarm connected to the facility fire alarm system. Heat trace is not permitted to be used.

Install backflow preventers so that the bottom of the assembly is a minimum of 150 mm6 inches above the finished floor/grade. Install horizontal backflow preventers so that the bottom of the assembly is no greater than [_____]610 mm24 inches above the finished floor/grade. Install vertical backflow preventers so that the upper operating handwheel is no more than [_____]1.8 meters6 feet above the finished floor/grade. Clearance around control valve handles must be minimum 150 mm6inches above grade/finished floor and away from walls.

[3.4.11.1 Test Connection

Provide downstream of the backflow prevention assembly UL 668 hose valves

with 65-mm2.5-inch National Standard male hose threads with cap and chain. Provide one valve for each 946 L/min250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve". Indicate location of test header. If an exterior connection, provide a control valve inside a heated mechanical room to prevent freezing. The piping between the backflow preventer test header control valve and the exterior test header must be provided with an automatic drip arranged to drain to the outside.

]3.4.12 Drains

a. Main drain piping must be provided to discharge [at a safe point outside the building, no more than 0.6 meters2 feet above finished grade][at the location indicated][to the sanitary sewer]. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.

b. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 151 L/min40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

3.4.13 Installation of Fire Department Connection

Connection must be mounted [on the exterior wall approximately 900 mm3 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 must be provided with an automatic drip in accordance with NFPA 13 and piped to drain to the outside or a floor drain within the same room.

3.4.14 Identification Signs

Signs must 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. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in NFPA 13. Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe") and normal valve position (e.g. "Normally Open", "Normally Closed"). For pipe sizes 100 mm4-inch and larger provide white painted stenciled letters and arrows, a minimum of 50 mm2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 100 mm4-inch, provide white painted stenciled letters and arrows, a minimum of 18 mm0.75-inch in height and visible from the floor.[Provide properly lettered and approved metal sign to elevator flow switch stating the circuits' voltage, and identify the switch as an "Elevator Power Shunt Flow Switch".]

3.5 ELECTRICAL

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

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Except as modified herein, electric equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.[Alarm signal wiring connected to the building fire alarm control system must be by the fire alarm installer.]

3.6 PAINTING

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NOTE: Designer will coordinate color code marking with Section 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.

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Color code mark piping [red][as specified in Section 09 90 00 PAINTS AND COATINGS].

3.7 FIELD QUALITY CONTROL

3.7.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level [III][or][IV] Fire Sprinkler Technician, and the representative of the installing company,[and reviewed by the QFPE] [60][_____] days prior to performing system tests. Detailed test procedures must list all components of the installed system. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data forms must be in a check-off format (pass/fail with space to add applicable test data; similar to the forms in NFPA 13 .) The test procedures and accompanying test data forms must be used for the pre-Government testing and the Government final testing.

a. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

3.7.2 Pre-Government Testing

3.7.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that equipment is functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" and "System Acceptance" as noted in NFPA 13. The Contractor [and QFPE] must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 13 and the test reports noted below.

a. NFPA 13 Aboveground Material and Test Certificate

b. NFPA 13 Underground Material and Test Certificate

3.7.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit

a formal request for Government final test to the [_____][Designated Fire Protection Engineer (DFPE)][Contracting Officers Designated Representative (COR)]. Government final testing will not be scheduled until the DFPE has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until after the connections to the [building fire alarm system][installation fire alarm reporting system] have been completed and tested to confirm communications are fully functional. Submit request for test at least [15][_____] calendar days prior to the requested test date.

3.7.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.7.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

a. The manufacturer's technical representative.

[b. The contractor's Qualified Fire Protection Engineer (QFPE).]

c. Marked-up red line drawings of the system as actually installed.

Government Final Tests will be witnessed by the [_____], [Designated Fire Protection Engineer][Contracting Officer][, Qualified Fire Protection Engineer (QFPE)]. At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.8 MINIMUM SYSTEM TESTS

The system, including the underground water mains, and the aboveground piping and system components, must be tested to ensure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure must be tested in accordance with NFPA 13 and NFPA 24.

3.8.1 Underground Piping

3.8.1.1 Flushing

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NOTE: Designer should check the site water section for inconsistencies and to verify flushing of all underground pipe will be performed prior to connection to the sprinkler system.

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Underground piping must be flushed in accordance with NFPA 24.

3.8.1.2 Hydrostatic Test

New underground piping must be hydrostatically tested in accordance with NFPA 24.

3.8.2 Aboveground Piping

3.8.2.1 Hydrostatic Test

Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.

[3.8.2.2 Air Pressure Test

As specified in NFPA 13, an air pressure leakage test at 350 kPa50 psi must be conducted for 24 hours. There must be no drop in gauge pressure in excess of 10 kPa1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

]3.8.2.3 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly must be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor must provide all equipment and instruments necessary to conduct a complete forward flow test, including 65-mm2.5-inch diameter hoses, playpipe nozzles or flow diffusers, calibrated pressure gauges, and pitot tube gauge. The Contractor must 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 loss) across the assembly must be recorded. A metal placard must 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 determined during the preliminary testing. The pressure drop must be compared to the manufacturer's data and the readings observed during the final inspections and tests.

3.8.3 Dry Pipe Valve Trip Test

Each dry pipe valve must be trip-tested by reducing normal system nitrogen pressure through operation of the inspector's test connection. Systems equipped with quick-opening devices must first be tested without the operation of the quick-opening device and then with it in operation. Test results will be witnessed and recorded. Test results must include the number of seconds elapsed between the time the test valve is opened and tripping of the dry valve; trip-point nitrogen pressure of the dry pipe valve; water pressure prior to valve tripping; and number of seconds elapsed between time the inspector's test valve is opened and water reaches the orifice. The delivery of water from the dry pipe valve to the system test connection must not exceed 60 seconds, regardless of system size. Water delivery times must be measured starting at the normal nitrogen pressure on the system.

3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply. Static and residual

pressures must be recorded on the certificate specified in paragraph SUBMITTALS.

3.8.5 Supervisory Nitrogen System Test

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

System supervisory nitrogen pressure must be reduced from the normal system pressure to the point at which a low-pressure alarm is sounded. Nitrogen pressure must be restored to verify trouble signal restoration. Automatic start/stop features of nitrogen generator must be tested.

3.9 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

[a. Provide one set of full size paper as-built drawings and schematics. The drawings must be prepared electronically and sized no less than the contract drawings.] [Furnish one set of CDs or DVDs containing software back-up and CAD based drawings in latest version of [MicroStation][AutoCAD,]DXF and portable document formats of as-built drawings and schematics.]

b. Provide operating and maintenance (O&M) instructions.

3.10 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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Conduct a training course for the responding fire department and operating and maintenance personnel as designated by the Contracting Officer. Training must be performed on two separate days (to accommodate different shifts of Fire Department personnel) for a period of [_____][4] hours of normal working time and must start after the system is functionally complete and after the final acceptance test. The on-site training must cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --