SECTION 21 30 00

FIRE PUMPS
07/21

PART 1 GENERAL

1.1 REFERENCES

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. Unless a specific document version or date is indicated, use criteria from the most current reference as of the date of solicitation or if amended, date of solicitation amendment.

AMERICAN SOCIETY OF CIVIL ENGINEERS

ASCE 7	Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.100	(2013) Pressure Gauges and Gauge Attachments

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	Standard Methods for the Examination of Water and Wastewater
AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	Metal-Seated Gate Valves for Water Supply Service

AWWA C606	Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B16.1	Gray Iron Pipe Flanges and Flanges Fittings: Classes 25, 125, and 250
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	Malleable Iron Threaded Fittings: Classes 150 and 300
ASME B16.39	Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
ASME B16.4	Gray Iron Threaded Fittings: Classes 125 and 250
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	Nuts for General Applications: machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A 135/A 135M	Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A 194/A 194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

ASTM A 47/A 47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 449	Standard Specifications for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 53/A 53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	Standard Specification for Ductile Iron Castings
ASTM A 795/A 795M	Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 135	Standard Specification for Seamless Brass Tube
ASTM B 42	Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 75/B 75M	Standard Specification for Seamless Copper Tube
ASTM B 88	Standard Specification for Seamless Copper Water Tube
ASTM C 533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM D 3308	Standard Specification for PTFE Resin Skived Tape
ASTM F 436	Standard Specification for Hardened Steel Washers

FM GLOBAL (FM)

FM P7825a	Factory Mutual Research Approval Guide - Fire Protection
FM P7825b	Factory Mutual Research Approval Guide - Electrical Equipment
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL BUILDING CODES

IBC	International Building Code

Joint Base Lewis - McChord

JBLM Design Standards	http://www.lewis-mcchord.army.mil/designstandards/index1.htm

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

MSS SP-58	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
MSS SP-71	Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	Installation of Sprinkler Systems
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code
NFPA 101	Life Safety Code
NFPA 291	Recommended Practice for Fire Flow Testing and Marking of Hydrants
NFPA 1963	Standard for Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

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

UNDERWRITERS LABORATORIES (UL)

UL 1247	Diesel Engines for Driving Centrifugal Fire Pumps
UL 142	Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 262	Gate Valves for Fire-Protection Service
UL 448	Pumps for Fire-Protection Service
UL 80	Steel Tanks for Oil-Burner Fuel
UL 668	Hose Valves for Fire Protection Service
UL Directory A	Building Materials Directory
UL Directory B	Fire Protection Equipment Directory

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	Structural Engineering
UFC 3-310-04	Seismic Design of Buildings
UFC 3-600-01	Fire Protection Engineering for Facilities
UFC 3-601-02	Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems

1.2 SYSTEM DESCRIPTION

a. Except as modified in this Section or on the drawings, install fire pumps in conformance with UFC 3-600-01, JBLM Design Standards, NFPA 13, NFPA 20, NFPA 24, NFPA 70, and NFPA 72 including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. For fire protection in aircraft hangars, reference UFC 4-211-01 in accordance with UFC 3-600-01. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM P7825a approved. Interpret reference to "Authority Having Jurisdiction" to mean JBLM Public Works Life Safety Systems Manager.

b. Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

c. 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 piping layout and sensing piping arrangement. Show engine fuel and cooling system or electric drive motor and electrical connections.

d. Post operating instructions for pumps, drivers, controllers, and flow meters.

e. Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

f. Fire pump systems shall be a designated seismic system in accordance with IBC and ASCE 7. Importance factor Ip shall be equal to 1.5. Provide seismic protection for equipment in accordance with Section 26 05 48.00 10, UFC 3-600-01, JBLM Design Standards, NFPA 13, and IBC. Provide special inspections in accordance with Section 01 45 35 CODE REQUIRED SPECIAL INSPECTIONS, STRUCTURAL OBSERVATIONS, TESTS AND PROCEDURES. Provide designated seismic system certification for the Fire sprinkler system components listed in this section in accordance with ASCE 7. Comply with all applicable Special Inspector of Record requirements of UFC 3-301-01.

g. All water discharged from drains in addition to water discharged during fire pump testing, hydrant flow testing, and full forward flow testing of the backflow preventer are subject to compliance with JBLM EPA issued Municipal Separate Storm Sewer (MS4) Permit and JBLM 200-3 for requirements for dechlorinization.

h. The Serial number of the Fire Pump placard shall match the Serial Number listed on the Fire Pump Controller.

1.3 BASIS FOR CALCULATIONS

The design of the system shall be based upon a water supply with a static pressure and flow at the residual pressure indicated on the drawings or contained in a hydrant Flow Test Report provided by the Fire Protection Specialist. Water supply shall be presumed available at the point of connection to the existing system. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

1.4 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Shop drawings, manufacturer's catalog data, sway brace calculations, preliminary system test procedures, final system test procedures, and contractor certifications, must be reviewed, approved, stamped, and signed by the Fire Protection Specialist prior to submitting for government approval per UFC 3-600-01.

SD-02 Shop Drawings

Shop Drawings; G

Submit two hard copies and one electronic (.pdf) version of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of the Fire Pump installation.

Piping Layout and Sensing Piping Arrangement; G

Pump Room; G

SD-03 Product Data

Materials and Equipment; G

The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete table of contents that includes equipment description and model number shall be provided. Catalog data sheets shall also indicate U.L. Listing / FM approval and the country of manufacture.

Fire Protection Specialist Review Letter for Equipment Submittals; G

Preliminary Tests Procedures; G

Proposed procedures for Preliminary Acceptance Testing shall be approved by the government at least 14 days prior to the proposed start of the tests. Proposed date and time to begin Preliminary Acceptance Testing, shall be submitted with the Preliminary Acceptance Testing Procedures. Contractor to coordinate all tests with the Fire Protection Specialist and the USACE representative and/or the DPW representative.

Final Acceptance Test Procedures; G

Proposed procedures for Final Acceptance Testing shall be approved by the government, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin Final Acceptance Testing, shall be submitted with the Final Acceptance Testing Procedures. Contractor to coordinate all tests with the Fire Protection Specialist and the USACE representative and/or the DPW representative.

Fire Pump Sequence of Operations Sign; G

Provide proposed Fire Pump Sequence of Operations Sign

SD-05 Design Data

Flow Test Data; G

Sway Brace Details and Calculations; G

Details and load calculations shall be provided for sizing of sway bracing.

SD-06 Test Reports

Preliminary Acceptance Testing Report; G

Electronic copies (.pdf) of the completed Preliminary Acceptance Testing Report, no later than 14 days after the completion of the Preliminary System Acceptance Tests.

Fire Protection Specialist Preliminary Acceptance Testing Report; G

Final Acceptance Test Report; G

Electronic copies (.pdf) of the completed Final Acceptance Testing Reports, no later than 14 days after the completion of the Final System Acceptance Tests.

SD-07 Certificates

Fire Protection Specialist Certification; G

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Final Acceptance Testing Certification Letter by Fire Protection Specialist; G

Qualifications of Welders; G

Qualifications of Installer; G

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

Manufacturer's Representative; G

The name and documentation of certification of the proposed fire pump and fire pump controller Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications. The Manufacturer's Representative must be employed by the manufacturer of the fire pump and fire pump controller,

respectively.

Certificates of qualifications, as specified; G

Seismic Certification of Dedicated Seismic Systems; G

State of Washington Certificate of Competency; G

Provide a State of Washington Certificate of Competency for any individual, business, or firm engaged in the inspecting, designing, testing, maintaining or servicing of fire and life safety systems.

Final Acceptance Testing Certification Letter; G

SD-09 Field Reports

Manufacturer's Representative's Field Report; G

Inspections by Fire Protection Specialist; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions; G

Submit two hard copies and one electronic (.pdf) version of manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training.

SD-11 Closeout Submittals

As-Built Drawings

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed. Provide electronic drawings in AutoCAD format on a CD.

Warranty Letter

Operation and Maintenance (O&M) Instructions; G

Instruction of Government Employees

On-site Training; G

After final system acceptance testing has been approved by the government, propose an On-site Training schedule along with proposed date and time at least 14 days prior to the proposed start of On-site Training.

1.6.1 Combined Submittals

The Shop Drawings, Materials and Equipment, and Sway Bracing Calculations shall be submitted in the same package so they can be reviewed at the same time.

1.7 FIRE PROTECTION SPECIALIST (QUALIFIED FIRE PROTECTION ENGINEER)

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist (Qualified Fire Protection Engineer). The Fire Protection Specialist shall be an individual who is a registered professional engineer in the State of Washington and has NCEES licensing. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Any individual, business, or firm engaged in the inspecting, testing, maintaining, designing, or servicing of fire and life safety systems and equipment shall be certified to perform these activities in accordance with the State of Washington. The Fire Protection Specialist shall not be a part of the specialty subcontractor design team and shall have no business relationships (owner, partner, operating officer, distributor, salesman or technical representative) with any construction subcontractors involved with the project or with any fire protection equipment device manufacturers, suppliers or installers for any such equipment provided as part of this project.

1.8 QUALIFICATIONS OF INSTALLER

The contractor performing the Sprinkler System work shall be licensed to perform this type of work in the State of Washington in accordance with UFC 3-601-02 and hold a State of Washington "Certificate of Competency".

1.9 MANUFACTURER'S REPRESENTATIVE

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) being installed and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 2 years.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Interpret reference to "Authority Having Jurisdiction" to mean JBLM Public Works Life Safety Systems Manager.

1.11 SHOP DRAWINGS

The Fire Pump Installation Shop Drawings shall conform to the requirements established for "Working Plans" as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Submitted shop drawing size shall be ISO A1 (22x34).

b. Each submittal drawing shall bear the NICET stamp, designer's

signature, and date of the signature. Submittal drawings not having this information will be returned without review by the Fire Protection Specialist.

c. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

d. Floor plans drawn to a scale not less than 1/2" = 1'-0".

e. Actual center-to-center dimensions between piping and equipment, equipment and walls, piping and walls, piping and ceilings, and piping and floors.

f. Electrical working distance clearance around all electrical equipment shall be indicated.

g. Gridlines horizontally and vertically shall be provided as part of the backgrounds.

h. When the floor plan exceeds a single drawing, match lines shall be provided that indicate on which sheet the building continues.

i. When the floor plan exceeds a single drawing, a key plan shall also be provided that identifies which portion of the building is provided on that drawing and which drawings are used for other portions of the building.

j. Longitudinal and transverse building sections showing the fire pump installation.

k. Details of each fire pump installation, each pipe hanger, restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

l. For all trapeze hangars, provide a table indicating the size of the pipe to be supported, size and type of the trapeze member, section modulus of the trapeze member, distance from the structure to pipe being supported (A and B dimensions), and the section modulus required.

m. Details for each sway brace configuration, orientation, angle, and structural connection along with calculations. The maximum L/R ratio shall be 200. The "total Calculated Load" divided by the "Allowable Load per Fastener" shall not exceed a maximum value of 0.90. A single sway brace calculation depicting a "worst case" calculation will not be acceptable.

n. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following at a minimum:

(1) Fire pumps, drivers, controllers, backflow preventer, piping, valves, reducers, flow meters, seismic separation assemblies, sway bracing, drains, and associated equipment.

(2) 3 feet clearance on one side of the fire pump, fire pump

controller, control valves.

(3) 3 feet clear width from room entry to the fire pump assembly and controller.

(4) Sensing line for each pump including the pressure maintenance (jockey) pump.

(5) Hose valve manifold test header.

(6) Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.

(7) Restraint of underground water main at entry-point or entry- and exit-points as indicated, to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

(8) A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

(9) A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

(10) Engine fuel system for diesel driven pumps.

(11) Engine cooling system for diesel driven pumps.

1.12 SEQUENCING OF PUMPS

1.12.1 Primary Fire Pump

Primary Fire Pump shall automatically operate when the system pressure drops to a minimum of 5 psi below the Pressure Maintenance (Jockey) Pump start point or manually when the starter is operated. The Primary Fire Pump shall continue to run until automatic shutdown. Automatic shutdown shall occur after reaching the stop pressure and the expiration of the minimum run time duration has been met. The minimum run time is 10 minutes for an electrically driven fire pump and 30 minutes for a diesel driven fire pump. Stop pressure must be at least 5 psi below maximum churn pressure at the lowest available static pressure.

1.12.2 Secondary Fire Pump

Secondary Fire Pump shall automatically operate when the system pressure drops to a minimum of 10 psi below the operating pressure of the Primary Fire Pump. The Secondary Fire Pump shall continue to run until automatic shutdown. Automatic shutdown shall occur after reaching the stop pressure and the expiration of the minimum run time duration has been met. The minimum run time is 10 minutes for an electrically driven fire pump and 30 minutes for a diesel driven fire pump. Stop pressure must be at least 5 psi below maximum churn pressure at the lowest available static pressure. Fire pumps shall be prevented from starting simultaneously and shall start sequentially at intervals of 5 to 10 seconds.

1.12.3 Pressure Maintenance (Jockey) Pump

Pressure Maintenance (Jockey) Pump shall operate when the system pressure drops to a minimum of 10 psi below the Pressure Maintenance (Jockey) Pump stop pressure. Pressure Maintenance (Jockey) Pump shall automatically stop when the system pressure reaches the Primary Fire Pump churn pressure plus the static water pressure combined and after the Pressure Maintenance (Jockey) Pump has operated for the minimum run time.

1.13 QUALITY ASSURANCE

1.13.1 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

1.14 FIRE PUMP HOUSE / FIRE PUMP ROOM

The fire pump installation shall be within a dedicated Fire Pump Room within a facility or in a dedicated stand-alone Fire Pump House. Fire Pump House / Fire Pump Rooms located on Lewis Main and Lewis North shall be keyed for a JBLM Master Key #750 and Fire Pump House / Fire Pump Rooms located on McChord Field shall be keyed for a JBLM Master Key 40-11 to prevent access. Fire Pump House / Fire Pump Rooms shall be provided with direct access to the exterior of the building through one of the following for pump and driver replacement and maintenance:

a. Double man doors.

b. An overhead garage style door with a single man door.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Materials and equipment shall be domestically made and standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete table of contents that includes equipment description, model number, and quantity shall be provided. Catalog data sheets shall also indicate U.L. Listing / FM approval and the country of manufacture. Manufacturer's catalog data shall be current and shall not indicate products that have been superseded or products that no longer are manufactured.

c. Catalog data for material and equipment shall include, but not be limited to, the following:

(1) Fire pumps, drivers and controllers.

(2) Manufacturer's certified shop test characteristic curve for

each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

(3) Pressure maintenance pump and controller.

(4) Piping components.

(5) Valves, including gate, butterfly, check, globe and relief valves.

(6) Gauges.

(7) Hose valve manifold test header and hose valves.

(8) Flow meter.

(9) Restricted orifice union or check valve.

(10) Associated devices and equipment.

d. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, contract number and accepted date; capacity or size; system in which installed and system which it controls and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.2 FIRE PUMP(S)

Fire Pump(s) shall be electric motor driven. Diesel engine driven will only be allowed if the primary electrical power has been deemed "not reliable" by DPW. Fire Pump(s) capacity shall have a rated g.p.m. and psi output as determined by the Fire Protection Specialist. Fire Pump(s) shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Size Fire Pump(s) to not exceed 140 percent the maximum sprinkler demand or interior standpipe demand. The maximum gpm rating for each Fire Pump(s) shall be 2,500 gpm. Fire Pump(s) shall be centrifugal horizontal split case, vertical shaft turbine, end-suction, or in-line style Fire Pump(s) as determined by the Fire Protection Specialist. Horizontal pump shall be equipped with automatic air release devices. The maximum rated electrically driven Fire Pump(s) speed shall be 2800 rpm when driving the Fire Pump(s) at rated capacity. Where allowed, the maximum rated diesel driven Fire Pump(s) speed shall be 2100 rpm when driving the Fire Pump(s) at rated capacity. Fire Pump(s) shall be automatic start and automatic stop. Pump shall conform to the requirements of UL 448. Fire Pump(s) discharge and suction gauges shall be oil-filled type.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

2.3.1 General Requirements

Materials and Equipment shall have been tested by Underwriters Laboratories,

Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.3.2 Alarms

Provide audible and visual alarms and remote supervision as required by NFPA 20, in accordance with NFPA 72. Alarm signal shall be activated upon the following conditions:

a. Controller has operated into a pump running condition.

b. Loss of electrical power to electric motor starter.

c. Phase reversal on line side of motor starter.

d. Controller main switch has been turned to OFF or to MANUAL position.

e. Trouble on controller

f. Trouble at Fire Pump.

Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe and Fittings

Provide outside-coated, cement mortar-lined, ductile-iron pipe (with a rated working pressure of 175 psi conforming to NFPA 24 for piping under the building and less than 5 feet outside of the building walls. Piping with a working pressure exceeding 175 p.s.i. shall be Class 250 having a minimum rated working pressure of 300 p.s.i. The fire pump underground suction piping and fire pump underground discharge piping shall be sized based upon 150 percent of the rated capacity of the fire pump while flowing at a maximum velocity of 10 feet per second in accordance with UFC 3-600-01. Piping more than 5 feet outside of the building walls shall 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 or provided under Section 33 11 00 WATER DISTRIBUTION.

2.4.2 Fittings and Gaskets

Flanged elbows or bends (straight sizes), tees, crosses, concentric reducers, base elbows (except reducing size) and bottom base tees shall be ductile iron conforming to AWWA C110/A21.10. Fittings with a working pressure exceeding 175 p.s.i. shall be Class 250 having a minimum rated working pressure of 300 p.s.i. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

2.4.3 Valves and Valve Boxes

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation. Except for post indicator valves, all underground valves shall be provided 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, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

2.4.4 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves for use with indicator post shall conform to UL 262. Indictor post shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.

2.4.5 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be provided in rolls, 3 inches minimum width, color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavement.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel or copper for the installation of fire pumps in accordance with NFPA 20.

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, Steel Pipe shall be black with a working pressure rating of Class 125 of 175 p.s.i. as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795/A 795M, ASTM A 53/A 53M, or ASTM A 135/A 135M. Piping with a working pressure exceeding 175 p.s.i. shall be Class 250 having a minimum rated working pressure of 300 p.s.i. Pipe in which threads are cut, grooves are cut, grooves are rolled formed, or flanges are installed shall be Schedule 40, except Schedule 30 piping is allowed for sizes 8 inches and greater in diameter. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation. Where corrosive water conditions exist, steel suction pipe shall be epoxy coated on the inside prior to installation with an epoxy coating that is recommended for submerged surfaces.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be Class 125 with a minimum working pressure rating of 175 p.s.i. and shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings with a working pressure exceeding 175 p.s.i. shall be Class 250 having a minimum rated working pressure of 300 p.s.i. Steel press fittings shall be approved for fire protection systems. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints an fittings shall be Class 125 with a minimum working pressure rating of 175 p.s.i. and shall be the product of the same manufacturer along with the grooving tools. Fittings with a working pressure exceeding 175 p.s.i. shall be Class 250 having a minimum rated working pressure of 300 p.s.i. Segmentally welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510, and ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Class 150 Flanges shall conform to NFPA 13 and ASME B16.1. Flanges with a working pressure exceeding 175 p.s.i. shall be Class 250 having a minimum rated working pressure of 300 p.s.i.

2.5.1.5 Gaskets

Gaskets shall be cloth inserted non-asbestos red rubber gaskets in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

2.5.1.6 Bolts

Bolts shall be ASTM A 449, Type 1 or 2, Grade 5. Bolts shall extend no less than three full threads beyond the nut with Bolts tightened to the required torque.

2.5.1.7 Nuts

Nuts shall be ASTM A 193/A 193M or ASTM A 194/A 194M, Grade 5.

2.5.1.8 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular Washers shall be provided under all bolt heads and nuts.

2.5.2 Copper Tube Components

2.5.2.1 Copper Tube

Copper tube shall conform to ASTM B 88, Types K and L, soft annealed.

2.5.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.5.3 Pipe Hangers and Supports

Pipe Hangers and Supports shall meet MSS SP-58 and MSS SP-69 requirements and shall be listed in UL Fire Prot Dir, FM P7825a, and FM P7825b for fire protection use. Pipe Hangers and Supports shall be adjustable and of the type suitable for the application, construction, and pipe type and sized to be supported. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

2.5.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire protection service. Valves shall have flange, grooved, or threaded end connections.

2.5.4.1 Control Valves and Gate Valves

Manually operated sprinkler control valve may be butterfly style with an integral tamper switch or gates valve style with an externally mounted tamper switch. Gate valve shall be outside stem and yoke (OS&Y) type, counter clock wise opening, and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

2.5.4.2 Check Valves

Check Valves 2 inches and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check Valves 4 inches and larger shall be of the swing type with flanged or grooved cast iron body, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.4.3 Hose Valves

Hose Valves shall comply with UL 668 and shall have a minimum rating of 300 psi. Hose Valves shall be non-rising stem, all bronze, 90 degree angle or straight pattern type, with 2-1/2 inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose Valves shall be equipped with 2-1/2 inch lugged cap, cap, gasket, and chain. Valve finish shall be polished brass or rough chrome plated.

2.5.4.4 Relief Valves

Relief Valves shall be pilot or spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

2.5.4.5 Circulating Relief Valves

An adjustable Circulating Relief Valve shall be provided for each Fire Pump in accordance with NFPA 20.

2.5.4.6 Suction Pressure Regulating Valves

A pilot operated Suction Pressure Regulating Valve shall be installed in the discharge piping that maintains positive pressure in the suction piping while monitoring pressure in the suction piping through a sensing line. Suction Pressure Regulating Valve shall be FM approved FM P7825a and FM P7825b and arranged in accordance with the manufacturer's recommendations.

2.5.4.7 Automatic Air Release Valves

Provide an Automatic Air Release Valve when piping forms an inverted "U: that traps air on the flow meter loop. A supervised normally closed control valve shall be installed on each side of the Automatic Air Release Valve when a shutoff ball valve cannot be installed that allows for maintenance or replacement of the Automatic Air Release Valve.

2.5.5 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised in the normally open position or in the normally closed position. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon closure/opening of the valve of more than two rotations of the valve stem from its normal position. The suction control valve(s), the discharge control valve(s), valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

2.5.6 Strainers for Fire Protection Pump Suction Piping

All fire pumps not taking water from the base water system shall be equipped with a removable and cleanable suction strainer installed at least 10 pipe diameters from the pump suction inlet to collect debris and foreign matter prior to the water supply entering the impeller of the fire pump. The suction strainer pressure drop shall be calculated to ensure that sufficient NPSH is available to the pump supply flange. The net open area of the strainer shall be at least four times the area of the suction piping. Strainer mesh size shall be in accordance with the pump manufacturer’s recommendation.

2.5.7 Escutcheon Plates

Provide one-piece or split-hinge metal Escutcheon Plates for piping penetrating floors, walls, and ceilings in exposed areas. Escutcheon Plates shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Plates shall be secured in place by internal spring tension or set screw.

2.6 DISINFECTING MATERIALS

All portions of the fire pump system installed on the potable side of the backflow preventer shall be disinfected.

2.6.1 Liquid Chlorine

Liquid Chlorine shall conform to AWWA B301.

2.6.2 Hypochlorites

Calcium Hypochlorite and sodium Hypochlorite shall conform to AWWA B300.

2.7 ELECTRIC MOTOR DRIVER

Motors, controllers, contactors, and disconnects shall be provided with their respective pieces of equipment, as specified herein and shall have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Controllers and contactors shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. All power connections to the motor(s) and fire pump controller(s) shall be coordinated with electrical for proper voltage and phase. When motor(s) and fire pump controller(s) furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section. Motor(s) shall conform to NEMA MG 1 Design B type. Integral size motor(s) shall be the premium efficiency type in accordance with NEMA MG 1. Motor horsepower shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor(s) and fire pump controller(s) shall be fully compatible.

2.7.1 Motor Capacity

Motor(s) shall have adequate horsepower to drive the pump(s) at all conditions of speed and load over the full range of the pump performance curve. The horsepower rating of the motor driver(s) shall be as recommended by the pump manufacturer and shall be de-rated for temperature and elevation in accordance with NFPA 20.

2.8 DIESEL ENGINE DRIVER

Diesel engine driver(s) shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Driver(s) shall be of the make recommended by the pump manufacturer. The engine shall be closed circuit, liquid-cooled with raw water heat exchanger. Diesel engine(s) shall be electric start type taking current from 2 battery units. Engine(s) shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gauge, lubricating oil pressure gauge, water temperature gauge, and ammeter gauge. Engine(s) shall be connected to horizontal-shaft pump(s) by flexible couplings. For connections to vertical-shaft fire pump(s), right-angle gear drives and universal joints shall be used. An engine jacket water heater shall be provided to maintain a temperature of 120 degrees F in accordance with NFPA 20.

2.8.1 Engine Capacity

Engine(s) shall have adequate horsepower to drive the pump(s) at all conditions of speed and load over the full range of the pump performance curve. The horsepower rating of the engine driver(s) shall be as recommended by the pump manufacturer and shall be de-rated for temperature and elevation in accordance with NFPA 20.

2.9 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Pump shall be arranged for automatic start and automatic stopping. The controller shall also be provided with a manual starting and a push-button stop. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 4 watertight and dust tight enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F. The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

2.9.1 Controller for Electric Motor Driven Fire Pump

Controller shall be electronic soft start starting type. Controller with a transfer switch is not required due to the primary power source being deemed "Reliable" by JBLM. Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors. Controller shall be equipped with a manual on/off lever. Controller shall be equipped with terminals for the following:

a. Engine Trouble (individually monitored)
   (1) Loss of Phase
   (2) Loss of Line Power
   (3) Phase Reversal
   (4) Motor Failure to Start

b. Main Switch Mis-set

c. Pump Running

d. Pump Room Trouble (individually monitored)
   (1) Low Pump Room Temperature
   (2) Low Reservoir Level

2.9.2 Controller for Diesel Engine Driven Fire Pump

Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.

Controller shall be equipped with two battery chargers; two ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller shall be equipped with a manual on/off lever. Controller shall be equipped with terminals for the following:

a. Engine Trouble (individually monitored)
   (1) Engine Overspeed
   (2) Low Oil Pressure
   (3) High Water Temperature
   (4) Engine Failure to Start
   (5) Battery
   (6) Battery Charger/AC Power Failure

b. Main Switch Mis-set

c. Pump Running

d. Pump Room Trouble (individually monitored)
   (1) Low Fuel
   (2) Low Pump Room Temperature
   (3) Low Reservoir Level

2.10 PRESSURE MAINTENANCE (JOCKEY) PUMP

2.10.1 General

Pressure Maintenance (Jockey) Pump shall be electric motor driven, in-line vertical shaft type with a rated discharge of approximately 10 g.p.m., but shall be less than the flow from the smallest orifice sprinkler head installed. Pressure Maintenance (Jockey) Pump suction shall be connected to the fire pump supply piping and shall discharge at a point downstream of the fire pump discharge control valve. An approved indicating gate valve of the outside screw and yoke (OS&Y) type shall be provided in the Pressure Maintenance (Jockey) Pump discharge and suction piping. A permanently installed 0 to 300 psi oil-filled water pressure gauge and approved check valve shall be provided in the Pressure Maintenance (Jockey) Pump discharge piping. Check valve shall be swing type with removable inspection plate.

2.10.2 Pressure Maintenance (Jockey) Pump Controller

Pressure Maintenance (Jockey) Pump Controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The Pressure Maintenance (Jockey) Pump Controller shall

be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The Pressure Maintenance (Jockey) Pump Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes. The jockey pump shall not be treated as a fire pump and shall be provided with overcurrent protection per NFPA 70 for Motors, Circuits, and Controllers.

2.11 PRESSURE SENSING LINES

A completely separate Pressure Sensing Line shall be provided for each fire pump and for the Pressure Maintenance (Jockey) Pump. The Pressure Sensing Lines shall be arranged in accordance with Figure A-4.31(a) and Figure A.4.31(b) of NFPA 20. The Pressure Sensing Lines shall be 1/2 inch brass tubing complying with ASTM B 135. Each Pressure Sensing Line shall be equipped with two restrictive orifice unions each or two restricted orifice swing check valves. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled with a 3/32 inch hole or swing check valves having the swing check drilled with a 3/32 inch hole. Restricted orifice unions or check valves shall be mounted in the horizontal position, not less than 5 feet apart on each sensing line. Two test connections shall be provided for each Pressure Sensing Line, one at the connection to the controller and the other located at the point of connection to the pump discharge piping. Test connections shall consist of two brass 1/2 inch globe valves and a 1/4 inch gauge connection tee arranged per NFPA 20. Each test connection shall be equipped with a permanently installed 0 to 300 psi oil-filled water gauge. Each Pressure Sensing Line shall be connected to the pump discharge piping it is serving between the discharge piping control valve and the discharge piping check valve.

2.12 DIESEL DRIVEN FIRE PUMP EXHAUST SYSTEM EXTERNAL TO ENGINE

Diesel driven fire pump exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler (silencer) shall be provided for each diesel engine driver to reduce noise levels to less than 85 dBA. A flexible connector with flange connections shall be provided at the engine between the engine exhaust and exhaust system hard piping. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 1000 degrees F.

2.12.1 Steel Pipe

Except as modified herein, steel pipe shall be black where indicated as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795/A 795M, ASTM A 53/A 53M, or ASTM A 135/A 135M. Pipe in which threads are cut or flanges are installed shall be Schedule 40 or Weight Class XS (Extra Strong), except Schedule 30 piping is allowed for sizes 8 inches and greater in diameter. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.12.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Steel press fittings shall be approved for fire protection systems. Plain-end

fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.12.3 Flanges

Class 140 or 300 flanges shall conform to NFPA 13 and ASME B16.5. Flanges shall be provided at connections to diesel engines, exhaust mufflers, and flexible connections.

2.12.4 Gaskets

Gaskets shall be ASME B16.21, composition ring, 0.0625 inch.

2.12.5 Bolts

Bolts shall be Grade B8 and ASTM A 194/A 194M and shall extend no less than three full threads beyond the nut with Bolts tightened to the required torque.

2.12.6 Nuts

Nuts shall be ASTM A 193/A 193M or ASTM A 194/A 194M, Grade 8.

2.12.7 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular Washers shall be provided under all bolt heads and nuts.

2.12.8 Piping Insulation

Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING and Section 01 62 35 RECYCLED/RECOVERED MATERIALS. Products containing asbestos will not be permitted.

2.12.8.1 Insulation Material

Exhaust piping system including the muffler (silencer) shall be insulated with ASTM C 533 calcium silicate insulation, minimum of 3 inches. Insulation shall be secured with not less than 0.375 inch width fibrous glass reinforced waterproof tape or Type 304 stainless steel bands spaced not more than 8 inches on center.

2.12.8.2 Jacket Material

An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.016 inches, a factory-applied polyethylene and Kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 0.5 inch wide stainless steel bands, spaced not less than 8 inches on centers.

2.12.8.3 Installation

Longitudinal and circumferential seams of the jacket shall be lapped not less than 3 inches. Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall

overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

2.12.9 Thimbles

A Thimble shall be provided at penetration of the roof or wall of the Fire Pump house or Fire Pump Room. Thimble shall be constructed entirely of 304 stainless steel and shall be of triple wall construction. Ventilation holes shall be located at each end of the Thimble to provide cooling with the ventilation holes on the outlet end of the Thimble being screened to prevent birds and debris from entering the Thimble. The Thimble shall be a minimum length of 2 feet and shall easily be mounted to the Fire Pump house or Fire Pump Room with holes that are factory drilled in the mounting flange.

2.13 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

Fuel system shall be provided that meets all requirements and advisory provisions of NFPA 20 and NFPA 37. The fuel tank vent piping shall be routed to the exterior of the Fire Pump house or Fire Pump Room and equipped with a screened weatherproof vent cap. Each tank shall be equipped with a visual fuel level gauge. Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be black steel piping or copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior of the Fire Pump House or Fire Pump Room. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill cap shall be able to be locked by padlock to a standard DPW keyset. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that 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. The bottom of the tank shall be pitched 1/4 inch/foot to the side opposite the suction inlet connection, and to an accessible 1 inch plugged globe drain valve.

2.13.1 Steel Piping Components

2.13.1.1 Steel Pipe

Steel pipe shall be black where indicated as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 53/A 53M or ASTM A 135/A 135M. Pipe in which threads are cut, grooves are cut, grooves are rolled formed, or flanges are installed shall be Schedule 40 without exception.

2.13.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.3 or malleable iron conforming to ASME B16.3. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.13.2 Copper Tube Components

2.13.2.1 Copper Tube

Copper tube shall conform to ASTM B 88, Types K and L, soft annealed.

2.13.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

2.13.3 Diesel Fuel Tanks

Diesel Fuel Tank shall be located above grade within the fire pump house or fire pump room and met the requirements of UL 80 or UL 142. A separate Diesel Fuel Tank is required for each diesel driven fire pump. Each Diesel Fuel Tank shall have a minimum capacity of 1 gallon for each engine horsepower rating plus 5 percent volume for expansion and 5 percent volume for sump, but shall not exceed a total capacity of 1,320 gallons. Diesel Fuel Tank(s) shall be of double wall construction. Diesel Fuel Tank(s) of single wall construction with a curbed or diked are will not be allowed.

2.13.4 Diesel Fuel Line Valves

A manual shutoff valve shall be provided within the Diesel Fuel Tank supply piping adjacent to the tank suction inlet connection. The valve shall be locked in the open position. The manual shutoff valve shall be of full port design with copper alloy body, stainless steel ball, and 2-position lever handle. A check valve (if specified by the diesel driven fire pump manufacturer) shall be permitted in the fuel return line and shall be of s swing check design. The manual shutoff valve and check valve (if installed) shall be suitable for oil service. No other valve is allowed in the fuel system piping.

2.14 BATTERIES

Batteries for diesel engine driver shall be sealed lead-acid batteries. Batteries shall be mounted on a steel rack with non-corrosive, non-conductive base, not less than 12 inches above the floor.

2.15 PUMP BASE PLATE AND PAD

2.15.1 Horizontal-Shaft Pumps

Provide a Common Pump Base Plate for each horizontal-shaft Fire Pump to mount Fire Pump and driver unit. The Pump Base Plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with

suitable drainage. Each Pump Base Plate for the horizontal Fire Pump shall be provided with a 1 inch galvanized steel drain line piped to the exterior of the building. Each Fire Pump and base shall be mounted on a minimum raised 5½ inch reinforced concrete pad that is an integral part of the reinforced concrete floor. After concrete is cured and the Fire Pump is leveled, solid fill with grout the area between the base plate and concrete pad.

2.15.2 Vertical Shaft Pumps

Vertical shaft Fire Pump(s) and the Pressure Maintenance (Jockey) Pump shall be provided with a cast-iron base plate that shall serve as the sole plate for mounting the discharge head assembly. Each Fire Pump and Pressure Maintenance (Jockey) Pump shall be mounted on a minimum raised 5½ inch reinforced concrete pad that is an integral part of the reinforced concrete floor. After concrete is cured and the Fire Pump is leveled, solid fill with grout the area between the base plate and concrete pad.

2.16 HOSE VALVE MANIFOLD TEST HEADER

Hose Valve Manifold Test Header shall be constructed on the inside of the Fire Pump House / Fire Pump Room for connection of hose valves for testing of the fire pump(s). Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b bronze angle or straight pattern body. Hose valves shall be provided with 2.5 inch American National Fire Hose Connection Screw Standard Threads (NH) per NFPA 1963. The number of hose valves shall be I accordance with NFPA 20. Each hose valve shall be equipped with a lugged cap and chain. Install hose valves on the exterior wall no more than 3 feet and less than 2 feet above exterior grade.

2.17 FLOW METERS

Flow Meters shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b as Flow Meters for fire pump installation with direct flow readout device. Flow Meters shall be capable of metering any water flow quantities between 50 percent and 150 percent of the rated capacity of the fire pump. The Flow Meter shall be arranged in accordance with Figure A.4.21.1.2(b) of NFPA 20. The Flow Meter throttle valve and the Flow Meter control valves shall be OS&Y or butterfly style valves. Provide an automatic air release when Flow Meter test piping forms an inverted "U" arrangement. Flow Meter shall be of the venturi annular probe orifice plate type.

2.18 IDENTIFICATION SIGN

2.18.1 Identification Sign

Valve Identification Signs shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "control valve", "auxiliary drain", and similar wording as required by NFPA 13 to identify operational components. All Fire Protection Sprinkler System valves must be marked with permanent tags indicating "Normally Open" or "Normally Closed".

2.18.2 Signage for Buildings

All auxiliary drains and control valves shall be identified with signage on

the access panel for items placed in access panels or at the ceiling for items installed above ceilings. Signage shall be metal or phenolic having a white background with a minimum 2 inch high red letters that is chain hung, the use of a "Sharpie" to write information will not be allowed. Locations of signage shall match locations identified on the Graphic Maps.

2.18.3 Fire/Smoke Wall, Ceiling, and Floor Assembly Marking and Identification

Fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions or any other wall, ceiling, or floor assembly required to have protected openings that are penetrated by Fire Protection Sprinkler System piping and equipment shall be provided with markings and identification in accordance with the IBC and NFPA 101. Wall, Ceiling, and Floor Assembly Marking and Identification shall meet the following criteria at a minimum:

a. Be located in accessible concealed floor, floor/ceiling, or attic spaces.

b. Be located within 15'-0" of the end of each wall.

c. At intervals not exceeding 30'-0" measured horizontally along the wall or partition.

d. Include lettering not less than 3" in height with a minimum 3/8" stroke in a contrasting color.

e. Identify the wall type and its fire-resistance rating, as applicable.

2.18.4 Equipment Signage

Equipment Signage shall have a white background with a minimum 2 inches high red letters unless indicated differently below, the use of a "Sharpie" to write information will not be allowed. Exterior wall mounted signs shall be located at an elevation not exceeding 8 feet above exterior grade. Equipment signage shall be provided for the following items:

a. Fire Department Connection: Wall mounted fire department connection shall be provided with a metal weatherproof sign that shall be placed on the exterior wall of the building directly over the fire department connection. The sign shall be a minimum of 20 inches long by 15 inches tall and shall state "FIRE DEPARTMENT CONNECTION". If facing a parking area, 'No Parking' signage shall be provided. Striping will be painted on the pavement in front of the device.

b. Fire Department Connection: Yard mounted fire department connection shall be provided with 2 inch high white reflective stenciling/labeling along the length of the exposed fire department connection piping. The stenciling/labeling shall indicate the building number (XXXX) that it serves and state "FDC XXXXX". If facing a parking area, 'No Parking' signage shall be provided. Striping will be painted on the pavement in front of the device.

c. Wall Mounted Post Indicating Valve:

   (1) Wall mounted post indicating valve shall be provided with a metal weatherproof metal sign that shall be placed on the exterior wall of the building directly over the post indicating valve. The sign shall

be a minimum of 20 inches long by 15 inches tall and shall state "POST INDICATING VALVE".

(2) Each post indicating valve shall be provided with a weatherproof metal sign that shall be placed on the exterior wall of the building directly over the post indicating valve. The sign shall indicate the area of the facility that the post indicating valve covers. Sign shall be a minimum of 8 inches long and 4 inches high and will have a white background with a minimum 1 inch high red letters.

d. Yard Mounted Post Indicating Valve:

(1) Yard mounted post indicating valve shall be provided with 2 inch high white reflective stenciling along the length of the yard post indicator housing. The stenciling shall indicate the building number (XXXX) that it serves and state "PIV XXXXX".

(2) If facing a parking area, 'No Parking' signage shall be provided. Striping will be painted on the pavement in front of the device.

(3) Each yard mounted post indicating valve shall be provided with a weatherproof metal sign that is secured to the post indicting valve housing with (2) stainless steel hose clamps. The sign shall indicate the area of the facility that the post indicating valve covers. Sign shall be a minimum of 8 inches long and 4 inches high and will have a white background with a minimum 1 inch high red letters.

e. Backflow Preventer Test valves: The test valves utilized for full forward flow testing of the backflow preventer shall be provided with a metal weatherproof sign that shall be placed on the exterior wall of the building directly over the backflow preventer test valves. The sign shall be a minimum of 20 inches long by 15 inches tall and shall state "BACKFLOW TEST VALVES".

f. Fire Pump Room: The room in which the fire pump has been installed shall be provided with a metal or phenolic sign. The sign shall be placed on the exterior side of the door of the room containing the fire pump. The sign shall be a minimum of 16 inches long by 3 inches tall and shall state "FIRE PUMP ROOM".

g. Fire Pump House: The building in which the fire pump has been installed shall be provided with a metal or phenolic sign. The sign shall be placed on the exterior side of the door of the fire pump house. The sign shall be a minimum of 16 inches long by 3 inches tall and shall state "FIRE PUMP HOUSE".

2.19 SEISMIC SEPARATION OR BUILDING EXPANSION / SEPARATION ASSEMBLIES

Provide a Seismic Separation Assembly or Building Expansion / Separation Assembly that is capable of allowing movement along all (3) axes of movement (up/down, Left/right, and in/out). Seismic Separation Assembly or Building Expansion / Separation Assembly shall be provided with grooved flexible couplings and installed where the overhead sprinkler piping crosses a seismic separation joint or a building expansion / separation joint. Seismic Separation Assembly or Building Expansion / Separation Assembly shall consist of either (2) flexible sections of braded hose, (2)

90° elbows, and (1) 180° return or (2) flexible section of braided hose, (2) 45° elbows, and (1) 90° elbow. Seismic Separation Assembly or Building Expansion / Separation Assembly shall include a factory supplied center support nut located at the midpoint of the assembly for hanging and a drain plug. Seismic Separation Assembly or Building Expansion / Separation Assembly comprised of (6) 90° elbows with grooved flexible couplings shall not be allowed.

2.20 WATER PRESSURE GAUGES

Fire Pump system shall have permanently installed oiled filled pressure gauges to provide visual supervision of the water pressure. Each Water Pressure Gauge shall be provided with a ball valve for easy Water Pressure Gauge replacement without shutting down the system. Provide a minimum 3-1/2" diameter pressure gauge with a 1/4" national pipe thread connection. The pressure gauge shall have an accuracy of 3-2-3% over the range of the gauge per ASME B40.100 (3% over the first 1/4 of the gauge range, 2% over the middle 1/2 of the gauge range, and 3% over the last 1/4 of the gauge range). The pressure gauge shall be calibrated to register up to a maximum of 300 p.s.i. for static water pressures less than 175 p.s.i. and a minimum of 50 p.s.i. above static water pressure when the static water pressure exceeds 175 p.s.i.

2.21 BACKFLOW PREVENTION ASSEMBLY

2.21.1 Double Check Valve Backflow Preventer Assembly

Double Check Valve Backflow Prevention Assembly shall be used on all sprinkler systems not using chemicals (i.e. AFFF, Hi-Ex Foam, Anti-Freeze) in the sprinkler system and shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 175 psi. A test port for a pressure gauge shall be provided on the supply side and on the discharge side of the Double Check Valve Backflow Prevention Assembly valves. The supply side and discharge side of the backflow preventer shall be provided with a permanently installed water pressure gauge in accordance with NFPA 13. Backflow preventers installed in Washington State must meet the State of Washington requirements.

2.21.2 Pressure Loss Through Double Check Valve Backflow Preventer Assembly

The pressure loss utilized in hydraulic calculations through the Double Check Valve Backflow Prevention Assembly shall be the greater of 8 psi or the pressure drop documented in the manufacturers pressure loss curve at a flow rate equal to the sprinkler water demand, at the location of the Double Check Valve Backflow Prevention Assembly.

2.21.3 Reduced Pressure Backflow Preventer Assembly

Reduced Pressure Backflow Prevention Assembly shall be used on all sprinkler systems using chemicals (i.e. AFFF, Hi-Ex Foam, Anti-Freeze) in the sprinkler system and shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on

the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 175 psi. Provide a funnel drain beneath the intermediate chamber that is routed to discharge on the outside of the building over a 2 foot by 2 foot concrete splash block to minimize damage to adjacent construction or landscaping unless discharge is directly over a hard surface such as concrete or asphalt. A test port for a pressure gauge shall be provided on the supply side and on the discharge side of the Reduced Pressure Backflow Prevention Assembly valves. The supply side and discharge side of the backflow preventer shall be provided with a permanently installed water pressure gauge in accordance with NFPA 13. Backflow preventers installed in Washington State must meet the State of Washington requirements.

2.21.4 Pressure Loss Through Reduced Pressure Backflow Preventer Assembly

The pressure loss utilized in hydraulic calculations through the Reduced Pressure Backflow Prevention Assembly shall be the greater of 12 psi or the pressure drop documented in the manufacturers pressure loss curve at a flow rate equal to the sprinkler water demand, at the location of the Reduced Pressure Backflow Prevention Assembly.

2.22 FULL FORWARD FLOW TESTING CONNECTION

Provide (1) permanently installed 2½" hose valve for each 250 g.p.m. of interior system demand for full forward flow testing of the backflow preventer assembly. Hose valves shall be permanently installed on the exterior wall of the building. The piping serving the 2½" hose valves shall be provided with a normally closed grooved butterfly valve.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Fire Protection Specialist, the USACE representative, and/or DPW representatives of any discrepancy before performing the work.

3.2 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.3 INSTALLATION REQUIREMENTS

Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection, and testing shall be in accordance with the applicable provisions of NFPA 13, NFPA 20, NFPA 24, UFC 3-600-01, JBLM Design Standards, and publications referenced therein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer. Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

3.4 INSPECTIONS BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the Fire Pump periodically during the installation to assure that the Fire Pump is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist, after completion of each inspection shall provide a site report within five working days that identifies the status of the installation and any corrections that are to be made to meet contract requirements. The site report is to be addressed to the General Contractor with a copy of the report being forwarded to the government representative acting as the Authority Having Jurisdiction.

3.5 ABOVEGROUND PIPING INSTALLATION

3.5.1 Protection of Piping Against Earthquake Damage

The system piping shall be seismically protected against damage from earthquakes. This requirement is not subject to determination under NFPA 13. Install the seismic protection of the system piping in accordance with UFC 3-310-04 and NFPA 13. Include the required features identified therein that are applicable to the specific piping system.

3.5.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.5.3 Piping Installation Limitations

Install piping and seismic bracing at such heights and in such a manner so as not to obstruct any portion of windows, doorways, passageways, or lights. Coordinate installation of piping with all trades and field conditions to avoid conflicts. Install piping and seismic bracing at such heights and in such a manner so as not pose hazards to normal walking head heights, impact the minimum clear height requirements or present tripping hazards. Provide tank supports, seismic bracing, piping offsets, fittings, and any other accessories required for a complete installation.

3.5.4 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided as required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness, and size. Grooved couplings, fittings, and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, Vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify

compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is provided for servicing or adjusting the joint.

3.5.5 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.5.6 Pipe Penetrations

Cutting of existing or new structural members for passage of pipes or for pipe-hanger fastenings will not be permitted.

3.5.6.1 Non-Fire Rated Penetrations in Existing Construction

Pipes that must penetrate existing non-fire rated concrete walls, masonry walls, or concrete floors shall be core-drilled. All other existing wall, ceiling, or floor penetrations shall be provided with a sleeve. The space between the existing wall, ceiling, or floor and the new sleeve shall be patched, sealed, and painted to match the existing finish where the penetration occurs.

3.5.6.2 Fire Rated Penetrations in Existing Construction

Pipes that must penetrate existing fire rated concrete walls, masonry walls, or concrete floors shall be core-drilled. All other existing fire rated wall, ceiling, or floor penetrations shall be provided with a sleeve. The space between the core-drilled hole or sleeve and the pipe shall be firmly packed with mineral wool insulation. Seal space at both ends of the core-drilled hole or sleeve with plastic waterproof cement which will dry to a firm but pliable mass. Where piping penetrates fire walls, fire partitions, or fire floors the piping shall be provided with a fire seal and fire stopped in accordance with Section 07 84 00 FIRESTOPPING. The space between the existing fire rated wall, ceiling, or floor and the new sleeve shall be patched and sealed to maintain the fire rating of the wall, ceiling, or floor and painted to match the existing finish where the penetration occurs.

3.5.6.3 Non-Fire Rated Penetrations of High Moisture Spaces in Existing Construction

Pipes that must penetrate existing non-fire rated concrete walls, masonry walls, or concrete floors shall be core-drilled, including the underground supply piping that enters the building from the exterior. All other existing wall, ceiling, roof, or floor penetrations through high moisture areas (showers, coolers, freezers, exterior walls) shall be provided with a sleeve. The space between the core-drilled hole or sleeve and the pipe shall be firmly packed with mineral wool insulation. Seal space at both ends of the core-drilled hole or sleeve with plastic waterproof cement which will dry to a firm but pliable mass. Underground supply piping penetrations that allows water into the building shall be provided with a mechanically

adjustable segmented elastomeric seal. The space between the existing wall, ceiling, roof, or floor and the new sleeve shall be patched, sealed, and painted to match the existing finish where the penetration occurs.

3.5.6.4 Non-Fire Rated Penetrations in New Construction

Pipes that must penetrate new non-fire rated concrete walls, masonry walls, concrete floors shall be core-drilled. The space between the wall, ceiling, or floor and the sleeve shall be patched, sealed, and painted where the penetration occurs.

3.5.6.5 Fire Rated Penetrations in New Construction

Pipes that must penetrate new fire rated concrete walls, masonry walls, or concrete floors shall be core-drilled. All other new fire rated wall, ceiling, or floor penetrations shall be provided with a sleeve. The space between the core-drilled hole or sleeve and the pipe shall be firmly packed with mineral wool insulation. Seal space at both ends of the core-drilled hole or sleeve with plastic waterproof cement which will dry to a firm but pliable mass. Where piping penetrates fire walls, fire partitions, or fire floors the piping shall be provided with a fire seal and fire stopped in accordance with Section 07 84 00 FIRESTOPPING. The space between the new fire rated wall, ceiling, or floor and the new sleeve shall be patched and sealed to maintain the fire rating of the wall, ceiling, or floor and painted to match the existing finish where the penetration occurs.

3.5.6.6 Non-Fire Rated Penetrations from High Moisture Spaces in New Construction

Pipes that must penetrate new non-fire rated concrete walls, masonry walls, or concrete floors shall be core-drilled, including the underground supply piping that enters the building from the exterior. All other new wall, ceiling, roof, or floor penetrations through high moisture areas (showers, coolers, freezers, exterior walls) shall be provided with a sleeve. The space between the core-drilled hole or sleeve and the pipe shall be firmly packed with mineral wool insulation. Seal space at both ends of the core-drilled hole or sleeve with plastic waterproof cement which will dry to a firm but pliable mass. Underground supply piping penetrations that allows water into the building shall be provided with a mechanically adjustable segmented elastomeric seal. The space between the new wall, ceiling, roof, or floor and the new sleeve shall be patched, sealed, and painted to match the existing finish where the penetration occurs.

3.5.7 Core-driller Holes

Core-driller holes shall provide required clearance between the pipe and the core-driller hole per NFPA 13. The installation of a flexible grooved coupling placed within 1 foot of each side of the core-driller hole will be allowable for the installation of an undersized core-drilled hole.

3.5.8 Sleeves

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of wall, ceiling, or floor penetrations. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The installation of a flexible grooved coupling placed within 1 foot of each side of the penetration will not be an

allowable substitution for an undersized sleeve. Sleeves shall be galvanized or black Schedule 40 steel pipe.

3.5.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.5.10 Drains

Terminate all drainage piping or test piping from the fire pump or associated appurtenances (i.e., circulation relief valve, bowl drains, packing glands, etc.), including backflow preventers, to the exterior of the building. All drains shall be provided with a 2 foot by 2 foot concrete splash block so as not to cause damage to adjacent construction or landscaping during full flow discharge unless discharge is directly over a hard surface such as concrete or asphalt. Discharge to the exterior must not interfere with exiting from the building. Water discharge must not cross an exit or exit discharge.

3.6 IDENTIFICATION SIGNS

3.6.1 Identification Signs

Signs shall be affixed to each control valve, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13 and NFPA 20. Signage shall be metal or phenolic having a white background with red letters that is chain hung and permanently affixed to each valve, the use of a "Sharpie" to write information will not be allowed.

3.6.2 Valve Tags

All fire pump system valves shall be marked with permanent tags indicating "Normally Open" or "Normally Closed".

3.6.3 Full Forward Flow Test Sign

Full Forward Flow Test Sign shall be metal or phenolic having a red background with white letters that is chain hung and permanently affixed to the backflow preventer, the use of a "Sharpie" to write information will not be allowed. The Full Forward Flow Test Sign shall indicate the following information:

a. Pressure on the supply side of the backflow preventer assembly prior to testing.
b. Pressure on the discharge side of the backflow preventer assembly prior to testing.
c. Pressure on the supply side of the backflow preventer assembly during testing.
d. Pressure on the discharge side of the backflow preventer assembly during testing.
e. Total pressure drop across the backflow preventer assembly during testing.
f. System test flow rate based upon hydraulic system demands.
g. Manufacturer’s documented pressure drop data from the pressure drop flow curve.

3.7 FIRE PUMP SEQUENCE OF OPERATIONS SIGN

3.7.1 Fire Pump Sequence of Operations Sign

Provide a typed written Fire Pump Sequence of Operations Sign that shall be installed directly adjacent to the Fire Pump Controller on the wall. The Fire Pump Sequence of Operations Sign shall be a minimum of 8½ inches by 11 inches in size, but may consist of multiple 8½ inch by 11 inch signs.

3.7.2 Fire Pump Sequence of Operations Sign Information

The Fire Pump Sequence of Operations Sign shall provide a detailed step-by-step procedure of how to start the installed Fire Pump for testing and how to return the Fire Pump to normal operation mode after testing has been completed. The detailed step-by-step procedures shall be detailed sufficiently that JBLM DPW personnel can perform Fire Pump testing.

3.7.3 Fire Pump Sequence of Operations Sign Material

The Fire Pump Sequence of Operations Sign shall be secured in a black anodized aluminum frame, have Plexiglas to protect the Fire Pump Sequence of Operations Sign, and be mounted with a concealed security hanging system to prevent unauthorized removal. Fire Pump Sequence of Operations Sign shall consist of the following:

a. Printed on the reverse side of 10 mil polycarbonate Lexan.
b. Standard background shall be white with black text.
c. The Lexan image shall mount to a rigid substrate with removable adhesive mounts.
d. Minimum text size shall be 1/8 inch in height

3.8 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be as required by NFPA 24, but no less than 3 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. Anchor the fitting below the building in accordance with NFPA 24. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 33 11 00 WATER DISTRIBUTION.

3.8.1 Underground Piping Restraint

Provide a concrete thrust block at the elbow where the pipe turns up toward the floor. In addition, the elbow shall be anchored by using steel rods from the elbow to the flange above the floor in the vertical direction and by using steel rods from the elbow to a pipe clamp on the horizontal run of piping at a point outside of the building's footing

3.8.2 Pipe and Fittings

Underground piping shall be inspected, tested and approved before burying,

covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used. Photograph all piping prior to burying, covering, or concealing.

3.8.3 Cleaning of Piping

Interior and ends of underground piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

3.8.4 Threaded Connections

Jointing compound for underground pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D 3308 and shall be applied to male threads only. Exposed underground ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

3.9 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 31 00 00 EARTHWORK.

3.10 ELECTRICAL WORK

Except as modified herein, electric motor and controls shall be in accordance with UFC 3-600-01, JBLM Design Standards, NFPA 20, NFPA 70 and NFPA 72. Electric equipment and wiring shall be in accordance with Sections 28 31 74 INTERIOR FIRE DETECTION AND ALARM SYSTEM and 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Sections 28 31 74 INTERIOR FIRE DETECTION AND ALARM SYSTEM and 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM. All wiring for supervisory and alarm circuits shall be #16 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

3.11 DISINFECTION

After all piping located on the potable side of the backflow preventer has been hydrostatically tested, the potable piping shall be disinfected. The potable piping shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine

residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

3.12 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS and in UFC 3-600-01.

3.13 SPECIAL INSPECTIONS AND SEISMIC CERTIFICATION

Special Certification Requirements for Designated Seismic Systems Certifications shall be provided in accordance with Section 13.2.2 of ASCE 7 for designated seismic systems assigned to Seismic Design Categories C through F as follows:

a. Active mechanical and electrical equipment that must remain operable following the design earthquake ground motion shall be certified by the manufacturer as operable whereby active parts or energized components shall be certified exclusively on the basis of approved shake table testing in accordance with Section 13.2.5 or experience data in accordance with Section 13.2.6 unless it can be shown that the component is inherently rugged by comparison with similar seismically qualified components.

b. Evidence demonstrating compliance with this requirement shall be submitted for approval to the authority having jurisdiction after review and acceptance by a registered design professional

3.13.1 Statement of Special Inspections

Where special inspection or testing is required by Section 1705 of the IBC, the registered design professional in responsible charge shall prepare a statement of special inspections in accordance with Section 1704.3.1 for submittal by the applicant in accordance with Section 1704.2.3.

Exception: The statement of special inspections is permitted to be prepared by a qualified person approved by the building official for construction not designed by a registered design professional.

3.13.2 Content of Statement of Special Inspections

In accordance with Section 1704.3.1 of the IBC, the statement of special inspections shall identify the following:

a. The materials, systems, components and work required to have special

inspection or testing by the building official or by the registered design professional responsible for each portion of the work.

b. The type and extent of each special inspection.

c. The type and extent of each test.

d. Additional requirements for special inspection or testing for seismic or wind resistance as specified in Sections 1705.11, 1705.12 and 1705.13.

e. For each type of special inspection, identification as to whether it will be continuous special inspection, periodic special inspection, or performed in accordance with the notation used in the referenced standard where the inspections are identified.

3.13.3 Designated Seismic Systems

In accordance with Section 1705.12.4 of the IBC, the special inspector shall examine designated seismic systems requiring seismic qualification in accordance with Section 13.2.2 of ASCE 7 and verify that the label, anchorage or mounting conforms to the certificate of compliance.

3.14 TESTING PRIOR TO PRELIMINARY ACCEPTANCE TESTING

3.14.1 Underground Piping

3.14.1.1 Hydrostatic Testing

New underground piping shall be Hydrostatically Tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter. Hydrostatic Testing shall be in accordance with NFPA 24 at not less than 200 psi or 50 psi in excess of maximum system operating pressure whichever is greater for a 2 hour duration.

3.14.1.2 Flushing

Underground piping on the suction and discharge side of the Fire Pump shall be Flushed in accordance with NFPA 24. This includes the requirement to Flush the lead-in connection to the Fire Pump at a minimum flow rate of not less than 10 feet per second or at 150 percent of the Fire Pump Rating, whichever is greater. The Fire Pump may be used to attain the required Flushing volume on the discharge side of the fire pump. The Fire Pump shall not be used for the Flushing. A copy of the underground flushing certificate shall be provided to the Fire Pump contractor prior to connecting the Fire Pump to the underground supply. If a flushing rate of 10 feet per second cannot be obtained, notify the contracting officer in writing no later than 3 working days after the date of testing. Flushing operations shall continue until water is clear, but not less than 10 minutes.

3.14.1.3 Disinfection

After Hydrostatic Tests and Flushing tests are successfully completed on the underground piping, the underground piping shall be Disinfected.

3.14.1.3.1 Chlorination

The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the underground piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire underground piping being tested is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system.

3.14.1.3.2 Sample Testing

Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.14.2 Aboveground Piping

3.14.2.1 Hydrostatic Testing

Aboveground piping shall be Hydrostatically Tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure whichever is greater and shall maintain that pressure without loss for a 2 hour duration. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the Hydrostatic Test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.15 TESTING PRIOR TO PRELIMINARY ACCEPTANCE TESTING REPORT

3.15.1 Underground Piping

Upon completion of specified tests, the Contractor shall complete the Material & Test Certificates for the underground system as specified in paragraph SUBMITTALS. Preliminary Test Report shall be provided by the installing contractor to the government for review and approval. The Contractor's Preliminary Test Report for underground work shall be signed.

3.15.2 Overhead Piping

Upon completion of hydrostatic test, the Contractor shall complete the portion of the Material & Test Certificate for hydrostatic testing only and retain the Material & Test Certificate for Preliminary Testing. The Material & Test Certificate shall not be submitted to the government for review and approval until the remainder of the Preliminary Testing has been completed.

3.16 PRELIMINARY ACCEPTANCE TESTING PROCEDURES

Preliminary Acceptance Testing Procedures shall include detailed step-by-step outline for each test and the expected test results to be performed at Preliminary System Acceptance Testing and shall be on its own page in the Preliminary Acceptance Testing Procedures. The Preliminary Acceptance Testing Procedures shall identify the sequence of testing, time estimate for each test, blank copies of the Material & Test Certificates. The Preliminary Acceptance Testing Procedures shall be in a check-off format (pass/fail) with space to add applicable test data. Preliminary Acceptance Testing Procedures shall include the following tests that would be applicable to the project's Scope of Work:

a. Backflow Prevention Assembly Forward Flow Test.

b. Integration with the Fire Alarm System Testing.

c. Fire Pump Automatic and Manual Start Testing.

d. Fire Pump Automatic and Manual Stop Testing.

e. Verification of Certified Fire Pump Characteristic Curve(s).

f. Automatic Start and Stop of the Pressure Maintenance (Jockey) Pump.

g. Sequence of Operations Verification.

h. Battery Changeover.

i. Alternate Source of Power Testing.

3.17 PRELIMINARY ACCEPTANCE TESTING PREPARATORY MEETING

A Preparatory Meeting may be held at the site to discuss the expectations and requirements of Preliminary Acceptance Testing by reviewing the Preliminary Acceptance Testing Procedures. The necessity of a Preparatory Meeting will be decided upon by the USACE representative and/or DPW representative that would be attending the Preliminary Acceptance Testing. The Preparatory Meeting shall involve the General Contractor, the sprinkler system contractor, and the USACE representative and/or DPW representative.

3.18 PRELIMINARY ACCEPTANCE TESTING

Preliminary Acceptance Testing (PAT)shall be performed in accordance with the approved Preliminary Test Procedures. Furnish instruments and personnel required for preliminary Acceptance Testing. The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The Fire Pump manufacturer's representative shall be an experienced technician employed by the manufacturer, capable of demonstrating operation of all features of components, and shall attend Preliminary System Acceptance Testing. Fire Pump(s) shall run without abnormal noise, vibration or heating. The USACE representative and/or DPW representatives shall be invited to attend and witness the Preliminary Acceptance Test, but are not required to be present. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.18.1 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable interior hose streams, as specified in NFPA 13. Backflow Preventers shall be tested in accordance with Washington State requirements. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5 inch or 3 inch diameter hoses, playpipe nozzles, Hose Monsters, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and discharge outlets during the test. Full Forward Backflow Testing information shall include the following information: Pressure on the supply side of the backflow preventer assembly prior to testing, Pressure on the discharge side of the backflow preventer assembly prior to testing, Pressure on the supply side of the backflow preventer assembly during testing, Pressure on the discharge side of the backflow preventer assembly during testing, Total pressure drop across the backflow preventer assembly during testing, System test flow rate based upon hydraulic system demands, and the Manufacturer's documented pressure drop data from the pressure drop flow curve.

3.18.2 Integration with the Fire Alarm System Testing

Each normally open control valve shall be closed and each normally closed control valve shall be opened to verify that the Fire Alarm System Control Panel identifies the correct control valve operated. Fire alarm connections to each Fire Pump Controller shall be verified at the Fire Alarm System Control Panel for proper identification.

3.18.3 Fire Pump Automatic and Manual Start Testing

Fire Pump(s) shall be tested for Automatic and Manual Starting including sequential starting. Setting of the pressure switches shall be tested when Fire Pump(s) are operated by pressure drop.

3.18.3.1 Automatic Start Testing

Automatic Start Testing shall be performed by operating the test connection on the pressure sensing lines. As a minimum, the Fire Pump(s) shall be started automatically a minimum of 10 times in accordance with NFPA 20. Tests of engine-driven Fire Pump(s) shall be divided equally between both set of batteries. Each Fire pump shall be operated for a period of a least 10 minutes for each of the starts, except that electric motors over 149 kW 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

3.18.3.2 Manual Start Testing

Manual Start Testing shall be performed by operating the manual test button on the Fire Pump Controller. As a minimum, the Fire Pump(s) shall be started manually a minimum of 10 times in accordance with NFPA 20. Tests of engine-driven Fire Pump(s) shall be divided equally between both set of batteries. Each Fire pump shall be operated for a period of a least 10 minutes for each of the starts, except that electric motors over 149 kW 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

3.18.3.3 Automatic Start Pressure of each Fire Pump

Pressure settings for Automatic Starting of each Fire Pump operation shall be verified at the Fire Pump Controller and shall be indicated on an etched plastic placard, attached to the corresponding Fire Pump Controller.

3.18.4 Fire Pump Manual Stop

Each Fire Pump shall be manually stopped after (5) automatic starts and (5) manual starts.

3.18.5 Fire Pump Automatic Stop

Fire Pump(s) shall be setup to automatically shut down after reaching the stop pressure and the expiration of the minimum time determined by N.F.P.A. #20. Stop pressure shall be at least 5 psi below maximum churn pressure at the lowest available static pressure. Each Fire Pump shall be allowed to automatically stopped after (5) automatic starts and (5) manual starts.

3.18.6 Verification of Certified Fire Pump Characteristic Curve(s)

Fire Pump manufacturer's Certified Fire Pump Characteristic Curve for each Fire Pump being tested shall be furnished by the Contractor at the time of the Fire Pump Preliminary System Acceptance Test. Flow tests using the test header, hoses, Hose Monsters, and/or playpipe nozzles shall be conducted. Flow readings shall be taken from each discharge port by means of a calibrated pressure gauge or other approved measuring equipment. RPM, suction pressure, and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall be taken on each leg of the phased power as part of each flow test for electric-motor driven pumps. Flow tests shall be performed at the following point:

a. Churn (No Flow Condition).
b. 75 Percent Rated Capacity.
c. 100 Percent Rated Capacity.
d. 125 Percent Rated Capacity.
e. 150 Percent Rated Capacity.
f. Maximum Fire Pump Demand (System Demand).

3.18.7 Automatic Start and Stop of Pressure Maintenance (Jockey) Pump

Pressure settings for Automatic Starting and Stopping of the Pressure Maintenance (Jockey) Pump operation shall be verified at the Pressure Maintenance (Jockey) Pump Controller and shall be indicated on an etched plastic placard, attached to the Pressure Maintenance (Jockey) Pump Controller.

3.18.8 Sequence of Operations Verification

The Fire Pump Sequence of Operations Sign shall be verified at Preliminary System Acceptance Testing for size and detailed step-by-step procedure of how to start the installed Fire Pump for testing and how to return the Fire Pump to normal operation mode after testing has been completed.

3.18.9 Battery Changeover

Diesel driven Fire Pump(s) shall be tested for automatic Battery Changeover in event of failure of initial battery units.

3.18.10 Alternate Source of Power Testing

Installations with an Alternate Source of Power and an automatic transfer switch, loss of primary power shall be simulated and transfer of the power source shall occur while each Fire Pump is operating at peak load. Transfer from normal to emergency source and retransfer from emergency to normal source shall not cause opening of overcurrent devices in either line. At least half of the 10 Automatic and Manual Starting operations shall be performed with the Fire Pump connected to the Alternate Source of Power.

3.19 PRELIMINARY ACCEPTANCE TESTING REPORTS

Upon completion of specified preliminary tests, the Contractor shall complete the Material & Test Certificates for overhead system as specified in paragraph SUBMITTALS. A Preliminary Acceptance Testing Report that provides an overview of all testing performed, results, and items needing corrections prior to Final Acceptance Testing shall be provided to the government for review and approval. The installing contractor shall provide a Preliminary Acceptance Testing Report to the government for review and approval that shall not be signed.

3.19.1 Fire Protection Specialist Preliminary Acceptance Testing Report

The Fire Protection Specialist shall generate a Preliminary Acceptance Testing Report (on company letterhead) summarizing all Preliminary Acceptance Testing performed along with the test results and a summary of items requiring corrections from Preliminary Acceptance Testing prior to Final Acceptance Testing. The Fire Protection Specialist Preliminary Test Report shall be addressed to and sent to the General Contract for corrections and to the government representative acting as the Authority Having Jurisdiction for their records.

3.20 FINAL ACCEPTANCE TESTING PROCEDURES

Final Acceptance Testing Procedures shall include detailed step-by-step outline for each test and the expected test results to be performed at Final System Acceptance Testing and shall be on its own page in the Final Acceptance Testing Procedures. The Final Acceptance Testing Procedures shall identify the sequence of testing, time estimate for each test, blank copies of the Material & Test Certificates. The Final Acceptance Testing Procedures shall be in a check-off format (pass/fail) with space to add applicable test data. Final Acceptance Testing Procedures shall include the following tests that would be applicable to the project's Scope of Work:

a. Integration with the Fire Alarm System Testing.

b. Fire Pump Automatic and Manual Start Testing.

c. Fire Pump Automatic and Manual Stop Testing.

d. Verification of Certified Fire Pump Characteristic Curve(s).

e. Automatic Start and Stop of the Pressure Maintenance (Jockey) Pump.

f. Sequence of Operations Verification.

g. Battery Changeover.

h. Alternate Source of Power Testing.

3.21 FINAL ACCEPTANCE TESTING PREPARATORY MEETING

A Preparatory Meeting may be held at the site to discuss the expectations and requirements of the Final Acceptance Testing by reviewing the Final Acceptance Testing Procedures. The necessity of a Preparatory Meeting will be decided upon by the USACE representative and/or DPW representative and JBLM Fire Prevention Representative that would be attending the Final Acceptance Testing. The Preparatory Meeting shall involve the General Contractor, the sprinkler system contractor, and the USACE representative and/or DPW representative.

3.22 FINAL ACCEPTANCE TESTING

Final System Acceptance Testing (FAT) shall begin only when the Preliminary Test Report has been approved. Coordinate with the Fire Protection Specialist and an USACE representative for required testing procedures. The Final Acceptance Testing shall be witnessed by the Fire Protection Specialist. The USACE representative and/or DPW representatives and JBLM Fire Prevention Representative shall be invited to attend and witness the Final Acceptance Testing, but are not required to be present. A backcheck inspection of deficiencies found during Preliminary Acceptance Testing will be conducted to verify corrections have been made. The contractor shall provide a complete demonstration of the operation of the system. The contractor shall provide copies of the current as-built drawings and certificates of tests previously conducted at the Preliminary Acceptance Testing. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

3.22.1 Integration with the Fire Alarm System Testing

Each normally open control valve shall be closed and each normally closed control valve shall be opened to verify that the Fire Alarm System Control Panel identifies the correct control valve operated. Fire alarm connections to each Fire Pump Controller shall be verified at the Fire Alarm System Control Panel for proper identification.

3.22.2 Fire Pump Automatic and Manual Start Testing

Fire Pump(s) shall be tested for Automatic and Manual Starting including sequential starting. Setting of the pressure switches shall be tested when Fire Pump(s) are operated by pressure drop.

3.22.2.1 Automatic Start Testing

Automatic Start Testing shall be performed by operating the test connection on the pressure sensing lines. As a minimum, the Fire Pump(s) shall be started automatically a minimum of 10 times in accordance with NFPA 20. Tests of engine-driven Fire Pump(s) shall be divided equally between both set of batteries. Each Fire pump shall be operated for a period of a least 10 minutes for each of the starts, except that electric motors over 149 kW 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

3.22.2.2 Manual Start Testing

Manual Start Testing shall be performed by operating the manual test button on the Fire Pump Controller. As a minimum, the Fire Pump(s) shall be started manually a minimum of 10 times in accordance with NFPA 20. Tests of engine-driven Fire Pump(s) shall be divided equally between both set of batteries. Each Fire pump shall be operated for a period of a least 10 minutes for each of the starts, except that electric motors over 149 kW 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

3.22.2.3 Automatic Start Pressure of each Fire Pump

Pressure settings for Automatic Starting of each Fire Pump operation shall be verified at the Fire Pump Controller and shall be indicated on an etched plastic placard, attached to the corresponding Fire Pump Controller.

3.22.3 Fire Pump Manual Stop

Each Fire Pump shall be manually stopped after (5) automatic starts and (5) manual starts.

3.22.4 Fire Pump Automatic Stop

Fire Pump(s) shall be setup to automatically shut down after reaching the stop pressure and the expiration of the minimum time determined by N.F.P.A. #20. Stop pressure shall be at least 5 psi below maximum churn pressure at the lowest available static pressure. Each Fire Pump shall be allowed to automatically stopped after (5) automatic starts and (5) manual starts.

3.22.5 Verification of Certified Fire Pump Characteristic Curve(s)

Fire Pump manufacturer's Certified Fire Pump Characteristic Curve for each Fire Pump being tested shall be furnished by the Contractor at the time of the Fire Pump Final System Acceptance Test. Flow tests using the test header, hoses, Hose Monsters, and/or playpipe nozzles shall be conducted. Flow readings shall be taken from each discharge port by means of a calibrated pressure gauge or other approved measuring equipment. RPM, suction pressure, and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall be taken on each leg of the phased power as part of each flow test for electric-motor driven pumps. Flow tests shall be performed at the following point:

g. Churn (No Flow Condition).
h. 75 Percent Rated Capacity.
i. 100 Percent Rated Capacity.
j. 125 Percent Rated Capacity.
k. 150 Percent Rated Capacity.
l. Maximum Fire Pump Demand (System Demand).

3.22.6 Automatic Start and Stop of Pressure Maintenance (Jockey) Pump

Pressure settings for Automatic Starting and Stopping of the Pressure Maintenance (Jockey) Pump operation shall be verified at the Pressure Maintenance (Jockey) Pump Controller and shall be indicated on an etched plastic placard, attached to the Pressure Maintenance (Jockey) Pump

Controller.

3.22.7 Sequence of Operations Verification

The Fire Pump Sequence of Operations Sign shall be verified at Final System Acceptance Testing for any updates made from Preliminary System Acceptance Testing regarding size and detailed step-by-step procedure of how to start the installed Fire Pump for testing and how to return the Fire Pump to normal operation mode after testing has been completed.

3.22.8 Battery Changeover

Diesel driven Fire Pump(s) shall be tested for automatic Battery Changeover in event of failure of initial battery units.

3.22.9 Alternate Source of Power Testing

Installations with an Alternate Source of Power and an automatic transfer switch, loss of primary power shall be simulated and transfer of the power source shall occur while each Fire Pump is operating at peak load. Transfer from normal to emergency source and retransfer from emergency to normal source shall not cause opening of overcurrent devices in either line. At least half of the 10 Automatic and Manual Starting operations shall be performed with the Fire Pump connected to the Alternate Source of Power.

3.23 FINAL ACCEPTANCE TESTING REPORTS

Upon completion of specified final acceptance tests, the Contractor shall complete the Material & Test Certificates for both the underground and overhead systems as specified in paragraph SUBMITTALS. Final Acceptance Testing Reports shall be provided by the installing contractor to the government for review and approval. The Contractor's Final Acceptance Testing Report shall be signed by the installing contractor, Fire Protection Specialist, and government representative acting as the Authority Having Jurisdiction.

3.23.1 Final Acceptance Testing Certification Letter

The Fire Projection Specialist shall certify in writing (on company letterhead) after completion of the Final Acceptance Testing that the Fire Pump system performs as intended, has been installed in accordance with the contract requirements, and is ready to be put into service. The Certification Letter shall be addressed to and sent to the government representative acting as the Authority Having Jurisdiction for their records.

3.24 CLOSEOUT SUBMITTALS

The Fire Pump Contractor shall submit the following items for JBLM records, review, and approval prior to any Operations and Maintenance Instructions or On-Site Training.

a. As-Built Drawings

b. Warranty Letter

c. Operation and Maintenance (O&M) Instructions

d. Instruction of Government Employees

3.25 OPERATION AND MAINTENANCE INSTRUCTIONS

The contractor shall submit Operation and Maintenance Instructions prior to performing On-Site Training to the government representative acting as the Authority Having Jurisdiction for approval. Manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4-hour onsite response to a service call on an emergency basis. The Operation and Maintenance Instructions shall include a distinct section for copies of test certificates, design calculations and for the Fire Pump Characteristic Curve.

3.26 ON-SITE TRAINING

The Contractor shall conduct a training course for operation and maintenance personnel as designated by DPW. Coordinate the training requirements for the Fire Pump(s) with training for the sprinkler system and fire alarm system. Provide training on the operation and maintenance of the Fire Pump and Fire Pump Controllers. A technical representative employed by the Fire Pump Manufacturer and Fire Pump Controller Manufacturer shall conduct On-Site operation and maintenance training. Training shall include step-by-step procedures required for system startup, operation, shutdown, and manufacturer’s published routine maintenance. The representative shall conduct demonstrations of these routine maintenance procedures. The training material shall be furnished to the government maintenance workers prior to training to allow them to follow along during demonstrations of maintenance procedures. Submit training lesson plans, materials that will be used for instruction, and proposed schedule at least 14 days prior to the start of related training. The training lesson plan shall break out individual subsystems and components into distinct lessons. Training shall be provided for a period of not less than 4 hours up to a maximum of 8 hours during normal working time. Training shall start after the system is functionally complete and after Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions. Provide (1) copy of the On-Site Training on a DVD to the following:

a. JBLM Fire Department.

b. DPW Public Works.

c. JBLM Fire Alarm Shop.

-- End of Section --