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Preparing Activity: NASA Superseding
UFGS-21 13 00.00 40 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2009

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DIVISION 21 - FIRE SUPPRESSION

SECTION 21 13 00.00 40

FIRE-SUPPRESSION SPRINKLER SYSTEMS

08/08

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SECTION 21 13 00.00 40

FIRE-SUPPRESSION SPRINKLER SYSTEMS 08/08

NOTE: This guide specification covers the requirements for wet and dry fire protection sprinkler systems, hydrants, standpipe equipment, and firehose stations.

Drawings should include the following:

Data on subsurface soil conditions

Location and invert elevations of existing obstructions on the ground surface and existing underground structures and utilities that are to be avoided during construction or are required to be plugged and abandoned or demolished and removed

Invert elevations of all work to be connected to size, type, and extent of selected conduit

Typical cross-section for each nonspecified trench, bedding, and backfill condition, indicating conduit, bedding, and backfill material

Location of soil storage areas and spoil areas on government property where disposal of excess and waste material is permitted

Typical riser details

Areas to be sprinkled, hazard by class, temperature setting of heads, ceiling type, height, and any other special design criteria

Existing alarm-system connections

Proper utilization and coordination of symbols, legends, or codes for various materials and classed conditions as provided in the specifications

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or

insert appropriate information.

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

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 REFERENCES

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.

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 IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2004) Standard Definitions for Use in the Design of Steel Structures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4 (2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110/A21.10 (2008) Ductile-Iron and Gray-Iron Fittings for Water

AWWA C111/A21.11 (2000) Rubber-Gasket Joints for

Ductile-Iron Pressure Pipe and Fittings

AWWA C151/A21.51

(2002; Errata 2002) Ductile-Iron Pipe,
Centrifugally Cast, for Water

ASME INTERNATIONAL (ASME)

ASME A112.18.1

(2005) Standard for Plumbing Fixture
Fittings

ASME B16.1

(2005) Standard for Gray Iron Threaded
Fittings; Classes 125 and 250

ASME B16.3

(2006) Malleable Iron Threaded Fittings,
Classes 150 and 300

ASME B16.34

(2009) Valves - Flanged, Threaded and
Welding End

ASME B16.39

(2009) Standard for Malleable Iron
Threaded Pipe Unions; Classes 150, 250,
and 300

ASME B16.4

(2006) Standard for Gray Iron Threaded
Fittings; Classes 125 and 250

ASME B16.9

(2007) Standard for Factory-Made Wrought
Steel Buttwelding Fittings

ASME B31.1

(2007; Addenda 2008; Addenda 2009) Power
Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M

(2009) Standard Specification for Steel,
Sheet, Cold-Rolled, Carbon, Structural,
High-Strength Low-Alloy and High-Strength
Low-Alloy with Improved Formability,
Solution Hardened, and Bake Hardened

ASTM A 126

(2004) Standard Specification for Gray
Iron Castings for Valves, Flanges, and
Pipe Fittings

ASTM A 135/A 135M

(2006) Standard Specification for
Electric-Resistance-Welded Steel Pipe

ASTM A 183

(2003; R 2009) Standard Specification for
Carbon Steel Track Bolts and Nuts

ASTM A 197/A 197M

(2000; R 2006) Standard Specification for
Cupola Malleable Iron

ASTM A 234/A 234M

(2007) Standard Specification for Piping
Fittings of Wrought Carbon Steel and Alloy
Steel for Moderate and High Temperature
Service

ASTM A 307

(2007b) Standard Specification for Carbon

	Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 568/A 568M	(2009) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM B 370	(2009) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 749	(2003) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C 592	(2008a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
FM GLOBAL (FM)	
FM P7825a	(2005) Approval Guide Fire Protection
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 13	(2010) Installation of Sprinkler Systems
NFPA 13E	(2005) Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
NFPA 14	(2006) Standard for the Installation of

Standpipe, Private Hydrants and Hose Systems

NFPA 1961 (2007) Standard on Fire Hose

NFPA 1963 (2009) Standard for Fire Hose Connections

NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 291 (2010) Recommended Practice for Fire Flow Testing and Marking of Hydrants

NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480 (Rev B; Notice 2) Coating Compound, Bituminous, Solvent, Coal-Tar Base

MIL-STD-101 (Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595 (Rev B; Am 1) Colors Used in Government Procurement

FS FF-S-325 (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

FS WW-P-421 (Rev D) Pipe, Cast, Gray and Ductile Iron, Pressure (For Water and Other Liquids)

UNDERWRITERS LABORATORIES (UL)

UL 19 (2001) Standard for Lined Fire Hose and Hose Assemblies

UL 6 (2007) Standard for Electrical Rigid Metal Conduit-Steel

1.2 GENERAL REQUIREMENTS

NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section. Design Analysis and Calculations and installation shall be in accordance with NFPA 13.

Records of Existing Conditions shall be submitted showing the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

1.3 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

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

SD-01 Preconstruction Submittals

Records of Existing Conditions shall be submitted in accordance with the paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing

and wiring details.

- Piping Materials
- Supporting Elements
- Fire-Department Connections
- Fire Alarm System
- Compressor
- Sprinkler Heads
- Valves
- Underground Piping Materials

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

- Underground Piping Materials
- Aboveground Piping Materials
- Valves
- Fire-Department Connections
- Riser Alarm Equipment
- Air Compressor
- Standpipe Equipment and Fire Hose Cabinet Stations
- Sprinkler Heads
- Miscellaneous Materials
- Supporting Elements

Equipment and Performance Data shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-05 Design Data

Design Analysis and Calculations shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section.

- Pressure Tests
- System Operating Tests
- Air Tests
- Valve-Operating Tests
- Drainage Tests

PART 2 PRODUCTS

2.1 GENERAL

Fire-protection system materials and equipment provided under this section shall conform to the requirements of Underwriters Laboratories (UL) or the Factory Mutual (FM P7825a) Approval Guide.

Products with UL label or seal or listing in UL 6, and products with FM label or listed in the FM P7825a Approval Guide are acceptable fire-protection system materials and equipment. Materials and equipment

furnished shall be compatible with existing system.

Equipment and Performance Data shall be submitted for fire protection sprinkler systems consisting of information on use life, system functional flows, safety features, and mechanical automated details.

2.2 UNDERGROUND PIPING MATERIALS

Ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions, and end caps shall be the same type and class of material as the pipe or shall be material having equal or superior physical and chemical properties.

2.2.1 Type CIWP

Cast-iron waterpipe shall be mechanical joint or push-on type, centrifugally cast, UL listed and labeled, conforming to FS WW-P-421 and, as applicable, to AWWA C151/A21.51, AWWA C110/A21.10, AWWA C111/A21.11. Piping shall be Class 150. Bell-and-spigot fittings shall conform to AWWA C110/A21.10.

For FS WW-P-421 wall-thickness criteria only, depth of cover shall be 1500 millimeter 5 feet unless drawings indicate less, in which case, drawing requirements shall apply; field-laying conditions shall be B (flat-bottom trench, without blocks, tamped backfill).

Flanged cast-iron pipe fittings shall be Class 125 conforming to ASME B16.1.

Piping and fittings shall be coated on the [inside] and [outside] with a bituminous sealer in accordance with AWWA C104/A21.4.

[Piping and fittings shall be coated on the inside with a mortar lining in accordance with AWWA C104/A21.4.]

Restraining joint against endwise separation due to internal pressure may be accomplished by NFPA-recommended metal harness consisting of clamping devices and bolting or by hardened-metal retainers molded into a push-on gasket and engaged by a groove in the spigot end.

Where electrical continuity is indicated, pipe shall be supplied with factory-brazed heavy cross section copper connectors to be joined with copper fasteners upon joint assembly. Connectors, as a minimum, shall be equal to No. 1/0.

2.2.2 Type DIWP

Ductile-iron water pipe shall be mechanical-joint or push-on type, centrifugally cast, UL listed and labeled, conforming to applicable provisions of AWWA C111/A21.11, and AWWA C151/A21.51. Wall-thickness criteria shall be 1380 kilopascal 200-pounds per square inch (psi) working pressure plus 690 kilopascal 100-psi surge allowance, AASHTO H-20 loading with specified trench conditions. Gasket elastomer shall be chloroprene.

Piping shall be coated on the [inside] and [outside] with a bituminous sealer in accordance with AWWA C104/A21.4.

[Piping and fittings shall be coated on the inside with a mortar lining in accordance with AWWA C104/A21.4.]

Restraining joint against endwise separation due to internal pressure may be accomplished by using a metal harness consisting of clamping devices and bolting or by hardened-metal retainers molded into a pushon gasket and engaged by a groove in the spigot end.

Where electrical continuity is indicated, pipe shall be supplied with factory-brazed heavy cross section copper connectors to be joined with copper fasteners upon joint assembly. Connectors, at a minimum, shall be equal to No. 1/0.

2.3 ABOVEGROUND PIPING MATERIALS

2.3.1 Type BCS - Black Carbon Steel

Pipe(DN6 through DN40) (1/8 through 1-1/2 inches): Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A 53/A 53M, or ASTM A 135/A 135M, Type F furnace butt welded; Schedule 10 conforming to ASTM A 135/A 135M, Grade B

Pipe (DN50 through DN2062 through 8 inches, where indicated): Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M or ASTM A 135/A 135M, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B; Schedule 10 conforming to ASTM A 135/A 135M, Grade B

Pipe (DN25010 inches and over): Schedule 30 black carbon steel conforming to ASTM A 53/A 53M, Type E (electric-resistance welded) or Type S (seamless)

Unions (DN502 inches and under): 2068 kilopascal 300-pound per square inch gage (psig) working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39

Standard pipe couplings: Extra-heavy screwed black steel

Grooved pipe couplings (all sizes): 1207 kilopascal 175-psig minimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of ASTM D 2000. Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A 183

Fittings (DN100 4 inches and under): 1207 kilopascal 175-psig working pressure, cast iron, screwed, conforming to ASTM A 126, Class A, and ASME B16.4

Fittings (DN150 6 inches and larger): 1207 kilopascal 175-psig working pressure, cast iron, conforming to ASTM A 126, Class A, screwed, conforming to ASME B16.4, or flanged, conforming to ASME B16.1

Fittings (DN200 8 inches and under): Couplings shall be rolled-groove type or mechanical locking (push-on) type. Grooves for rolled-groove type shall be rolled only; cut grooving will not be allowed. Rolled grooves shall be dimensionally compatible with the couplings.

Grooved fittings (all sizes): 1207 kilopascal 175-psig working pressure fittings used with grooved couplings shall be fabricated of black malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless-steel pipe and

long-radius seamless welding fittings, with wall thickness to match pipe, conforming to [ASTM A 234/A 234M](#) and [ASME B16.9](#).

2.3.2 Type GCS - Galvanized Carbon Steel

Pipe ([DN15 through DN250 1/2 through 10 inches](#) and where indicated): Schedule 40 seamless or electric resistant welded galvanized steel conforming to [ASTM A 53/A 53M](#), Type E (electric-resistance welded) or Type S (seamless). Type F (furnace butt welded continuous welded) is acceptable for sizes less than [DN50 2 inches](#).

Fittings (all sizes): [1034 kilopascal 150-psig](#) working pressure banded, galvanized, malleable, screwed, conforming to [ASTM A 197/A 197M](#) and [ASME B16.3](#)

Fittings ([DN65 2-1/2 inches](#) and over): [862 kilopascal 125-psig](#) working pressure cast-iron flanges and flanged fittings conforming to [ASTM A 126](#), Class A and to [ASME B16.1](#)

Grooved pipe couplings (all sizes): [1207 kilopascal 175-psig](#) minimum working pressure with a housing fabricated in two or more parts of galvanized malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of [ASTM D 2000](#). Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to [ASTM A 183](#).

Grooved fittings (all sizes): [1207 kilopascal 175-psig](#) working pressure fittings used with grooved couplings shall be fabricated of galvanized malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to [ASTM A 234/A 234M](#) and [ASME B16.9](#).

Unions ([DN50 2 inches](#) and under): [2070 kilopascal 300-psig](#) working pressure female, screwed, galvanized malleable iron, with brass-to-seat and ground joint

2.4 SUPPORTING ELEMENTS

Piping system components and miscellaneous supporting elements shall be provided, including, but not limited to, building-structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces.

NOTE: Refer to Section [23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT](#) if design may induce vibration considerations.

Supporting elements shall be FM approved or UL listed and shall conform to [ASME B31.1](#), [MSS SP-58](#), and [ASME B16.34](#).

2.4.1 Building-Structure Attachments

2.4.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to **FS FF-S-325**:

Group I: Shield, expansion (lead, bolt, and stud anchors)

Group II: Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2

Group III: Shield, expansion (self drilling tubular expansion shell bolt anchors)

Cast-in floor-mounted equipment-anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support mechanical-systems components.

2.4.1.2 Beam Clamps

Beam clamps shall be center-loading Types 21, 28, 29, and 30, UL listed, cataloged, and load-rated commercially manufactured products.

Type 20 beam clamps shall be used for pipe **DN50 2 inches** and under.

Two Type 25 beam clamps shall be used per point of pipe support.

2.4.1.3 C-Clamps

NOTE: C-clamps, as a means of attaching hangers to structural steel, should be avoided. Where used, consider vibration forces and single or accumulated load and resultant moment on structural steel.

C-clamps shall [not be used] [be used to support piping sizes **DN40 1-1/2 inches** and smaller.] C-clamps shall be FM approved and UL listed, with hardened cup-tip setscrew, locknut, and retaining strap. Retaining-strap section shall be not less than **6 by 25 millimeter 1/8 by 1 inch**. Beam-flange thickness to which clamps are attached shall not exceed **15 millimeter 0.60 inch**.

2.4.1.4 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements of **MSS SP-58** for Type 18 and **ASME B16.34**. When applied to piping in sizes **DN50 2-inch** iron pipe size (ips) and larger, and where otherwise required by imposed loads, a **300 millimeter length of 15 millimeter 1-foot length of 1/2-inch** reinforcing rod shall be inserted and wired through wing slots.

2.4.2 Horizontal-Pipe Attachments

2.4.2.1 Single Pipes

Piping in sizes up to and including **DN50 2-inch** ips shall be supported by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type

attachments.

Piping in sizes **DN65 2-1/2 inches** and larger shall be supported by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.4.2.2 Parallel Fire-Protection Pipes

Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used when so specified. Structural-steel shapes shall conform to supplementary steel requirements or the support shall be of commercially available, approved proprietary-design rolled steel.

2.4.3 Vertical-Pipe Attachments

Single vertical-pipe attachments shall be Type 8.

2.4.4 Hanger Rods and Fixtures

Only circular solid cross section rod hangers shall be used to connect building structure attachments to pipe-support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.4.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with **AISC/AISI 121**.

2.5 FIRE-DEPARTMENT CONNECTIONS

Hose connections shall have National Firehose standard-thread form and rocker lugs in accordance with **NFPA 1963**. Hose-connection sizes and threads shall be compatible with the equipment used by the fire department serving the facility.

2.5.1 Wall Siamese

Unit shall be cast brass or bronze flush-mounted escutcheon-plate type, with two **DN65 2-1/2-inch**, fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with **ASME A112.18.1**.

2.5.2 Sidewalk Siamese

Unit shall be cast brass or bronze, with two **DN65 2-1/2-inch**, fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with **ASME A112.18.1**.

Unit shall be mounted on a Schedule 40 **ASTM A 53/A 53M** galvanized carbon-steel pipe with red-enameled finish on prime-coated surface. All surfaces embedded in concrete or below grade shall be protected with a

0.508 millimeter 20-mil thick bituminous coating.

2.5.3 Wall Hydrant

Unit shall be of cast brass or bronze flush-mounted escutcheon-plate type with two DN65 2-1/2-inch, fire-department, male outlets; rocker lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with ASME A112.18.1.

2.5.4 Roof Manifold

Unit shall be of cast brass or bronze, horizontal type, with two DN65, 1200 kilopascal 2-1/2-inch, 175-pound rated hose valves fitted with rocker-lug caps and chains. Finish shall be rough body with polished trim.

2.5.5 Fire Hydrants

Hydrants shall be dry-barrel type, with low-profile and modern appearance. Hydrants shall be designed to remain closed if hydrant barrel is sheared or damaged. Unit shall have two DN65 2-1/2-inch, hose outlets and one DN115 4-1/2-inch hose outlet complete with nonbinding caps and cap chains. Hydrant direction of opening shall be counterclockwise. Surface shall be filled, primed, and finished with a multiple-coat high-gloss weather-resistant enamel. All surfaces below grade shall receive a coating of bitumen not less than 0.508 millimeter 20 mils thick. Care shall be exercised not to plug barrel drainage provisions. Color shall be standard for the project site.

2.6 RISER ALARM EQUIPMENT

Riser alarm equipment shall be UL listed or FM approved for fire-protection use.

2.6.1 Wet-Pipe Alarm Check Valve

Wet-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm and shall include pressure gages, retard chamber, testing provisions, and all necessary intercomponent piping, fittings, and valves. Pilot valve and clapper shall have individual elastomer seats.

2.6.2 Standard Check Valve

Check valve shall be FM-approved or UL-listed standard swing-check type with elastomer-disc seat. Pressure gages shall be provided on both sides of the clapper. Water-flow alarm shall be vane type.

2.6.3 Dry-Pipe Alarm Check Valve

Dry-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm, and shall include pressure gages, accelerator, priming provisions, testing provisions, and all necessary intercomponent compressed-air and water piping, fittings, and valves.

System shall include a trouble alarm indicating a loss of air pressure.

2.6.4 Water-Flow Alarm Device

Water-flow alarm devices shall be UL listed for the particular type of system.

2.6.4.1 Water Motor Gong Local Alarm

Assembly shall include a gong with an aluminum or chrome-plated brass hood with nonstaining weather-resistant mounting. Water motor shaft shall have tetrafluoroethylene bearings and an inlet strainer. Waste water shall drain as indicated.

2.6.4.2 Pressure Switch Remote Alarm

Pressure switch shall be wired to make or break a circuit depending on rise or fall of water pressure.

2.6.4.3 Vane-Type Flow Alarm

Vane-type flow alarm shall make or break an alarm circuit upon deflection by a volume of flowing water that equals or exceeds the capacity of a single sprinkler. Alarm shall have an instant-recycle pneumatic-retard time delay.

2.6.4.4 Electric Motor Gong

NOTE: Rewrite following for dc systems.

Electric motor gong shall be a 150 millimeter 6-inch diameter bell, synchronous-motor type.

[Weather-exposed units shall be weatherproof and shall be provided with a weather hood. Assembly shall be constructed of nonstaining materials.]

2.7 DRY-PIPE MAINTENANCE AIR

2.7.1 Independent Source

Dry-pipe system air pressure shall be maintained by an independent Air Compressor mounted on the riser. Compressor shall be spring and elastomer vibration-isolated from the riser, of oil-free construction, complete with adjustable set point low-differential pressure switch, check valve, and necessary unloader and intercomponent piping and wiring. Spare inlet-air filter media shall be provided.

2.7.2 Continuous Source

Dry-pipe system air pressure shall be maintained by an adjustable set point low-differential-diaphragm pressure-reducing valve connected to 690 kilopascal 100 psig facility compressed-air system to maintain air side of dry-pipe valve. Unit shall be entirely of nonferrous-metal construction with a replaceable cartridge inlet-air filter. Air-maintenance device shall be complete with intercomponent piping, fittings, and valves. Spare inlet-air filter media shall be provided.

2.7.3 Retard Orifice

Air-supply line near each dry-pipe valve shall be provided with an orifice union with a 3 millimeter 1/8-inch orifice corrosion-resistant steel plate, externally identified, and a DN15 1/2-inch three-valve bypass around the orifice union.

2.8 STANDPIPE EQUIPMENT AND FIRE HOSE CABINET STATIONS

2.8.1 Fire Hose Cabinet Stations

Fire hose cabinet stations shall be furnished with cabinet, firehose rack, DN40 1-1/2-inch hose, valve, and spanner wrench.

2.8.2 Firehose Racks and Hoses

Rack-and-hose assemblies shall be nipple mounted, swinging, semiautomatic, and red enameled. Racks shall be fitted with spring-friction retainer clip.

Hoses shall be DN40 1-1/2-inch diameter, 20 meter 75 feet long, cotton-polyester jacketed, rubber lined, mildew-proof, conforming to NFPA 1961, and UL approved for rack service. Couplings shall be rocker-lug type. A spanner, mounted in clips, shall be provided at each rack.

Rack valves shall be polished brass, 1200 kilopascal 175-psi rated, DN65 2-1/2-inch angle valve with 65 millimeter 2-1/2-inch female to 40 millimeter 1-1/2-inch male reducer, and fitted with automatic drain-vent device.

Hose nozzles shall be DN40 1-1/2-inch chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type.

2.8.3 Standpipe-Mounted Hose Racks and Hoses

Hose racks shall be suitable for specified hose length. Firehose racks and accessories shall be red enameled, designed for standpipe mounting at an elevation high enough to avoid damage. Suitable clips or spring-loaded retainers shall be provided to prevent hoses from unwinding and hoses and nozzles from swinging from their mounted position until placed into service.

Rack hoses shall be DN40 1-1/2-inch diameter, 30 meter 100-foot long, cotton-polyester jacketed, rubber lined and mildew-proof, conforming to [NFPA 1961] [UL 19]. Couplings shall be rocker-lug type. A spanner, mounted in clips, shall be provided at each rack.

Rack valve shall be polished brass, 1200 kilopascal 175-psi rated, DN65 2-1/2-inch angle valve with 65 millimeter 2-1/2-inch female to 40 millimeter 1-1/2-inch male reducer, and fitted with automatic drain-vent device.

Hose nozzle shall be DN40 1-1/2-inch chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type.

2.8.4 Hose Reels and Hoses

Hose reels, frames, and accessories shall be red enameled and suitable for specified hose diameter and length. Reels shall be fitted with a swivel and piping to allow continuous flow through hoses. Friction brakes shall be provided to prevent hoses from accidentally unwinding.

Hoses shall be 40 millimeter 1-1/2-inch inside diameter, 45 millimeter

1-3/4-inch outside diameter, 3-braid, single-jacket, 2070 kilopascal 300-psi working pressure, 30 meter 100 feet long, hard rubber or heavy duty synthetic cover, noncollapsible, and fitted with couplings. Hoses shall be red covered, flexible, nonkinking, and shall weigh not over 35 kilogram per 30 meter 75 pounds per 100 feet.

Couplings shall be hole type, one female swivel and one male, both with chemical hose thread (M44 - 3.175 male) (1-3/4-inch outside diameter - 8 NH male threads per inch).

Reel control valve shall be 1200 kilopascal 175-psi rated, quarter-turn, ball- or butterfly-valve, for quick-opening operation.

Hose nozzle shall be DN40 1-1/2-inch chemical hose thread, polished brass, adjustable fog, off-and-on solid-stream type.

2.8.5 Standpipe Valve

Valve shall be DN65 2-1/2-inch angle hose type, 1200 kilopascal 175-psi rated, with 65 millimeter 2-1/2-inch female to 40 millimeter 1-1/2-inch male reducer, 40 millimeter 1-1/2-inch cap and chain, and chrome-plated polished brass.

In multistory buildings with fire pumps, valve shall include orifice plate to restrict discharge pressure to 450 kilopascal 65 psig.

2.8.6 Fire-Hose Cabinet

Cabinet body shall be recessed heavy-gage steel with primed surfaces and baked white enamel interior.

[Cabinet door and trim shall be 450 kilopascal 1-1/4-inch 32 millimeter projecting type, of commercial quality cold-rolled steel, conforming to ASTM A 1008/A 1008M, stretcher-leveled to standards of flatness in accordance with ASTM A 568/A 568M, and furniture-quality construction with continuous hinge and prime coat.]

[Cabinet door and trim shall be 32 millimeter 1-1/4-inch projecting type, of AISI Type 302 corrosion-resistant steel, with No. 4 finish on all surfaces, including faces and edges exposed to view. Weld burns shall be removed and smooth radii developed. Warpage of edges shall be controlled, especially those which mate to wall, to prevent gaps. Hinges shall be continuous corrosion-resistant steel, and door pulls shall be 115 millimeter 4-1/2-inch satin finish, chrome-plated brass or corrosion-resistant steel, enclosed, file-cabinet type.]

Door shall be fitted with full size 6 millimeter 1/4-inch thick safety or tempered glass and dual friction latches.

Cabinet shall be sized to accommodate the valve, rack, hose, and either one 9.5 liter 2-1/2-gallon air-pressurized water fire extinguisher or one 7 kilogram (15 pound) 15-pound carbon-dioxide extinguisher. Extinguisher will be furnished by the Government.

2.9 SPRINKLER HEADS

2.9.1 Head Types

Standard 13 millimeter 1/2-inch orifice sprinkler heads shall be used.

Heads shall be automatic on-off type. On-off type heads shall be installed only in wet-pipe systems.

Heads in finished areas below suspended ceilings shall be flush chrome-plated brass. Escutcheon plate shall be baked enamel finished to match ceiling.

Heads in finished areas below suspended ceiling shall be flush or pendant type. Heads and escutcheon plates shall be chrome-plated brass.

Heads in unfinished areas below suspended ceilings shall be pendant type. Heads in all other locations shall be [upright] [pendant] [sidewall] type.

Corrosion-resistant heads shall be lead-coated.

2.9.2 Temperature Rating

Fusible links shall be for ordinary hazard, except where otherwise indicated.

2.9.3 Spares

Spares shall be furnished for each type of sprinkler head, complete with appropriate storage cabinet and wrench.

2.9.4 Head Protection

Heads shall be protected with paper or plastic bags during painting operations. Protection shall be removed immediately upon finishing painting operations.

Head guards shall be provided wherever mechanical damage could occur. Guard finish shall be red enamel.

2.10 VALVES

2.10.1 Underground

2.10.1.1 Post Indicator Valve Assembly (PIV)

Assembly shall consist of a standard FM-approved or UL-listed inside-screw gate valve 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 shall be counterclockwise.

Quarter-turn valve shall be a wafer-type butterfly valve, rated at 1200 kilopascal 175 psi, elastomer-lined and sealed. Liner shall act as a gasket between ASME B16.1, Class 125 or Class 250 flanges. Post shall have a fail-safe feature to keep valve intact in case of breaking off above grade. Operator shall be worm-gear type with permanently oil-lubricated watertight gear case complete with handle.

Surfaces below grade shall receive a coating of bitumen not less than 0.508 millimeter 20 mils thick. Above-grade surfaces shall be filled, primed, and finished with a multiple coat of high-gloss, weather-resistant, red enamel.

Post indicator valves shall be fitted to accommodate electrical supervisory switches.

Electrical supervisory switches shall be provided for interconnection to the building **Fire Alarm System**. Switches and connections shall meet the requirements of Section **28 31 13.00 40 FIRE DETECTION AND ALARM CONTROL, GUI, AND LOGIC SYSTEMS**.

2.10.1.2 Fire-Hydrant Service Valves

Fire-hydrant service valves shall be standard FM-approved or UL-listed inside-screw gate valve, with valve box connection flange.

2.10.1.3 Valve Boxes

Valve boxes shall be not less than **5 millimeter 3/16-inch** thick cast-iron construction with locking cover that has a cast-in identification legend. Boxes shall be adjustable extension type with screw- or slide-type adjustment. Base flange shall be fitted to the valve flange. Full extended length of box shall be greater than required by depth of cover by not less than **100 millimeter 4 inches**. One valve-operating wrench shall be supplied for each size valve nut. Guide rings shall be provided where operating rods are longer than **2 meter 6 feet**.

2.10.2 Aboveground

Gate, globe, and check valves (all sizes) shall be FM approved or UL listed.

Ball valves, **DN50 2 inches** and under, shall be FM approved, rated **2070 kilopascal 300 psi**, with provisions to wire or lock handle in place where critical alarm function may be isolated.

Butterfly valves, **DN150, DN200, and DN250 6-, 8-, and 10-inch** shall be FM approved, rated **1200 kilopascal 175 psi**, cast-iron bodied wafer type, with elastomer liners and seals. Liners shall act as gasket between standard piping-system flanges. Operator shall be worm-gear type, with permanently lubricated gears, and oiltight and watertight case, complete with handle and automatic position indication.

2.11 MISCELLANEOUS MATERIALS

2.11.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavy-bodied material to produce not less than a **0.305 millimeter 12-mil** dry-film thickness in one coat and shall be as recommended by the conduit manufacturer for compatibility with factory coating and rubber joints.

For previously coal-tar-coated and for uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to **MIL-C-18480**.

2.11.2 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to **ASTM F 568M, Class 4.8 or higher ASTM A 307, Grade B**. Heavy hex-nuts shall conform to **ASTM A 563M. ASTM A 563**. Square-head bolts and nuts are not acceptable.

2.11.3 Elastomer Calk

Polysulfide- or polyurethane-base elastomer-calking material shall be two-component type, conforming to [ASTM C 920](#).

2.11.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated, except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to [ASME A112.18.1](#).

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing and one-piece or split-pattern type elsewhere. Escutcheons shall have provisions consisting of internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.11.5 Flashing

2.11.5.1 Lead

Sheet lead shall conform to [ASTM B 749](#), and shall weigh not less than 20 kilogram per square meter 4 pounds per square foot.

2.11.5.2 Copper

Sheet copper shall conform to [ASTM B 370](#) and shall weigh not less than 4.88 kilogram per square meter 16 ounces per square foot.

2.11.6 Flange Gaskets

Gaskets shall be suitable for the intended use and shall contain no asbestos.

2.11.7 Pipe-Thread Compounds

Tetrafluoroethylene tape or other suitable compounds shall be used.

2.12 FIRE-PROTECTION SYSTEM IDENTIFICATION

A coordinated system of piping and equipment identification shall be provided which includes the following:

- Framed and plastic-protected diagrammatic layout of all piping systems, identifying and locating piping, equipment, and valves. Where existing systems are being modified, existing layouts shall be brought up to date.

- Metal-tag-identified major valves, piping-system components, and equipment

- Metal identification plate at controlling alarm valve identifying system and area protected

- Service-labeled piping

- Color coding shall be used for flow-capacity identification of fire hydrants only. Color coding shall be in accordance with [NFPA 291](#). Numbering of post-indicator valves, hydrants, and other components shall be an extension of existing systems.

2.12.1 Diagrams

Chart listing of equipment shall be by designation number and shall show pertinent data. Diagrams shall be neat, mechanical drawings mounted in extruded aluminum frames, with 3 millimeter 1/8-inch thick acrylic plastic protection. Location shall be as directed by the Contracting Officer. A minimum of one mounted chart and diagram, plus one extra copy of each, shall be provided for each fire-protection system.

2.12.2 Metal Tags

Identification tags made of brass or aluminum and indicating function of valve or similar component, shall be installed on such system devices. Tags shall be not less than 50 millimeter 2 inches in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags bearing an equipment designation number matching the drawing or diagram designations.

Tags shall be secured to valve or equipment items with 2.7 millimeter 12-gage galvanized wire.

2.12.3 Service Labeling

Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels or tag designations shall be as follows:

<u>SERVICE</u>	<u>LABEL OR TAG DESIGNATION</u>
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler branch	SPRINKLER BRANCH
Standpipe piping	STANDPIPE

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit through walls

Each change in direction

In congested or hidden areas, at each point required to clarify service or indicate hazard

In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 12.2 meter 40 feet.

Label lettering shall be 50 millimeter 2 inches high. Where the size of pipes is 65 millimeter 2-1/2-inch outside diameter and smaller, labels shall be attached to 1.6 millimeter 16-gage aluminum sheet which shall be attached to the pipe with 2.7 millimeter 12-gage galvanized wire. Labels shall be legible from the primary service and operating area.

Labels shall be made of self-sticking plastic film designed for permanent installation. Labels shall have red letters on white background.

Label and valve tag schedule above shall not be construed as defining or limiting the work. All piping systems shall be labeled.

2.13 PAINTING

Equipment of the manufacturer's standard product shall be furnished with the manufacturer's standard finish coat.

Other mechanical equipment shall be furnished with a shop-applied prime paint.

PART 3 EXECUTION

NOTE: Rewrite following paragraph if no NFPA 13, NFPA 13E, NFPA 14, or NFPA 24 work is included in project.

3.1 GENERAL

Installation of system materials and equipment shall be in accordance with the recommendations and provisions of NFPA 13, NFPA 13E, NFPA 14, and NFPA 24. Work shall be performed in the presence of the Contracting Officer who shall be notified by the Contractor 48 hours in advance of the start of work.

All installation work shall be performed by licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed.

3.2 UNDERGROUND PIPING INSTALLATION

Installation of piping materials shall conform to the written or published instructions of the manufacturer.

Pipes passing through walls below grade and ground-floor slab shall pass through pipe sleeves one size larger than pipe and shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.

In fill areas, pipe passing under or through building grade beams shall have a minimum clearance of 100 millimeter 4 inches in all directions.

Rubber- or elastomer-jointed piping embedded in concrete walls shall have a joint within 150 millimeter 6 inches of the face of the wall, capable of absorbing movement without leakage.

Piping penetrating earth or concrete grade shall be extended-joint or flange-bolt height plus 150 millimeter 6 inches above the grade.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

On excavations near and below building footings, the backfilling material shall consist of 13.8 Megapascal 2,000-psi cured-strength concrete poured or pressure-grouted up to the level of the footing.

After piping has been inspected, and not less than 48 hours prior to being lowered into a trench, external surfaces of the piping, valves, valve operators, and valve boxes shall be coated with a compatible bituminous coating suitable for protection against brackish ground water. Application shall be in accordance with the manufacturer's instructions to a dry-film thickness of not less than 0.305 millimeter 12 mils.

3.2.1 Construction Tolerances for Types CIWP and DIWP

Maximum deviation from design elevation at any point along piping shall not exceed 65 millimeter 2-1/2 inches for all sizes of piping.

Maximum deviation from line at the end of an 5.5 meter 18-foot length of piping shall be 65 millimeter 2-1/2 inches and cumulatively shall not exceed 150 millimeter .6 inches. Corrections from line within preceding tolerances shall be made at a rate not to exceed 65 millimeter 2-1/2 inches for any one length of piping.

Maximum deflection for curves for 5.5 meter 18-foot lengths of cast ferrous pipe shall be in accordance with NFPA 24.

When the alignment requires deflections in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within established limits, as approved.

3.2.2 Fire Hydrants

Hydrant outlets shall be 600 millimeter 24 inches, minimum, to 900 millimeter, 36 inches, maximum, above grade. The DN115 4-1/2-inch outlet shall face the road or area of access.

3.2.3 Valve Boxes

Valves and valve boxes and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside traffic areas. Soil shall be carefully tamped around each valve box to a distance of 1.2 meter 4 feet on all sides of the box or to the undisturbed trench face when less than 1.2 meter 4 feet.

[Class 3000A concrete slabs 600 millimeter square by 100 millimeter 2 feet square by 4 inches thick shall be provided to protect valve boxes, unless other protection is indicated.]

3.2.4 Thrust Blocks

Thrust blocks shall be provided to absorb hydraulic thrust at caps, plugs, and at system change-of-direction fittings.

Thrust block shall be 20 Megapascal 3,000-psi cured-strength concrete placed against undisturbed soil, with an area sufficient to provide load transmittal.

3.3 ABOVEGROUND PIPING-SYSTEMS INSTALLATION

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there will be not less than 13 millimeter 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel shall be arranged to be in line with each other and parallel to the lines of the building.

Load rating for pipe-hanger supports shall be based on all lines filled with water. Deflection per span shall not exceed slope gradient of pipe. Schedule 40 and heavier ferrous pipe supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing. For concentrated loads such as valves, allowable span shall be reduced proportionately.

PIPE SIZE (DN) (MILLIMETRE)	ROD SIZE (MILLIMETRE)	HANGER SPACING FOR
		STEEL PIPE (MILLIMETRE)
Up to 25	10	2400
32	10	3600
40	10	4500
65 to 90	10	4500
125	15	4500
100	15	4500
150	15	4500

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	HANGER SPACING FOR
		STEEL PIPE (FEET)
Up to 1	3/8	8
1-1/4	3/8	12
1-1/2	3/8	15
2-1/2 to 3-1/2	3/8	15
5	1/2	15
6	1/2	15
8	1/2	15

Vertical risers shall be supported at the base where possible and at intervals specified. Piping shall be guided for lateral stability as necessary. Clamps shall be placed under fittings wherever possible. Carbon-steel pipe shall be supported at each floor at not more than 4.5 meter 15-foot intervals for pipe DN50 2 inches and smaller, and at not more

than 6.1 meter 20-foot intervals for pipe DN65 2-1/2 inches and larger.

Piping shall be securely supported with allowance for thrust forces and thermal expansion and contraction and shall not be subject to mechanical, chemical, vibrational, or other damage, in conformance with ASME B31.1.

3.4 SOUND STOPPING

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts, and large floor and wall openings may be accomplished by packing with properly supported mineral fiber insulation or by foaming-in-place with self-extinguishing, 0.9 kilogram 2-pound density polyurethane foam to a depth not less than 150 millimeter 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 3 millimeter 1/8-inch thickness of vinyl mastic applied to visible and accessible surfaces. Where fire stopping is a consideration, only mineral fiber shall be used, and, in addition, openings shall be covered with 1.6 millimeter 16-gage sheet metal.

3.5 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry or concrete walls, or floors.

Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

Sleeves extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers shall be continuous and fabricated from Schedule 40 steel pipe with welded anchor lugs. Other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally shall provide a minimum 10 millimeter 3/8-inch clearance. Sleeve shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and generation of noise.

Space between a pipe and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with mineral fiber conforming to ASTM C 592 wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration shall be filled with an elastomer calk to a depth of 15 millimeter 1/2 inch. Surfaces to be calked shall be oil- and grease-free.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

3.6 ESCUTCHEONS

Escutcheons shall be provided at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. Escutcheons shall be chrome plated in occupied spaces and shall conceal openings in building construction. Escutcheons shall be firmly attached.

3.7 FLASHINGS

Flashings at systems penetrations of building boundaries shall be provided as indicated.

3.8 BRANCH-LINE TESTERS

Branch-line testers shall permit testing and flushing lines without shutdown of system or loss of fire-protection capability. Line testers shall be fitted with chain-attached caps.

Line testers shall be installed where indicated and on most remote branch lines being served by cross mains, so that testing may be accomplished at the dead corners of each sprinkler system.

3.9 PAINTING

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Government.

Pipe hangers, supports, and other iron work in concealed spaces shall be thoroughly cleaned and painted with one coat of primer paint.

All firex piping, valves, and appurtenances, including hose racks and reels, but excluding hoses, hose nozzles and siamese connections, shall receive two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

3.10 ELECTRICAL WORK

Electrical work is specified in Division 16, "Electrical," except for control and fire alarm wiring which shall be provided under this section in accordance with NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except that electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

Motors, controllers, contactors, and disconnects shall be furnished with their respective pieces of equipment, except that controllers indicated as part of the motor control centers shall be provided under Section 26 24 19.00 40 MOTOR-CONTROL CENTERS. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Controllers and contactors shall have maximum 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment are furnished larger than sizes indicated, the cost of providing additional electrical service and related work shall be included

under this section.

3.11 SYSTEM TESTING

Prior to acceptance of the work, completed systems shall be tested in the presence of the Contracting Officer. Upon approval, certificates of testing shall be provided.

Tests shall be hydrostatic, unless otherwise specified. Only potable water shall be used for testing.

Air Tests, Valve-Operating Tests, and Drainage Tests shall be performed for dry-pipe systems.

Full-flow System Operating Tests shall be performed for standpipe systems.

Government will supply testing water at a location determined by the Contracting Officer, but the Contractor shall be responsible for approved disposal of contaminated water.

Contractor shall prepare and maintain test records of piping-system tests. Records shall show personnel responsibilities, dates, test-gage identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance shall require the signature of the Contracting Officer.

3.11.1 Test Gages

Test gages, to be acceptable, shall have 115 millimeter 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to the test, test gage number, and the project number.

3.11.2 Pneumatic Testing

Pressure Tests shall be pneumatic when freezing conditions may occur and upon prior approval by the Contracting Officer. Compressed air used for testing shall be oil-free.

Pneumatic testing shall include swabbing all joints under a test pressure of 34 kilopascal 5 psig with a standard high film strength soap solution and observing for bubbles.

Duration of the test will be determined by the Contracting Officer and will be for 2 hours, minimum, to 24 hours, maximum. Test may be terminated by direction of the Contracting Officer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

3.11.3 Test and Acceptable Criteria

Aboveground systems shall have Pressure Tests at 1380 kilopascal 200 psi and the applied pressure shall be maintained without further addition of test media for not less than 2 hours. Maximum allowable pressure drop

shall be 14 kilopascal 2 psi.

Underground rubber-jointed ferrous-pipe water systems shall be tested at 1380 kilopascal 200 psi, and the applied test pressure shall be maintained for not less than 2 hours. Maximum allowable pressure drop shall be 14 kilopascal 2 psi. After satisfactory hydrostatic testing, piping shall be tested for leakage as follows:

Duration of each leakage test shall be not less than 2 hours; during the test, the main shall be subjected to 200 psi pressure based on the elevation of the lowest section under test and corrected to the elevation of the test gage.

Leakage shall be defined as the quantity of water supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No piping installation will be accepted if the leakage in gallons per hour exceeds 2.04 0.00054 times the number of joints in the length of the pipe line tested times the nominal diameter of the pipe in inches times the square root of the average test pressure expressed as psig. Amount of leakage at the joints shall not exceed 1.89 liter 2 quarts per 100 joints regardless of pipe diameter.

Hydrostatic tests shall be applied to piping with concrete thrust blocking only after the concrete has cured for more than 7 calendar days.

[Backflow prevention into connected potable-water systems and system devices shall be tested for proper functioning under conditions normal to their application.]

Dripping or weeping joints shall be repaired.

3.12 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than 8 hours, at which time the solution shall contain a minimum residue of 2 ppm of available chlorine or the system shall be re-disinfected. After successful disinfection the piping shall be thoroughly flushed before placing into service. Water for disinfection, and flushing will be furnished by the Government.

3.13 CLEANING AND ADJUSTING

At the completion of the work, all parts of the installation shall be thoroughly cleaned. Equipment, pipes, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Automatic control devices shall be adjusted for proper operation.

-- End of Section --