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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 30 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-21 30 00.00 98 (November 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION 21 30 00.00 98

FIRE PUMPS
07/20

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NOTE: This specification covers the requirements for internal combustion engine and electric motor driven fire pumps and associated equipment.

Provide combustion engine drive, unless electric power is provided from two separate sources or the KSC AHJ deems the power source to be reliable. Dual drive pumps are not permitted. Conform system requirements to KSC-STD-F-0004 (latest revision), "Standard for Fire Protection Design" and NFPA 20, "Installation of Centrifugal Fire Pumps."

Adhere to http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc **UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.**

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

Recommended changes to a NASAKSC Master Specification Section should be submitted to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk**.**

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NOTE: Show the following information on the project drawings:

a. Configuration, and minimum sizes for each piping system (see Table 2-20 in NFPA 20);

b. Location and type of each pump, controller, test header including associated equipment housekeeping pads and appurtenances;

c. Capacity of each item of equipment, including showing the size of all floor drains and their locations. Ensure the minimum size floor drain is 152 mm 6 inches. Show the pitch of the floor also.

d. Locations and details for special supports for piping; and

e. For pipe larger than 300 mm 12 inches, details of anchoring piping including pipe clamps and tie rods.

f. Provide redundant pumping for all installations.

g. This specification is intended for use as part of a performance based criteria, with the detailed engineering calculations and design to be provided by the Contractor. Evaluate the existing water supply and estimated system requirements to provide an approximation of the actual pump capacity and pressure needed.

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PART 1 GENERAL

This is a performance based specification with the Contractor responsible for providing engineering design, installation and testing associated with the work to be performed.

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 are automatically 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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2022) Power Piping

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 C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service

ASTM INTERNATIONAL (ASTM)

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

ASTM A193/A193M	(2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B135	(2010) Standard Specification for Seamless Brass Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C533	(2017; R 2023) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

FM GLOBAL (FM)

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

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

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2022; ERTA 3 2022) Standard for the Installation of Sprinkler Systems
NFPA 20	(2022;TIA 21-1; TIA 21-2) Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 24	(2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 37	(2021) Standard for the Installation and

	Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code

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

U.S. DEPARTMENT OF DEFENSE (DOD)

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

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 3) Shield Expansion (Nail Anchors)
CID A-A-55614	(Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Basic; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors
FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 80	(2007; Reprint Jan 2014) Standard for Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids
UL 142	(2006; Reprint Jan 2021) UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service
UL 789	(2004; Reprint May 2017) UL Standard for Safety Indicator Posts for Fire-Protection Service
UL 1247	(2007; Reprint Jun 2020) Diesel Engines for Driving Stationary Fire Pumps
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 DEFINITIONS

a. Authority Having Jurisdiction(AHJ) - The [Kennedy Space Center][Cape Canaveral Air Force Station] Fire Protection Engineer, whose opinion is final regarding interpretation of the National Fire Protection Association(NFPA) codes.

b. Delegated engineer - A Professional Engineer, as defined under Florida Statutes, Chapter 471, licensed to practice in the State of Florida.

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.

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.

An "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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

SD-02 Shop Drawings

Piping Layout and Sensing Piping Arrangement[; G]

Pump Room[; G]

SD-03 Product Data

Fire Pumps[; G]

Jockey Pump[; G]

Driver[; G]

Fire Pump Controller[; G]

Jockey Pump Controller[; G]

Pipe[; G]

Fittings[; G]

Valves[; G]

Hose Valve Manifold Test Header[; G]

Pipe Hangers and Supports[; G]

[Flow Meter[; G]

] SD-07 Certificates

Qualifications of Welders[; G]

Qualifications of Installer[; G]

Contractor's State Certification[; G]

Signed and Dated Flushing Certificate[; G]

Preliminary Test Certificate[; G]

Final Test Certificate[; G]

Manufacturer's Certified Test Characteristic Curves for Each Pump [; G]

SD-10 Operation and Maintenance Data

Fire Pumps[; G]

Driver[; G]

Fire Pump Controller[; G]

[Flow Meter][; G]

Valves[; G]

Operation and Maintenance Manuals[; G]

SD-11 Closeout Submittals

Posted Operating Instructions[; G]

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; do not provide certifications that are more than one year old.

1.4.2 Qualifications of Installer

Qualifications of System Technician: Prepare installation drawings, shop drawings and as-built drawings, by or under the supervision of, an individual who is experienced with the types of work specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET 1014-7) as an engineering technician with minimum Level-III certification in Automatic Sprinkler System layout program. Submit data for approval showing the name and certification of all involved individuals with such qualifications prior to submittal of drawings. Provide a Florida Contractor's State Certification as a Class I, Fire Pump Installation Services by the installing fire pump contractor.

1.4.3 Preliminary Test Certificate

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.4.4 Components

Do not include components installed under this contract that are more than one (1) year older than the date of installation.

Provide UL Fire Prot Dir listed or FM APP GUIDE approved devices and equipment for fire protection services.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide fire pumps and associated equipment complete and ready for operation. Provide equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with NFPA 20, NFPA 70, and NFPA 72, except as modified herein.

2.1.1 Design Requirements

Prepare working drawings on sheets not smaller than 610 by 914 mm 24 by 36 inches. Sign and seal drawings by a registered engineer, licensed to practice in Florida. In addition to hard copies, provide an electronic .DWG, .DXF or .DGN computer format on a CD ROM.

2.1.1.1 Pump Room

Show detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Show piping schematic of pumps, devices, valves, pipe, and fittings.[Provide an isometric drawing of the fire pump and all associated piping.] Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

a. Pumps, drivers, and controllers

b. Hose valve manifold test header

c. Circuit diagrams for pumps

d. Wiring diagrams of each controller

2.1.1.2 Fire Pumps

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NOTE: In selecting rated head pressures of fire pumps, consider the fact that horizontal split case fire pumps and vertical turbine fire pumps develop 140 percent of rated head pressure when operating under shutoff or "churn" conditions. Maximum desired fire pump rated head pressure is 862 kPa (gage) 125 psig.

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Provide [[_____] electric motor driven] [and] [[_____] diesel engine driven] [horizontal split-case] [vertical turbine][vertical in-line][end suction][factory skid mounted] fire pump(s). Provide fire pump(s) that are [automatic start and manual stop] [manual pushbutton start and stop] [and] [_____] pump[s] and are [automatic start and automatic stop]. Provide each pump with capacity at rated head to be [not less than that indicated] [_____] liter per minute (L/m) gpm at a discharge pressure of [_____][kPa (gage) psig]. Furnish with each pump not less than 150 percent of rated capacity at not less than 65 percent of total rated head. Provide pumps that are of the centrifugal [horizontal split case with automatic air release] [water lubricated, vertical turbine type]. [Provide maximum pump, motor, and engine speed to be 188 rad/sec 1800 rpm.]

Provide fire pump bearings that have an L-10 rating of not less than 5,000 hours, based on load ratings and fatigue life.

Submit manufacturer's certified test characteristic curves for each pump.

2.1.1.3 Electrical Motors, Controllers, Contactors, And Disconnects

Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Provide motors, controllers, contactors, and disconnects as specified herein and that have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Provide controllers and contactors that have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, provide additional electrical service and related work required for an operational system.

2.1.1.4 Electrical Work

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NOTE: Include Section 28 31 00.00 98 FIRE DETECTION AND ALARM when a fire alarm panel or transmitter is required to transmit pump supervisory signals to a constantly attended location as required by NFPA 20. Provide four (4) signals for each pump, pump

controller in manual/off mode, pump running, loss of AC power, phase reversal.
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Provide electrical power work associated with this section under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL except for control and fire alarm wiring. Provide fire alarm system under Section 28 31 00.00 98 FIRE DETECTION AND ALARM. Provide control wiring under this section in accordance with NFPA 20 and NFPA 70. Provide wiring in metal conduit of a type as specified in DIVISION 26 ELECTRICAL.

2.2 SYSTEM COMPONENTS

2.2.1 Fire Pumps

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NOTE: Use the following requirements for horizontal split case pumps.
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[Provide a double suction type impeller, made of cast bronze, balanced hydraulically and dynamically, keyed to the shaft and securely retained in an axial position by positive mechanical means.

] Locate suction and discharge connections on opposite sides of the lower half casing, allowing removal of the rotating element without disturbing the system piping connections.

Rate fire pump discharge flange for 79.4 kilograms 175 pounds.

Provide a fire pump casting that is smooth, free of scale, lumps, cracks, sand holes, and defects of any nature, which make the casting unfit for it's intended use.

Provide the bolting of pressure-holding castings to be such that the maximum stress on any bolt does not exceed 1/4 the elastic limit of the material as computed by using the stress area and on the basis of the water pressure equivalent to the shut-off pressure effective over the area out of the centerline of the bolts.

Seal the shaft with a stuffing box and packing with external water-seal piping. Provide stuffing box glands that exert uniform pressure on the packing.

Furnish replaceable shaft sleeves constructed of a corrosion-resistant material.

Provide the following accessories:

a. Suction eccentric reducer, with the flat side on top, at the pump inlet. Provide a reducer of cast iron or wrought steel material with flanged connections.

b. Automatic air release valve with threaded inlet and discharge connections, to vent air from the pump casing.

c. Casing relief valve, non-adjustable bronze-type, set above the design pressure anticipated but below the combined suction pressure and shut-off head pressure, to discharge water from the system to avoid

pump overheating. Ensure valve conforms to NFPA 20.

[d. Main relief valve and open waste cone discharge where required by NFPA 20.

]2.2.2 Fire Pump Alarms

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NOTE: Provide power for alarms to be from a source other than the engine starting batteries and that does not exceed 125 volts. Do not supply power from the same circuit supplying power to the fire pump controllers or from an emergency circuit. The preferred method of remote pump supervision is via the KSC/CCAFS supervised alarm system reporting to KSC FMS, not via a remote pump trouble panel. Use a remote pump panel only as a last resort, and only if the wiring between the pump and the panel is supervised in accordance with NFPA 72.
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Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72 under [Section 28 31 00.00 98 FIRE DETECTION AND ALARM][_____]. [Provide remote pump trouble panel located [at [_____]] [where shown].] Provide weatherproof exterior alarm devices where shown. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

Activate alarm signal upon the following conditions:

[a. Electric motor controller has operated into a pump running condition

b. Pump controller has been turned to manual or to off position

c. Loss of electrical power to electric motor starter

d. Phase reversal on line side of motor starter

][e. Engine drive controller has operated into an engine running condition, engine drive controller main switch has been turned to OFF or to MANUAL position

f. Trouble on engine driven controller or engine

]2.2.3 Pressure Maintenance (Jockey) Pump

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NOTE: Include this item to prevent fire pumps from cycling due to system pressure drops. Pump capacity is to be less than the flow from a sprinkler head.
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Provide a jockey pump with an UL listed full voltage combination motor controller to maintain a pressure of [_____] kPa (gage) psig on the system. Provide a pump that is [horizontal shaft][or][in-line vertical shaft] centrifugal type with rated discharge pressure of [_____] L/m gpm at [_____]kPa (gage) psig. Ensure the pump shut off pressure does not exceed [the design working pressure of the system] [_____] kPa (gage)

[_____] psig. Start pump when the fire system pressure drops to [_____] kPa (gage)[_____] psig and stops when the pressure reaches [_____] kPa (gage) [_____] psig.

Rate the jockey pump to 2068 kilopascal 300 psi [_____]. Provide drain and gauge tappings on the pump. Provide pump impeller that is hydraulically balanced, non-vapor-binding type, mechanically keyed to the shaft. Provide pump that has replaceable bronze impeller (casing) wear rings, threaded connections, mechanical seal, non-regreasable cast iron cartridge roller ball bearings, close-coupled to an open-drip proof motor.

Arrange pump to draw water [from the suction supply side of the gate valve of the fire pump(s)][as indicated] and discharge into the system on the downstream side of the pump discharge gate valve. Provide an approved indicating gate valve of the outside stem and yoke (O.S.&Y.) type in the jockey pump discharge and suction piping. Provide an approved [oil-filled with a pulsation snubber][glycerin filled] pressure gauge and approved check valve in the jockey pump discharge piping. Provide a check valve that is a swing type with removable inspection plate.

2.2.3.1 Jockey Pump Controller

Provide a Jockey pump controller that is UL listed, completely assembled, wired, and tested at the factory. Provide a lockable disconnect switch adjacent to, or as an integral part of the jockey pump controller.

Provide a unit that is complete with:

a. Across-the-line magnetic starter equipped with overload protection

b. 3-pole fusible disconnect switch, H-O-A selector switch

c. 2068 kilopascal 300 psi bourdon tube type pressure regulator, with independent high and low setpoints

[d. Solid-state pressure switch with independent high and low adjustment for automatic starting and stopping

] e. Pump run light

f. [NEMA 2][NEMA 4][NEMA 12] enclosure with lockable handle

g. Automatic stop function

h. Minimum run time clock

i. Contacts for remote start.

Provide and connect a sensing line to the pressure maintenance pump discharge piping between the control valve and the check valve. Conform the sensing line in accordance with the paragraph entitled, "Pressure Sensing Line," of this section. Completely separate the jockey pump sensing line from the fire pump sensing line(s). Provide an adjustable relay (0-60 minute) with a Form "C" NO/NC alarm contact such that if the jockey pump cycles off and then is restarted before the expiration of the relay timer, the alarm contact is energized and an excessive cycling alarm is sent to the FEMS and KCCS. Exceed start/stop pressure settings by those of the main fire pump(s). Also include a run timer to ensure the jockey pump runs for the minimum time, as recommended by the manufacturer

of the jockey pump motor.

2.2.3.2 Pressure Sensing Line

Provide a completely separate pressure sensing line for each fire pump and jockey pump. Arrange the sensing line in accordance with Figure A-7-5.2.1 of NFPA 20. Provide a sensing line that has 12.7 mm 1/2 inch H58 brass tubing complying with ASTM B135. Equip the sensing line with two (2) restrictive orifice unions each. Provide restricted orifice unions that are ground-face unions with brass restricted diaphragms drilled for a 2.4 mm3/32 inch. Mount restricted orifice unions in the horizontal position, not less than 1.5 m 5 feet apart on the sensing line. Provide two (2) test connections that consist of two (2) brass 12.7 mm 1/2 inch globe valves and 6.3 mm 1/4 inch gauge connection tee arranged per NFPA 20. Equip one of the test connections with a 0 to 2068 kPa 0 to 300 psi water oil-filled gauge. Connect sensing line to the pump discharge piping between the discharge piping control valve and the check valve.

2.2.4 Electric Motor Driver

Provide an electric motor drive by the fire pump manufacturer, with the electrical characteristics indicated. Provide a motor that is open drip-proof (ODP), with a 1.15 service factor. Provide an electric motor that has an energy efficiency of 93[_____] percent or greater.

Provide fire pump and jockey pump electrical motors, controllers, contactors, and disconnects as specified herein. Conform power supply to each motor and controller as indicated.

2.2.4.1 Motors

Provide motor power that is not less than the pump power requirements at all points on the pump operating curve.

2.2.4.2 Fire Pump Controller [Electric Driven]

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NOTE: Do not specify an automatic power shutdown for pumps which provide the sole source of water supply to a sprinkler system or standpipe. Verify whether the AHJ requires a second source of power or deems the existing power source reliable as defined in NFPA 20.

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Conform the fire pump controller to meet NFPA 20 requirements for fire pump service.

[Provide controllers for electric motor driven fire pump service and arrange for manual pushbutton [and automatic] starting and manual pushbutton shutdown [and automatic shutdown following expiration of a minimum running period of 10 minutes, then begin the timing after all starting causes have returned to normal.] [Provide a controller that is completely terminally wired, ready for field connections, and mounted in a moisture resistant [NEMA 2] [NEMA 3] [NEMA 4] [_____] enclosure arranged so that controller current carrying parts is not less than 300 mm 12 inches above the floor. Provide controllers with [[_____] and]]: sequential start timers as required by NFPA 20.] Provide a NEMA rated starting contactor sized for the motor load.

[Provide the controller with:

[a. Digital pressure readout which displays water system pressure

][b. Paperless recorder which records water pressure, time, and date for at least the previous 7 days into a non-volatile memory

][c. Low voltage monitor which alarms when the starting and running voltage drops below the level required by NFPA 20

][d. Motor overload monitor which alarms when the motor exceeds 125 percent of the full load motor current

][e. Low pump room temperature monitor which alarms when the pump room temperature drops below 40 degrees F][4.4 degrees C

][f Low reservoir monitor which alarms when the suction supply water reservoir level drops below 85 percent of capacity

] Furnish controllers to include:

] a. A built-in 2068 kilopascal 0 to 300 psi bourdon tube type pressure switch with independent high and low setpoints

b. Automatic and manual start and manual stop pushbuttons

c. An adjustable minimum run timer

d. Power available light

e. Power monitoring sensing all phases for loss of any phase

f. Under voltage or phase reversal

Provide controller with Form "C" dry contacts for remote monitoring of each condition required to be monitored by NFPA 20 and by this specification. [Provide controller enclosures with legs that are a minimum of [304] [_____] mm [12] [_____] inches long.] Provide controller that is of the [solid-state reduced voltage] [across the line] [part winding] [primary resistor], [primary reactor], [autotransformer] [wye delta] [open or closed transition] starting type with a fault current interrupting capacity of [_____] amperes RMS. Design controller for [_____] kilowatt (kW) horsepower (HP) at [_____] volts and include service entrance label. [Provide an approved power transfer switch to transfer emergency power to the fire pump; Provide a transfer switch that transfers power from [an emergency generator.]]

2.2.5 Diesel Engine Driver

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NOTE: Select bracketed choice of method of specifying power requirements. Exercise special caution in using the second expression because once a proper pump is selected only that diesel engine driver in the UL Fire Protection Equipment Directory corresponding to pump requirements is acceptable. Selection of a specific power can then further limit the suppliers of the equipment. Where

diesel-engine-driven pumps are provided because reliable electrical power is not available to the pump, design the pump room so that electrical power is not required to supply ventilation for engine operation or engine cooling, or provide two totally independent sources of ventilation.
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Conform to UL 1247 and list or approve for fire pump service and [of the make and kW hp rating recommended by the pump manufacturer for the pump being provided. Provide adequate engine power to drive the pump at all conditions of speed and load over the full range of the pump performance curve] [of [_____] kW hp rating]. Provide a compression ignition diesel type engine with an electric starting device taking current from two battery units mounted not less than 304 mm 12 inches above the floor. Provide lead-acid or lead-calcium type batteries.

2.2.5.1 Fire Pump Controller (Diesel Engine)

Provide approved controllers for diesel-engine-driven fire pump service and arrange for manual pushbutton [and automatic] starting and manual pushbutton shutdown [and automatic shutdown following expiration of a minimum running period of 30 minutes, begin timing after all starting causes have returned to normal.] Provide a weekly program timer to automatically start and run the engine for a test period of at least 30 minutes once per week. [If during this test period the engine develops critically low lubricating oil pressure or high engine jacket coolant temperature, initiate on the controller a "trouble on engine or controller" alarm as required by NFPA 20 and stop the engine. While in this stopped condition, if any other starting input is received by the controller, restart the controller and run the engine as required by NFPA 20.] [Provide the controller with:

[a. Digital pressure readout which displays water system pressure

][b. Paperless recorder which records water pressure, time, and date for at least the previous 7 days into a non-volatile memory

][c. Low voltage monitor which alarms when the starting and running voltage drops below the level required by NFPA 20

][d. Motor overload monitor which alarms when the motor exceeds 125 percent of the full load motor current

][e. Low pump room temperature monitor which alarms when the pump room temperature drops below 4.4 degrees C40 degrees F

][f. Low reservoir monitor which alarms when the suction supply water reservoir level drops below 85 percent of capacity.

]]Provide the controller with Form "C" dry contacts for remote monitoring of each condition required to be monitored by NFPA 20 and by this specification.

2.2.5.2 Battery Charger

Provide charger that is an integral part of the controller or a separate wall-mounted unit. For each battery unit, provide voltmeter to indicate the state of the battery charge and provide ammeter to indicate rate of

charge.

2.2.5.3 Fuel System External to Engine

Ensure external fuel system is in accordance with NFPA 20 and NFPA 37. Provide vent piping with weatherproof vent cap. Provide flexible bronze or stainless steel piping connectors with single braid at each piping connection to diesel engine. Provide steel piping for supply, return, vent, and fill piping. Supply and return piping can be made of copper tubing.

a. Steel Pipe: ASTM A53/A53M, Weight Class XS (Extra Strong), black steel, threaded end connections. Provide ASME B16.3 threaded fittings and ASME B16.39 threaded unions.

b. Copper Tubing: ASTM B88M ASTM B88, Type K, soft annealed, with ASME B16.26 flared fittings or compression type fittings.

c. Tanks: UL 80 or UL 142 for aboveground steel tanks.

d. Valves: Ensure valves are suitable for fuel oil service. Provide valves with union end connections or threaded end connections.

(1) Gate, Globe, and Angle Valves: MSS SP-80, Class 125.

(2) Check Valves: MSS SP-80, Class 125, swing check.

(3) Ball Valves: Full port design, copper alloy body, two-position lever handles.

Extend engine vents to outside the building. Equip each tank with a fuel level gauge. Protect fuel lines against mechanical damage. Equip fill lines with 16 mesh removable wire screen. Extend fill lines to the exterior. Mount a weatherproof tank gauge on the exterior wall near each fill line for each tank. Provide a fill cap that is able to be locked by padlock. Locate the engine supply (suction) connection on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. Place fuel tank at an elevation where the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. Pitch the bottom of the tank 21 mm per meter 1/4 inch per foot to the side opposite the suction inlet connection, and to an accessible 25.4 mm 1 inch plugged globe drain valve.

Provide an indicating and lockable ball valve in the supply line adjacent to the tank suction inlet connection. Provide a check valve in the fuel return line.

2.2.5.4 Exhaust System External to Engine

Ensure exhaust system is in accordance with NFPA 20 and NFPA 37. Provide exhaust mufflers to reduce noise levels less than 85 [_____] dBA.

Meet the following:

a. Steel Pipe: ASTM A53/A53M, Weight Class XS (Extra Strong), black steel, welding end connections. Provide ASME B16.9 or ASME B16.11 welding fittings of the same material and weight as the piping.

b. Flanges: ASME B16.5, Class 150. Provide flanges at connections to

diesel engines, exhaust mufflers, and flexible connections. Ensure gaskets conform to ASME B16.21, are composition ring, and are 1.60 mm 0.0625 inch thick. Provide ASTM A193/A193M, Grade B7 bolts and ASTM A194/A194M, Grade 7 nuts.

c. Piping Insulation: Products containing asbestos are not permitted. Provide exhaust piping system inside the building with ASTM C533 calcium silicate insulation minimum of 76 mm 3 inches thick; secure with not less than 9.65 mm 0.38 inch width fibrous glass reinforced waterproof tape or stainless steel bands spaced not more than 203 mm 8 inches on centers. Provide one layer of asphalt-saturated felt over the insulation prior to installing aluminum jacket. Provide insulation with aluminum jacket, minimum thickness of 0.40 mm 0.016 inch, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Secure jacket with stainless steel bands spaced not more than 203 mm 8 inches on centers.

2.2.6 Flow Meter

****
NOTE: Where a flow meter is desired, show a straight line run of pipe without valves or fittings equal to at least 10 times the pipe diameter on the intake side and at least 5 times the pipe diameter on the discharge side of the flow meter. Where possible, arrange the piping so that the metered flow can be discharged through the pump test header and/or back into the pump suction supply by the proper configuration of valves. Only use flow meters where testing can not be performed on an open stream and with the concurrence of the NASA AHJ.
****

Provide an UL listed or FM approved flow meter for the fire pump installation with a direct flow readout device. Select a flow meter with a flow range between [_____] gpm and [_____] gpm. [Provide a [venturi] [annular probe] [orifice plate] [_____] meter.]

2.2.7 Pressure Gauges

Provide pressure gauges that are a minimum of 89 mm 3.5 inch in diameter, brass cased with chrome finish, glass or polycarbonate window, brass dial with white background, black markings, dual units (English and metric), phosphor bronze bourdon tube, brass precision geared movement, plus or minus 3 percent accuracy, 2068 kilopascal 300 psi working pressure, and three-way globe style gauge isolation valve with a plugged end. Provide liquid filled gauges or pulsation dampers for gauges located at pumps.

****
NOTE: Carefully coordinate piping requirements including supports and valves in related fire protection system specifications, to avoid conflicting requirements.
****

2.3 ABOVEGROUND WATER PIPING SYSTEMS

The following requirements apply to miscellaneous fire pump trim piping located in the fire pump room, except where other related specification

sections have more stringent requirements, the more stringent requirements prevail.

2.3.1 Sizes 63.5 Millimeter 2.5 Inches and Larger

2.3.1.1 Steel Pipe

Use ASTM A53/A53M, or ASTM A135/A135M Weight Class Schedule 40; black steel pipe.

2.3.1.2 Buttwelding

ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Use black steel pipe with buttwelding end connections.

2.3.1.3 Steel Pipe Flanges and Fittings

Provide ASME B16.5, Class 150 flanges at valves, connections to equipment, and where indicated. Provide elbows of the long radius type. Do not use reducing bushings. Extend bolts no less than two full threads beyond the nut with the bolts tightened to the required torque.

a. Gaskets: AWWA C111/A21.11, provide one piece factory cut cloth inserted red rubber gaskets.

b. Bolts: ASTM A193/A193M, Grade B7 bolts.

c. Nuts: ASTM A193/A193M, Grade 7.

d. Washers: Use steel flat circular washers under bolt heads and nuts.

2.3.2 Piping Sizes 50 mm 2 Inches and Smaller

2.3.2.1 Steel Pipe

ASTM A53/A53M, Weight Class Schedule 80; zinc-coated steel pipe with threaded end connections.

a. Threaded Fittings: ASME B16.3, Class 300, zinc-coated.

b. Unions: ASME B16.39, Class 300, zinc-coated.

c. Copper Tubing: ASTM B88M ASTM B88, Type L, soft annealed.

d. Fittings: ASME B16.26 flared joint fittings.

e. Pipe Nipples: ASTM B42 copper pipe with threaded end connections.

2.3.3 Valves

Provide valves of types listed or approved for fire protection service with flanged grooved or threaded end connections.

2.3.3.1 Gate Valves

Provide outside screw and yoke type which open by counterclockwise rotation.

Do not use butterfly type control valves.

2.3.3.2 Check Valves

Provide a check valve that is a UL listed or FM approved, standard swing check type with elastomer disc seat. Provide check valve with a ductile iron body with flanged or grooved ends of a clear opening type with a flanged inspection and access coverplate for sizes 152 mm 6 inches or larger.

Install check valve vertically or horizontally, and rate for 2068 kilopascal's 300 psi working pressure. Provide a clapper that is type 304 stainless steel or bronze, with a field replaceable EDPM or Nitrite seal and a nickel or bronze seat. Ensure spring, hinge shaft, and retaining ring are stainless steel. Paint the valve body with a corrosion resistant non-lead coating.

2.3.3.3 Relief Valve

Provide each [engine driven] pump with an approved [pilot operated] [or] [spring operated] circulation relief valve conforming to NFPA 20. Provide a discharge relief valve where the combination of the static pressure and pump churn pressure produce pressures downstream of the pump that exceeds the rating of the components.

2.3.3.4 Circulating Relief Valve

Provide an adjustable circulating relief valve for each fire pump in accordance with NFPA 20.

2.3.4 Hose Valve Manifold Test Header

****

NOTE: Indicate a detail of the hose valve manifold test header on the contract drawings showing supply arrangement, size of header supply piping, number of hose valves, valve arrangement, and test header location. Provide a "straight line manifold" test header which allows the pump to be tested without the use of fire hoses. The "rosebud" test header is not permitted. Where the straight line manifold test header is not a stock item and is shop fabricated, provide a fabrication detail on the contract drawings. In lieu of the hose valve manifold test header, this paragraph can be changed to specify an inline water metering device in accordance with NFPA 20, subject to the approval of the NASA AHJ.

****

Construct manifold test header of steel pipe as specified in paragraph entitled "Aboveground Water Piping Systems," of this section. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide an approved bronze hose gate valve with 63.5 mm 2.5 inch National Standard male hose threads with cap and chain; locate .91 m 3 feet above grade in the horizontal position for each test header outlet. Ensure metallic arc process welding is in accordance with ASME B31.1. Base the number of DN 65 2.5 inch valves upon the capacity of the fire pump with not less than one (1) valve for every 946 liters per minute 250

gallons per minute of pump capacity.

2.3.5 Pipe Sleeves

Install pipe sleeves where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide 25 mm one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which dries to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled hole with UL listed fill, void, or cavity material.

Install the following:

a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete is allowed in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide 26 gage galvanized steel sheet.

2.3.6 Escutcheon Plates

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

2.4 BURIED WATER PIPING SYSTEMS

2.4.1 Pipe and Fittings

****

NOTE: In last sentence, use first phrase in brackets for connection to existing water distribution system where no other Civil work is being performed; delete first phrase in brackets only for connection to new water distribution system where underground piping materials are specified in DIVISION 02 EXISTING CONDITIONS, Section 33 11 00 WATER DISTRIBUTION. For pipe larger than 300 mm 12 inches, detail methods for anchoring piping including pipe clamps and tie rods. Consult NFPA 24 for required depth of coverage of buried fire mains.

****

Provide outside-coated, cement mortar-lined, ductile-iron pipe and fittings conforming to NFPA 24 for piping under the building and less than 1.50 m 5 feet outside of the building walls. Anchor the joints in accordance with NFPA 24; provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size is 152 mm 6 inches. Provide minimum depth of cover as required by NFPA 24,

but no less than .91 m 3 feet. Provide piping more than 1.50 m 5 feet outside of the building walls to be [outside-coated, AWWA C104/A21.4 cement mortar-lined, AWWA C151/A21.51 ductile-iron pipe, and AWWA C110/A21.10 fittings conforming to NFPA 24][provided under [Section 33 11 00 WATER DISTRIBUTION.]].

2.4.2 Valves

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

2.4.3 Post Indicator Valves

Provide gate valves conforming to UL 262 and indicator posts conforming to UL 789. Locate operating nut .91 m 3 feet above grade. Provide post indicator valves with one coat of primer and two coats of red enamel paint.

2.4.4 Valve Boxes

Except where indicator posts are provided, provide each gate valve in buried piping with an adjustable cast-iron or ductile-iron valve box of a size suitable for the valve on which the box is to be used. Provide cast-iron or ductile-iron cover for the box with the word "WATER" cast on the cover. Boxes outside of paved areas are allowed to be constructed of ABS plastic or inorganic fiber reinforced black polyolefin plastic. Provide the shaft of the box with a minimum diameter of 133 mm 5.25 inches. Coat cast-iron and ductile-iron boxes with bituminous paint.

2.4.5 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. Provide tape that is detectable by an electronic detection instrument. Provide tape in rolls, 76.2 mm 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Provide warning and identification that states CAUTION BURIED WATER PIPING BELOW or similar statement. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 304 mm 12 inchesbelow the top surface of earth or the top surface of the subgrade under pavements.

2.5 PAINTING

Furnish equipment of the manufacturer's standard product with the manufacturer's standard finish coat.

Furnish other mechanical equipment with a shop-applied prime paint.

Paint piping in accordance with paragraph entitled, "Painting," of this section.

2.6 SUPPORTING ELEMENTS

Provide piping system components and miscellaneous supporting elements, including, but not limited to, building-structure attachments; standpipe equipment and fire hose cabinet stations; supplementary steel; hanger

rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Provide supporting elements that are suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces. Include an additional 113 kilogram 250 pound load at each anchor per NFPA 13.

****

NOTE: Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT if design requires vibration isolation.

****

Provide supporting elements to be FM approved or UL listed and conforms to ASME B31.1, MSS SP-69, and ASME B16.34.

2.6.1 Building-Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Conform anchor devices to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614 and CID A-A-55615 with:

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

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

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

Provide adjustable positions for cast-in floor mounted equipment anchor devices.

Do not use powder-actuated anchoring devices to support mechanical systems components.

2.6.1.2 Beam Clamps

Provide beam clamps that are center-loading types 21, 28, 29, and 30, UL listed catalogued, and load-rated commercially manufactured products.

Type 20 beam clamps are allowed for pipe DN 50 2 inches and under.

Where Type 25 beam clamps are used, use two (2) per point of pipe support.

2.6.1.3 C-Clamps

****

NOTE: Avoid C-clamps as a means of attaching hangers to structural steel. For metal building system roofs, Z-purlin beam clamps can be used if approved by the Contracting Officer and KSC AHJ. Where used, consider vibration forces and single or accumulated load and resultant moment on structural steel.

****

Do not use C-clamps.

2.6.1.4 Inserts, Concrete

Construct concrete inserts in accordance with the requirements of MSS SP-58 for Type 18 or 19, and ASME B16.34. When applied to piping in sizes DN 50 2 inch iron pipe sizes (ips) and larger, and where otherwise required by imposed loads, insert a 300 mm length of 15 mm 1 foot length of 1/2 inch reinforcing rod and wire through wing slots.

2.6.2 Horizontal-Pipe Attachments

2.6.2.1 Single Pipes

Support piping in sizes up to and including DN 50 2 inch ips by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Support piping in sizes DN 65 2-1/2 inches and larger by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.6.2.2 Parallel Fire Protection Pipes

Use trapeze hangers fabricated from approved structural steel shapes, with U-bolts, when so specified. Conform structural steel shapes to supplementary steel requirements or provide supports of commercially available, approved proprietary design rolled steel.

2.6.3 Vertical Pipe Attachments

Provide single vertical pipe attachments that are Type 8.

2.6.4 Hanger Rods and Fixtures

Use only circular solid cross-section rod hangers to connect building structure attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.6.5 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, design and fabricate such supplementary steel in accordance with AISC 325.

Provide supplementary steel that is hot dipped galvanized or otherwise protected from corrosion, as acceptable to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Conform equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with NFPA 20, except as modified herein. Provide all materials required for a completely functional and operational system. Install piping straight and true to bear evenly on supports.

Install fire pumps, jockey pumps and controllers on minimum 152.4 mm 6 inch thick concrete housekeeping pads. Anchor pumps to the housekeeping pads using leveling bolts and grouted with non-shrink grout. Anchor controllers to the pad, jockey pump controller can be of the wall mount type.

3.1.1 Pumps

Factory test the pump and motor combination prior to shipment. Cover the suction and discharge flanges with wood or metal blanks. Thoroughly clean and paint the pump with one coat of machinery enamel, and assemble and seal the entire pump unit in plastic for shipment.

Prior to fire pump testing, verify proper rotation and check for excessive noise or vibration.[Install vibration isolation for the fire and jockey pump according to the manufacturers recommendations.]

Install pumps with recommended clearances provided for service and maintenance. Completely service the pump without breaking piping or motor connections.

Align the pump and motor with a dial indicator to within 0.05 mm 1.97 mil misalignment tolerance.

3.1.2 Accessories

Unless otherwise indicated, include in pump assemblies suction and discharge isolation valves with tamper switches and discharge check valve. Rigidly connect suction and discharge piping. Provide strain relief coupling where pump and suction piping are installed on separate foundations.

Provide pressure gauges with gauge valves and equip with a pulsation snubber or fill with glycerin. Locate the gauges as close to the pump impeller as possible on each suction and discharge. Provide suction side gauge of the compound type.

Extend all drain and outlets from relief valves, drip rims, and similar items full size to discharge directly above floor drains. Provide drain piping that is Type "L" copper with soldered joints or galvanized Schedule 80 steel with threaded or welded joints.

[Provide conduit, wiring, relays, contacts, and related devices for control signals between the fire pump controller, jockey pump controller and the remote alarm panel. Test each alarm point and control point.

]3.1.3 Cleaning of Piping

Keep the interior and ends of new piping and existing piping affected by construction thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping and fittings so that water and foreign matter does not enter the pipes or fittings. Inspect piping before placing into position.

[3.1.4 Demolition

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by operations with new work of the

same construction.

]3.2 PIPE AND FITTINGS

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through tapered reducing pipe fittings; do not use bushings. Perform welding in the shop, field welding is not permitted.[Photograph all piping prior to burying, covering, or concealing.]

3.2.1 Threaded Connections

Provide jointing compound for pipe threads that is Teflon pipe thread paste; apply only on male threads. Provide exposed ferrous pipe threads with one coat of zinc molybdate primer applied to a minimum dry film thickness of 0.025 mm one mil.

3.2.2 Pipe Hangers and Supports

Provide additional hangers and supports for concentrated loads in piping between hangers and supports, such as for valves.

3.2.2.1 Vertical Piping

Support metal piping at each floor, but at not more than 3 m 10 feet intervals.

3.2.2.2 Horizontal Piping

****
NOTE: Add to table for pipe sizes greater than DN 150 six inch.
****

Support piping as follows:

MAXIMUM SPACING (METERS)										
Nominal Pipe Size (mm)	25 and under	32	40	50	65	80	90	100	125	150
Copper Tube	1.80	2.10	2.40	2.40						
Steel Pipe	2.10	2.40	2.70	3.00	3.40	3.70	4.00	4.30	4.57	4.57

MAXIMUM SPACING (FEET)										
Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper Tube	6	7	8	8						
Steel Pipe	7	8	9	10	11	12	13	14	15	15

3.3 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Provide nameplates that are melamine plastic, 3 mm 0.125 inch thick, black with white center core. Matte finish the surface and square the corners. Accurately align lettering and engrave into the white core. Provide nameplates with minimum size of 63.5 mm 1 by 2.5 inches. Provide lettering with minimum of 6.3 mm 0.25 inch high normal block style. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed by the Contracting Officer near each system. Furnish two copies of each chart and schedule. Identify each inscription's function. On equipment nameplates show the following information:

a. Manufacturer, type, and model number;

b. Contract number and accepted date;

c. Capacity or size;

d. System in which installed; and

e. System which it controls.

3.4 FLUSHING

Flush all new pump suction and discharge piping at 150 percent of rated pump capacity. Where the pump installation involves more than one pump, provide the flushing volume to be the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps can be used to attain the required flushing volume. Do not flush any underground piping by using the fire pumps. Continue flushing operations until water is clear, but for not less than 10 minutes. Submit a signed and dated flushing certificate with a request for field testing.

3.5 FIELD INSPECTIONS AND TESTS

3.5.1 Inspections

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals.

3.5.2 Preliminary Tests

Use only potable water for testing. Perform tests on pumps, drivers, and equipment, including visual equipment checks to ensure compliance with approved detail drawings; pump start-run to ensure proper operation and to detect leakage of piping, valves, and fittings; sequence of operation check; verification that required pump accessories have been provided; test of pump alarm devices; and additional inspections and tests necessary to ensure that the entire pump installation is correct, complete, and ready for operation.

Hydrostatically pressure test each above ground piping system at [_____] 345 kPa (gage) 50 psig above normal system working pressure or 1379 kpa (gage) 200 psig, whichever is greater, for a period of 2 hours in accordance with NFPA 20. No drop in pressure or observed leakage is allowed.

Hydrostatically test below ground piping at not less than 1379 kilopascal 200 psi pressure for not less than two hours, or at 345 kilopascal 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 1034 kilopascal 150 psi. Measure leakage in underground systems by pumping from a calibrated container at the required test pressure. For new piping, do not exceed a leakage rate of 1.89 liters two quarts per hour per 100 gaskets or joints irrespective of pipe diameter. This rate can be adjusted upwards where the test section contains metal seated valves or dry barrel hydrants under pressure by the amounts specified in NFPA 24.

Upon completion of the preliminary test, submit a preliminary test certificate to the Contracting Officer.

3.5.3 Final Formal Inspection and Tests

****
NOTE: Where a specific list of test equipment is warranted by design or site conditions, list equipment such as hoses, pipe, pipe nozzles, tachometers, and current measuring devices.
****

The Contracting Officer and NASA AHJ will witness the final formal tests and approve all systems before they are accepted. Conduct tests in accordance with NFPA 20. Submit the request for formal inspection at least [15] [_____] days prior to the date the inspection is to take place. Ensure an experienced technician regularly employed by the pump installer is present during the inspection. Where pumps are engine driven, ensure an experienced technician regularly employed by the engine manufacturer capable of demonstrating that all engine trouble alarms and operating features perform as required is present. Provide portable radios, hoses, nozzles, calibrated pitot gauges, calibrated pressure gauges, digital tachometer, and volt/ammeter to conduct a complete fire pump acceptance test. Include in acceptance test a full water flow test. Secure all hoses and nozzles during the tests. Conduct water flow testing in a safe manner with no destruction to the existing facility or new construction. Include tests for 100 and 150 percent capacity flows and pressures, along with no-flow pressures for compliance with manufacturer's characteristic curves. At this inspection repeat the required tests as directed. Correct defects in the work, and make additional tests to demonstrate that the system complies with the contract requirements. Furnish appliances, equipment, [water,] electricity, instruments, connecting devices, and personnel for the tests.

[The Government will furnish water for the tests.] Upon completion of the final test, submit a final test certificate to the Contracting Officer.

3.5.4 Operational Testing

Perform system operating tests, valve operating test, fire pump/controller test, and jockey pump/controller test in accordance with NFPA 20. Ensure the controller manufacturer's representative[and transfer switch manufacturer's representative is present].

3.5.4.1 Sequence

Set the jockey pump pressure switch to energize the jockey pump when the system pressure falls through the pressure deadband, and open upon

re-pressurizing the system to the set point pressure. Upon further loss of pressure, the pressure switch for the lead fire pump is to close and start the main pump.

Provide the [_____] pump to [be the lead pump which]starts [automatically whenever the pressure in the main system is reduced to [_____] kPa (gage) [_____] psig] [automatically upon activation of the [_____] sprinkler system,] [and][or] manually when the starter is operated. [Continue to run pump(s) until they shut down manually.] [Automatically shut down pump(s) after a running time of [_____] minutes, unless manually shut down.] [If after [_____] seconds, the lead pump can not maintain a pressure of at least [_____] kPa (gage) [_____] psig on the system, then start Pump No. 2.] [If after an additional [_____] seconds, Pump No. 1 and Pump No. 2 can not maintain a pressure of at least [_____] kPa (gage) [_____] psig on the system, then start Pump No. 3.] [Do not let failure of the lead pump starting prevent subsequent pumps from starting.]

Base final pressure settings upon actual performance during acceptance testing with approval of the Contracting Officer.

3.5.4.2 Testing

Perform testing of the automatic operation of the jockey and fire pump(s). Slowly partially open the inspectors test station until the jockey pump starts. Then fully close the inspectors test and restore the system to "normal" status. Then fully open the inspectors test station, which first starts the jockey pump then the lead fire pump. If the inspectors test station does not generate sufficient pressure loss when opened, use the main drain or other approved method to activate the lead pump.

3.5.4.3 Adjusting

Adjust and record the pressure switch setpoints and deadbands upon successful completion of the above test. Correct deficiencies such as rapid cycling of the jockey pump, activation of both fire pumps (non-sequential starting) and similar anomalies for final acceptance. Verify all trouble, supervisory and alarm conditions.

3.6 CLEANING AND ADJUSTING

At the completion of the work, thoroughly clean all parts of the system. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that accumulated from the installation and testing of the system. Adjust automatic control devices for proper operation.

3.6.1 Painting

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

Thoroughly clean and paint pipe hangers, supports, and other iron work in concealed spaces.

Paint all fire sprinkler system piping, valves, and appurtenances with two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

3.7 DEMONSTRATION

3.7.1 Operating Personnel Instruction

Upon completion of the work and at a time designated by the Contracting Officer, provide the services of experienced technicians regularly employed by the manufacturer of the pumps and the drivers to instruct Government operating personnel in the proper operation and maintenance of the equipment for a period of not less than two separate four hour sessions on two separate days.

At the option of the Contracting Officer, all training sessions are documented by the Government using audio, visual, or a combination of methods. Contain all training information presented in the Operations and Maintenance Manuals.

3.8 OPERATION AND MAINTENANCE MANUALS

Submit operation and maintenance manuals, grouped by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended spare parts, recommended test equipment, and safety precautions. Submit this information prior to acceptance tests being performed.

Include manufacturers catalog data, installation instructions, maintenance manuals, wiring diagrams, and test results. Organize data in a three ring loose-leaf notebook binder, into sections with identifying tabbed dividers, a table of contents and identifying front and spline covers.

3.8.1 Posted Operating Instructions

Post operating instructions for all devices to include pumps, drivers, controllers, valves, and flow meters. Include warning statements as to actions that can take the system out of service, or that can cause accidental discharge and/or activation in the instructions.

-- End of Section --