PART 1 - GENERAL

This section references contractors participation in: (1) the submittal process, (2) procurement, (3) installation, (4) factory and site testing, (5) commissioning. Whereas this section clarifies DOS/OBO requirements, and narrows the scope, the most expansive collection of technical data is contained in those referenced documents noted in Section 1.2, Standards and Definitions.

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Constitution Contract, including Contract Clauses and Conditions (CC&C), and Division 1 Contract Specification Sections apply to work of this Section.

1. Other Specifications Sections: Comply with applicable requirements of other Division 15, and Division 16 Sections hereof, for work of this Section, and interfaces of related work of other Sections. In particular, comply with basic mechanical/material/method requirements, basic electrical requirements for mechanical equipment, and basis piping system materials/methods/controls/supports/anchorages; to the extent more stringent requirements are not specified herein for work in this Section.

2. Related Work: Other Sections of these Contract Specifications indicate requirements for related work; which is not work of this Section, except to the extent, certain portions of such work are required for inclusion in the fire pump assemblies to be delivered as packaged units; refer to related Sections specifying: mechanical insulations, fuel handling, electrical provisions, alarm/control systems, labeling, identification/signage, painting/special coatings, and similar requirements.

1.2 STANDARDS AND DEFINITIONS

A. General: Comply with applicable standards as indicated herein, and as required by governing authorities; refer to Section 01091, "Definitions and Standards", hereof for general requirements to comply with applicable standards for work in this Section. The latest edition of the following industry standards contain provisions which are explicitly applicable to work of this Section.

1. "Approval Guide" by Factory Mutual (FM)

2. "Fire Protection Equipment Directory" by Underwriters Laboratories, Inc. (UL)

3. Standards by the National Fire Protection Association (NFPA), including the following:

   a. Std. 13, Installation of Sprinkler Systems.
   b. Std. 20, Installation of Centrifugal Fire Pumps.
   c. Std. 24, Installation of Private Fire Service Mains/Apparatuses.
   d. Std. 25, Water Based Fire Protection Systems.

e. Std. 70, National Electric Code.

B. Definitions: Except as otherwise indicated herein, refer to NFPA 20 for definition of general fire pump terminology used in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide installed fire pump assemblies which perform operationally in accordance with provisions of this Section, including each "Fire Pump Assembly Data Sheet" as attached hereto.

1.4 SUBMITTALS

A. General: For each prefabricated assembly, submit the following, in compliance with provisions of Section 01301, "Construction Submittals" hereof, and in compliance with CC&C provisions.

1. Product Data For each fire pump prefabricated assembly, submit (6) bound copies of product data to include, but not limited to, the following prepared information:

a. Manufacturers general plan and elevations of fabricated assembly, with each principal element of the unit indicated and dimensioned approximately to scale of not less than 1:20; including separate plan of fabricated skid framing; listing part numbers, and weights of entire assembly.

b. 200 mm x 250 mm (8" x 10") colored glossy photographs of each assembly, from previously produced equivalent, if not identical assemblies.

c. Specific pump certified performance curves for each fire pump; recording head developed, pump efficiency, and brake horsepower required for full range of operation.

d. Six (6) copies of printed product literature for each of the principal component and sub-components installed in the assembly; covering recommended installation, testing, operation, maintenance, trouble-shooting, special tools, service, spare parts, and similar user need-to-know information. Specific factory/field pressure settings for the pressure switches specific to installed equipment combination. Include base price lists, and ordering information for all replaceable parts. Include; approved copy of factory pump curve, drafts of field operating instructions, to be laminated and posted on the inside of the fire pump controller door. Instructions for, but not limited to; setting mechanical and/or digital time clocks, solid state/mercoid pressure switches, pressure recorders, battery chargers, and pressure relief valves. Post and explain (a,b,c... method), abbreviated, emergency start/stop procedures on universal language placard with simplified, operator pump/controller orientation chart, including bright, contrasting, florescent, color coded chart, and corresponding colors on emergency fire pump start/stop devices. Referenced information to be laminated, and permanently attached to inside of controller in conspicuous location, except emergency instructions, to be attached outside unit.

e. Properly executed product warranties from the manufacturer of the principal

components in the assembly; both as required by these Contract Specifications, and as noted, to be available by published product literature.

2. Shop Drawings: Show installation of each fire pump assembly with overall layout of service lines and assembly location at not less than 1:20 scale, fully dimensioned, marked elevations, sequencing, and electrical/electronic wiring diagrammatically with circuit diagrams.

3. Quality Control Data: Following installation of work in this Section, including field testing of the fire pump assembly performances, submit field test report and certified statement of compliance with requirements signed by the fire pump manufacturer and installing contractor. Include markup of each previously certified pump curve sheet, recording start-up field test data for the installation. Cover performance compliances for each primary component of the assembly in field test reports and in certified compliance statements. Comply with the Project Director, and/or OBO/PE/DE/ADB/FPE requests.

4. Operation and Maintenance Manuals: After submitted quality control data has been accepted by the Project Director, and OBO/PE/DE/ADB/FPE; prepare and submit in compliance with Sections 01301 and 01701 hereof, six (6) complete, updated (additional), operation and maintenance manuals for every component of the installed fire pump assemblies in titled, and indexed, loose-leaf binders; to include product data as specified in Section 1.4 Submittals, and all final adjustments/settings, and/or changes specific to contract installation upon completion and acceptance testing to OBO/PE/DE/ADB/FPE designated acceptance representative while in the field. Include complete parts listings, prices, and source information as specified in Section, 1.4 Submittals, item 1. Product Data, item d.; and Section, 1.8 Extra Materials, Pump Assembly/ Controller. Include recommended spare parts inventory by manufacturer, and required spare parts inventory by OBO/PE/DE/ADB/FPE, including stock/quantity listing for expendable items, and every component of the fire pump assemblies for Owner's inventory of replacement materials and parts. Manuals shall contain one (1) set each of laminated, abbreviated, and emergency instruction information placards as posted on the controller(s).

5. Hydraulic calculations: Calculations indicating suction supply requirements, elevations, distance, fittings, pipe material, valves, static pressure, residual pressure, velocity, hydraulic reference points, and pump size. Approval for suction line installation will be denied until calculations are submitted. Failure to comply may result in excavation, and removal of installed suction piping.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The manufacturer of the fire pump assembly shall produce the package system at their facility, and maintain ISO 9001 Quality. The manufacturer must provide same-day, technical point of contact/response for inquiries from with-in the United States, and OBO/PE/DE/ADB/FPE personnel TDY around the world.

1. Provide Permanent labels on components of equipment, recording approval stamps, recorded listings, recognized ratings, and other markings to show compliance with applicable standards by NFPA, UL, IEEE, MSS, NEMA, and other trade associations.

2. Comply with applicable provisions of ASME B31.9 "Building Service Piping" for materials/products installations; and comply with ASME "Boiler and Pressure Vessel Code", Section IX, for qualifications of welding processes and operators, including engine exhaust pipe welding where required. The welding certificates shall be to AWS Dl.l for structural and pipe welding.

3. Manufacturers must perform both factory testing and start-up/field testing of the fire pump assembly operations; comply with recognized industry standards, Project Director, and OBO/PE/DE/ADB/FPE requirements. The pump manufacturers' field representative shall provide one (1) day assembly and component training to OBO, and FSN maintenance personnel on location. Training shall include; classroom and practical hands-on operation, adjustments, theory, and trouble-shooting. Specific operation maintenance manuals as described in, SUBMITTALS, ITEM 4, upon completion, final testing and acceptance shall be utilized for this training. The fire pump manufacturers' representative shall provide a detailed punch-list, on company letterhead, for each bound volume, and all personnel present for acceptance and training. The punch-list shall include the manufacturers' recommendations to correct. The Fire Pump manufacturer, General Contractor, Project Director, and OBO/PE/DE/ADB/FPE representatives signature's shall complete the form.

4. Seismic Testing: The pump manufacturer shall demonstrate that the packaged system has been subjected to a seismic simulation test program consisting of single-axis resonance search testing, single axis random multi-frequency testing, and single-axis random multi-frequency testing in each horizontal axis per IEEE Standard #344-1975. The units shall be instrumented with accelerometers, electrically powered and monitored, pressurized, and subjected to nozzle loading during the test program. It shall be demonstrated that the specimen possess sufficient integrity to withstand, without compromise of structures or electrical functions, the prescribed seismic event, for the specific contract location.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Fabricate structural steel skid unit, and assemble fire pump assembly components on skid unit with sufficient strength to withstand shipping and handling stresses as well as operational stresses. Equip skid unit with suitable hoisting "eyes", and similar devices for the accommodation of hoisting slings and other handling methods. Handle assembled unit in compliance with the manufacturers' instructions and recommendations for rigging and hoisting.

1. Preparation of Unit: After completion of factory test procedure for assembled unit, drain water and fuel from assembly, dry entire unit, and treat bare steel/iron surfaces, internal and external, with rust-inhibiting coating of light oil and similar, easily removed harmless substances. Package assembly components for overseas shipment in a manner which will exclude moisture intrusion, and prevent corrosion of metal parts. Protect equipment, piping flanges, nozzles, and other openings or connections; and protect machines against intrusion of sand and other foreign matter. Plastic inserts/flange covers into the pipe ends is not acceptable. Bolted wooden flange covers are acceptable.

2. Store and ship packaged/protected fire pump assemblies in a clean, airtight, moisture resistant, durable shipping container, and retain in a dry location at all times.

1.7 WARRANTY

A. Manufacturers Special Product warranty: OBO/PE/DE/ADB/FPE requires the manufacturer of the fire pump assemblies provide a special product warranty for a period of one year after start-up/testing by the manufacturers' representative, and witnessed by the Project Director and OBO/PE/DE/ADB/FPE. The warranty must be in writing, and be presented to the Project Director upon final pump acceptance by OBO/PE/DE/ADB/FPE.

1.8 EXTRA MATERIALS, PUMP ASSEMBLY/CONTROLLER

A. Initial Spare Parts Stock: For each required fire pump assembly and controller, furnish an initial stock of expendable items, specific maintenance materials, and spare parts. Comply with OBO/PE/DE/ADB/FPE requirements, and manufacturers' recommendations on items. Include not less than the following categories/quantities of materials: Two (2) complete engine and pump rebuild gasket sets, gasket material, seals and O-rings. Two (2) complete sets of engine filter and engine filter O-rings (in addition to O-rings in rebuild kits). Thirty-eight (38) liters (10 gallons coolant), and thirty-eight (38) liters (10 gallons) engine oil, recommended by engine manufacturer. Two (2) sets of drive belts. Twenty (20) indicator light bulbs. Five (5) each type relay and diode. Two (2) battery charge cards. One (1) crank control. One (1) voltage sensing unit. One (1) solenoid drain valve. One (1) tachometer cable, and one (1) overspeed cable. Two (2) complete sets of all fuses for fire pump and jockey pump controller. Two (2) 0-2000 kPa (two (2) 0-300 psi), liquid filled gauges. One (1) each jockey pump pressure switch and fire pump pressure switch. All spare parts inventory to be housed in a separate, designated, storage cabinet, attached to, or located adjacent to the fire pump assembly, and in all cases located in the fire pump room. All parts shall be individually labeled, and packaged to resist the environment in extended storage. There shall also be a laminated parts list, with corresponding, manufacturers' part numbers, and manufacturers' telephone and fax numbers permanently attached inside of the same cabinet. The fire pump package will not be accepted unless this requirement is complete.

1.9 MAINTENANCE AND OPERATION

A. General: Following completion of installation and start-up/field testing of the fire pump assemblies on the project site, and through the remainder of the project construction time, provide continued maintenance, and scheduled weekly automatic testing, and/or emergency operational readiness of units; comply with instructions and recommendations of the manufacturer. Operate units weekly for a continuous running period of not less than 30 minutes. Refer to Section 01501, "Temporary Facilities" for requirements on staffing fire pump assemblies with operators who have been adequately trained by the manufacturer.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Include the following, in addition to the primary components, encompassing the fire pump, drive

unit, pump controllers, fuel tank, batteries with charger, flow meter, skid assembly internal-to-package piping and electrical/electronic control wiring as applicable for each unit as required.

1. The jockey pump shall be equipped with a pressure relief valve on the discharge side. The pressure relief valves shall be installed after the discharge side of the pump and before the system check valve. It shall be UL listed and/or FM rated and no smaller than 3/4" (19 mm). It shall be visibly piped to a open floor drain so the flow can be regulated and adjusted. The drain line shall be piped of non-corrosive material.

2. All pump casings shall be equipped with an automatic air relief valve.

3. Suction and discharge gauges, Ashcroft mfg., or equal, -200 to 2000 kPa (-30 to 300 psi) suction, 0 to 2000 kPa (0-300 psi) discharge, 89 mm (3.5 inch) dials on the fire pump. Suction and pressure gauges shall be liquid filled and piped so they can be readily viewed by the operator from the fire pump controller. Gauges shall have a brass ballcock to facilitate gauge maintenance.

4. The fire pump and jockey pump controller sensing lines shall have one (1) each, 0 to 2000 kPa (0-300 psi) liquid filled gauge, Ashcroft mfg., or equal, piped with a brass ballcock 305 mm (1'-0") above the piping entrance to their respective enclosures.

5. The fire pump discharge piping shall have a 0 to 2000 kPa (0-300 psi) liquid filled gauge, Ashcroft mfg., or equal, with a brass ballcock, located on the discharge, after the discharge check valve and flow meter by-pass, and at the furthest point of the pump manufacturers discharge piping.

6. The piping between the fire pump suction and the supply tanks shall be galvanized steel with galvanized fittings.

7. The fire pump discharge piping, up to and including the backflow preventer, shall be galvanized steel.

8. Valves on the discharge piping shall be cast-iron and UL listed and/or FM approved.

9. Provide a test valve for fire pump testing.

10. The fire pump discharge piping shall have a 25 mm (1-inch) drain valve, with a 25 mm (1 inch) plug, located at the furthest point of the fire pump manufacturers' discharge piping.

11. All drains located on the fire pump package, including, but not limited to; the fire pump packing bowls, fire pump and jockey pump controller sensing line drains, and 25 mm (1-inch) drain line on the furthest point of the fire pump discharge piping shall be piped to a common 38 mm (1½-inch) galvanized pipe header, piped to the edge of the skid, and ready for the Contractor's piping to a floor drain. Each drain branch line shall have a union, for maintenance, and shall be piped above the level of a properly grouted skid, and substantially supported. The galvanized piping from the fire pump packing bowls shall be one inch (1"), and have a check valve installed so as to prevent backflow through the bowls during substantial discharge of the other lines. All drain lines shall be of non-corrosive material.

12. Tapered concentric increaser at discharge outlet. Tapered eccentric reducer at suction inlet. Both must be flanged and with straight tapers. Weld reducers/increasers are not acceptable.

13. Main relief valve, when a diesel driven unit, shall be piped back to the reservoir unless otherwise approved by OBO/PE/DE/ADB/FPE. The piping must have a sight glass of the type with removable window and an indicator ball. The relief valve discharge piping must have a check valve installed if the piping is returned below the expected reservoir water level, or the piping is installed in such a manner as to trap five gallons or more water. If trapped water is present, a one inch drain valve must be installed after the relief valve, and before the check valve, to facilitate maintenance on the sight glass, or the relief valve. If the one inch (1"), drain is installed it must be piped to the common skid drain header. If the pump drivers are electric, the typical 3/4" relief valve will also be piped to the drain header and be equipped with a sight glass

14. A water level detecting device capable of signaling auto-fill solenoids for the fire pump reservoir, piped in liquid tight fittings, junction boxes, conduit, and other connections and devices in line. The water level monitor must also be capable of signaling a remote fire pump alarm panel of high/low water levels. If the water level detecting device is mechanical, it must be constructed of brass, stainless steel, or equal rust inhibitive materials.

15. The fire pump assembly shall be monitored by an independent alarm panel, Metron mfg. or equal, and shall supervise the following: Engine Run, System Failure, Controller Selector Switch Position, Battery Failure, AC Failure, Low Fuel, Reservoir Water Level as referenced in item j. The remote annunciator must require a key to disable, and a test switch for the indications.

16. Name plates on fire pump skid package and components must be permanent, and legible throughout the life of the equipment. If component name plates are not easily accessible, or subcontracted component labels of the fire pump manufacturer are not of the permanent stamped steel type, a permanent label shall be constructed and placed in a conspicuous location near the referenced equipment by the fire pump skid package manufacturer. If the fire pump manufacturer utilizes an "in-house" reference number, the number shall appear on a permanent metal placard, attached to the skid in a conspicuous location.

17. Flow meter shall be Gerand mfg. or equal.

18. An OS&Y valve with a DPDT tamper switch shall be provided on the suction side of the pump. A butterfly valve equipped with a DPDT tamper switch shall be provided on the discharge side of the pump.

19. A wafer type check valve or swing check valve shall be provided on the discharge side of the fire pump. All system control valves and check valves shall be UL listed and/or FM approved. They shall be rated not less than 1200 kPa (175 psi). All check valves shall have Rubber Faced Clapper Assemblies.

20. A UL listed backflow preventer shall be provided downstream of the relief valve as part of the fire pump skid assembly.

21. The fuel tank shall be 568 liters (150 gallon) capacity, and be provided with a mechanism

to drain sediment from the tank bottom. A ball valve, with a locking feature and designed to maintain integrity against diesel fuel should be provided.

22. The fuel tank shall be provided with a water separator, in-line to the diesel driver.

23. Day tank digital level sensor: A UL Listed, integrated level sensor package shall be supplied which provides tank level indication for control by a Building Automation System(BAS) for activation of remote pumps and for operation of an automatic control valve in the day tank supply pipe. House devices within a NEMA 4 box mounted on top of the day tank. All indicators are to be long life light emitting diodes. Digital Display to read tank volume in 13mm high characters.

    a. Provide the following indication at the day tank:
        1) Fuel level.
        2) Power available.
        3) Low-level alarm.
        4) High-level alarm.
        5) Overflow alarm/pump control backup activated.
        6) Day Tank leak.

    b. Provide a 4-20 mA output signal for interface to the Building Automation System (BAS). The sensor output signal shall be proportional to the fuel level in the day tank and shall be capable of sensing a fuel level between 5 percent and 95 percent of the tank capacity.

    c. Refer to mechanical drawings for fuel oil system flow diagram and sequence of operation.

24. Provide a day tank mounted overflow-return pump with controls: 0.6 L/s at 200 kPa of head; direct drive, motor driven pump coupled via flexible coupling; motors shall be open drip proof construction, NEMA type B, continuous duty at 40°C, 240 V AC, 1-phase, 50 hertz, 1.15 service factor.

    a. Pumps to be directly driven, positive displacement, internal gear type with mechanical shaft seal. Pump shall be a high pressure, hydraulic type consisting of two intermeshing, hardened steel, precision ground gear assemblies enclosed by a high strength, die cast aluminum housing, hardened drive shaft, pressure loaded mechanical shaft seal.

    b. Provide check valve on return pump outlet.

    c. Provide overflow-return pump controller.
        1) Arm pump at 70% day tank level.
        2) Activate pump at 95% day tank level and pump down to 70% level.
        3) Lock-out fill system when overflow-return pump is activated.
        4) Provide alarm when overflow-return pump is activated.
        5) Provide test push-button, running and armed indicators.

25. The jockey pump shall be a Grundfos mfg. or equivalent.

26. The jockey pump controller shall not to be equipped with a minimum run timer. ?

27. The fire pump controller to be provided with a minimum run timer. Not there

28. The batteries shall be dual acid starting type.

29. All control valves shall be tamper equipped, except ball valves on the heat exchanger lines, fuel tank, jockey pump isolating valves, controller test/drain valve, and other miscellaneous drain valves installed for service use.

30. Controller sensing lines shall be equipped with brass check valves, with 2.4 mm (3/32")orifices or 2.4 mm (3/32") restricting unions, installed per NFPA 20 guidelines for pressure switch protection against surges. All related piping for sensing lines shall be brass piping and no smaller than DN12 (1/2") in size.

31. The jockey pump shall be equipped with a brass suction strainer, with a clean-out. The suction side of the jockey pump shall be tied-in before the OS&Y valve on the suction side of the main fire pump. The jockey pump discharge shall be piped to the system side of the OS&Y valve.

32. Red factory finish for (virtually) entire assembly. The fire pump suction and discharge piping, flow meter return piping, heat exchanger discharge piping, the combination drain header (at contractor's connection point), and pressure relief piping (for diesels), shall be provided with flanged, braided, stainless steel type vibration isolation devices. Diesel exhaust piping shall be connected to the engine with a flanged strain relief, rated for diesel exhaust use. All of the above equipment shall be mounted on a prefabricated, structural steel base. All piping, pressure sensing lines, by-pass with check valves (when applicable), shut-off valve drains, meters, controllers, backflow preventer, and pumps shall be firmly anchored to the steel skid by means of structural steel supports. All electrical wiring between controllers, motors, and engine shall be completed and tested at the factory. The entire package will require one power connection by the electrical contractor.

B. Component Description: The packaged fire pump system shall be designed in accordance with the requirements of NFPA 20. The fire pump shall be listed by Underwriters Laboratories and/or approved by Factory Mutual for fire pump services. The pump manufacturer will assume unit responsibility for the proper operation of the entire system as specified herein.

1. The fire pump shall be of the double suction, horizontal, split case design, and shall be U.L. listed and/or F.M. approved. It shall develop at least 65% of its rated head, and shall not exceed 149% of the rated head at zero capacity. The pump shall be manufactured by ITT-AC Pumps or approved equal.

2. The pump will provide a rated capacity of 750 GPM and a differential pressure of 140 psi. At 150 percent of rated capacity, the pump shall develop at least 65 percent of its rated head and shall not exceed 140 percent of the rated head at zero capacity. The pump shall be tested at the factory and a test curve shall be submitted showing the performance and horsepower requirements based on this test before final acceptance.

3. The fire pump will be driven by a diesel engine that is specifically listed by Underwriters Laboratories, and approved by Factory Mutual for fire pump service. Engine horsepower

shall be derated for elevation and temperature as required by NFPA 20. The engine shall have sufficient horsepower to operate the fire pump under any condition of pump load. The Design Build Team shall identify the require voltage and phase for the battery charger and hot-start. The engine will be tested prior to shipment from the manufacturer's factory. Omit testheaders and related components when a flow meter is utilized.

4. A UL and FM approved automatic diesel engine controller by Metron mfg. or approved equal shall be provided. The Design Build Teams shall identify the required voltage. The controller shall provide automatic starting, and be provided with a minimum run timer, having a minimum run time of ten (10) minutes. The controller shall sense pressure on the system by way of a solid state pressure switch. The controller shall also be equipped with surge protection, and a digital, programmable time clock. Omit devices designed to stop the pump in the event of low suction pressure. A UL and FM approved automatic electric engine controller by Metron mfg. or equal. The Design Build Team shall identify required voltage. The controller shall provide automatic starting, and be provided with a minimum run timer, having a minimum run time of ten (10) minutes. The controller shall sense pressure on the system by way of a solid state pressure switch.

5. The jockey pump shall be of the centrifugal, or multistage, stacked turbine design, Grundfos mfg. or equal, close coupled to a, ODP motor. The installation shall be furnished with a fusible disconnect. Pre-piped sensing lines equipped with brass check valves with 2.4 mm (3/32") orifices. Restricted unions are not acceptable. The jockey pump controller shall be mounted in a NEMA type 4 enclosure, with a front mounted HAND-OFF-AUTO selector switch and overload relays. The jockey pump shall be provided with an emergency AC power circuit.

6. For the jockey pump, the Design Build Team shall identify 1) the delivered GPM, 2) the total dynamic head in psi, and 3) the operating HP, RPM, voltage, phase, and hertz.

7. The enclosures for the controllers shall be NEMA type 4. Tropicalization is required via a humidistat and a thermostat, wired in parallel to a heater. The tropicalization devices shall be adjustable to protect the controls from the effects of humidity. The equipment shall be installed at the factory by the controller manufacturer.

8. Provide 3 phase power distribution system to accept incoming feeder, and distribute power to: (a) Engine controller, (b) Engine jacket water heater. (c) Jockey pump. The distribution shall have a disconnect from the main power supply. Each item referenced shall have an independent breaker or approved disconnect, properly labeled with permanent signage.

9. The fire pump package shall be hydrostatically tested at the factory at 13.8 bar for two (2) hours. The system shall be tested as a unit, at the manufacturer's facility prior to shipment. The system shall be energized through the power distribution system panel, and all system failures shall be demonstrated. The test shall be witnessed, and approved by OBO/PE/DE/ADB/FPE. A copy of the pump manufacturer's test procedure shall be submitted for approval prior to testing.

2.2 INSTALLATION MATERIALS

A. General: Except as otherwise indicated, provide materials for completing connections for

mechanical and electrical service lines to installed fire pump assemblies so as to match materials of those service lines, either as specified in other Sections hereof, or as existing on previously installed lines; applicable to piping, conduit, wiring and other lines for materials, finishes, operational equipment and devices, including valves and switches.

1. Skid Anchor Bolts: Provide steel-pipe sleeved anchor bolts of the size/shape and quantity indicated for casting poured-in-place concrete foundations as work in this Section. Fabricate and deliver anchor bolts in coordination with time scheduled for construction of foundations, so as to avoid construction delays.

2. Pump Foundation Materials: Comply with applicable provisions of this Section 03300, "Cast-in-Place Concrete", hereof for concrete and reinforcing materials as required to form/pour/reinforce, pump foundations as indicated; using 27,580 kPa (4000 psi), Portland cement mix. Comply with fire pump manufacturers' printed directions/recommendations for selection of materials.

3. Skid Grout: Non-shrinking and non-metallic grout mix, complying with ASTM 1107, Grade B; with a design-mix strength of 34,470 kPa (5000 psi), for 28 day compression. Assembly shall be filled level to top of skid and not cover any type drain, power, control, or sensing line of any type.

4. Engine Exhaust Piping: ASTM A 53 Type E/S, schedule 80 galvanized pipe; ANSI B16.9, weld type pipe fittings, ANSI B16.21, non-metallic gaskets 1.6 mm (0.0625"), thick, and ASTM A 193/194 steel bolts/nuts of grade B8/8. Exhaust gasses shall not be discharged where they will affect persons, disrupt occupants, or endanger buildings.

5. Exhaust Piping Insulation: Provide inorganic, high temperature, fabric jacketed type pipe insulation, rated by the manufacturer for pipe temperature up to 538 C (1000 degrees F.); with a thermal conductivity (K-value) of 0.72 w/m-k (.5 Btu/inch/hr-sq ft F), except as otherwise shown.

6. Exhaust Sound Suppression: Engine exhaust shall be provided with Residential mufflers.

7. Engine Exhaust Installation: The exhaust piping shall be connected to the engine with a flanged, strain relief, rated for diesel exhaust use. All exhaust piping must be suspended by approved devices that allow limited movement of the pipe, to prevent stress cracks from developing. Piping that must pass through walls shall utilize steel sleeves, with a minimum of 25 mm (1-inch) clearance. The exhaust piping-to-sleeve clearance shall be filled with a non-hardening, fire proofing.

8. Heat Exchanger Discharge: The manufacturer of the fire pump assembly shall provide a stainless steel, flexible hose connection at the discharge of the heat exchanger for the installing contractor to begin piping to the tank overflow drain. A sight glass for the heat exchanger discharge line must have a spring loaded "ball" to indicate water flow. The heat exchanger discharge gauge must be liquid filled, isolated from destructive engine vibration, and be equipped with a brass ballcock to facilitate maintenance.

9. Suction Piping: Shall be a minimum diameter of DN200 (8"). Larger pipe sizes may be required for hydraulic losses, or pumps greater than 31.5 l/s (500 GPM). The fire pump must be capable of flowing 150% of rating, never delivering a suction pressure less than

zero. A negative suction pressure at 150% will constitute a failed test.

PART 3 - EXECUTION

3.1 ASSEMBLY INSTALLATION

A. General: Comply with manufacturers' and OBO/PE/DE/ADB/FPE instructions/recommendations for installation, alignment of equipment, and connected piping. Comply with industry standards, see Part 1 hereof. Support connected pipelines independently from support of the fire pump components. Include flowmeter and heat exchanger discharge return lines to water source, unless otherwise approved by OBO/PE/DE/ADB/FPE. Locate lines so as not to interfere with access to components for service and maintenance, including removal of driver units, couplings, pump impellers, seals, and accessories. Proceed as follows:

1. Disconnect driver-to-pump couplings during the setting, leveling, anchoring, and grouting of structural skid on foundation. It shall be the contractor's responsibility to assure qualified personnel perform this function correctly.

2. Support structural skid at required elevation on steel plate wedge shims at each anchor bolt location, nominally at one inch (1"/ 25.4 mm) above concrete foundation. Adjust level of skid so that pump shaft and driver are level. Check to insure coupling face and suction/discharge flanges are plumb when anchor bolts are nominally tightened.

3. Install forms at edges of foundation to retain grout, and to form edges of grout into a one inch (1", 25.4 mm), chamfer.

4. Pour skid grout to a depth of approximately 38.1 mm (1.5 inches), inside skid and strike to level of skid bottom for exposure outside skid. Ensure grout is substantially under skid frame members so as not to have any voids under the skid. Allow initial pour to harden and cure.

5. Nominally retighten anchor bolt nuts, and recheck level/plumb of main components.

6. Align pump and driver shafts and reconnect driver to pump couplings. Ensure with dial indicator, precision straight edge and taper gauge (if applicable), alignment is correct.

7. Fill skid frame to top flange with skid grout, allow to harden and cure. Tighten the anchor bolts and nuts. Recheck pump/driver alignment, and correct as necessary, complying with the manufacturer's recommendations. Repeat coupling alignment checks after making pipe connections.

B. Connections, General: Reinstall any components, connections, or accessories that might have been temporarily removed, or disassembled for the fire pump assembly installation. Exercise care to remove temporary fluids, coating and closures. Replace with operational fluids, coatings, and lubricants as specified by the manufacturer. Proceed with final pipe sizes and connections as shown, with suction piping elevations and configurations fully complying with standards, manufacturers' recommendations, and OBO/PE/DE/ADB/FPE. Keep pipe and equipment clean internally by the use of plugs and temporary closure plates. Comply with applicable Division 15

Sections hereof for the extension of pipelines to fire pump assemblies, and for the connections thereto, including the installation of flanges, unions, valves, and other pipe line devices indicated. Refer to Division 16 Sections hereof for the extension of electrical/electronic services to fire pump assemblies and for connections thereto; for supplying power, controlling equipment, operating connecting alarms, devices, and other systems; not work of this Section, except as otherwise indicated.

1. Exhaust System: Fabricate engine exhaust piping as required to remove exhaust gas from the pump room, and/or building. Connect flexible piping units to engine, and mount muffler units as indicated near shield/cage units to protect personnel from accidental contact and resulting burns. Install exhaust piping system with vibration dampeners, and supported independently from the fire pump assembly. Insulate extended piping system, except where shown to be non-insulated; apply indicated thickness of exhaust piping insulation in compliance with insulation manufacturer's instructions and recommendations.

2. Welding: Comply with ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications" for qualification of welding processes and operators used in the fabrication of exhaust piping systems.

3. Reservoir:

   a. Where indicated, provide a vortex plate at the reservoir end of the suction piping; comply with NFPA 20. Provide 12.7 mm (0.5-inch) thick steel plate, 1.2 m (4 feet) square with orifice, and pipe flange welded/bolted at center of plate. Locate plate as shown, 152 mm (6 inches), above and parallel with bottom of tank/reservoir. Fabricate vortex plate orifice based on the suction requirement DN200 (8" minimum pipe), and hydraulically calculated pipe to reservoir distance of the specified fire pump.
   b. The reservoir or tank shall be constructed and located as specified elsewhere in the contract. It shall be constructed of concrete or steel, unless otherwise specified. Under no circumstances will it be lined with a water proof membrane, or other materials, not integral to the structure.
   c. All above ground tanks, or tanks located in the building shall have an OS&Y valve provision at the bottom, for draining the reservoir, and shall have the OS&Y valve chained and locked. The water shall be plumbed to a location no water damage will occur, specifically outside or to a water drainage system.
   d. Below ground, or sub-foundation reservoirs shall have a 610 mm x 610 mm x 610 mm (2' x 2' x 2') sump positioned directly below the access door to facilitate draining the tank with an auxiliary sump pump (pump not required).

   e. Provisions for a stainless, or equal rust inhibitive material, ladder to the bottom of the reservoir shall be installed from the access door. The ladder shall continue to the bottom of the sump.
   f. The reservoir shall be graded to provide complete drainage to the sump and the required auxiliary drain.
   g. The reservoir shall be provided with an automatic refill capability.
   h. The reservoir shall have high water/low water supervision to the building fire alarm control panel (FACP), or if the building is not equipped with a fire alarm system, to a place of constant attendance, and shall be provided with an audible alarm.
   i. The reservoir shall have an over flow drain, 305 mm (1'-0") from the bottom of the

access door, capable of discharging water equal to the automatic fill, piped via a dedicated drain line, to an area no flooding will occur.

j. The reservoir shall be provided with a flood light, installed in a liquid tight fixture, with liquid tight fittings and conduits. The light must be accessible from the access door for maintenance, and have a switch located the same area.

k. In all instances the reservoir, and all reservoir related components will be accessible for service, inspection, and maintenance.

l. The reservoir shall have a ladder and/or platform to the access door.

m. The access door shall be a minimum of 915 mm x 915 mm (3'-0" x 3'-0").

n. The reservoir shall be sized to flow 94,000 liters.

o. All underground piping shall be as follows: Either all lined ferrous metal pipe; black steel and galvanized pipe shall be wrapped and coated after hydraulic testing before back filling; designed/installed per NFPA #24

p. All piping, fittings and equipment upstream of the backflow preventer shall be cleaned and sterilized per the requirements of the domestic piping system. This includes jockey pump piping and equipment.

C. System Finishes, General: Refer to specification section on "Painting" hereof for cleaning/priming/painting exposed surfaces of any work of this section; to include touch-up of abraded factory finishes on fire pump assemblies, and extensions of red enamel finishes, and other finishes as indicated on connected service piping, conduits, and similar work not in this Section. The Project Director will determine extent of specific paint color applications.

3.2 FIELD QUALITY CONTROL

A. General: Perform each fire pump assembly installation and field testing procedure under direct supervision, at the project site, by the manufacturer's authorized, technical representative; who is acceptable to, and provides supervision, acceptable to the Project Director, and OBO/PE/DE/ADB/FPE. Record in writing, and deliver copy promptly to the Project Director, a running record on each installation activity, with observed/measured/tested results of such activities. Begin and maintain a fire pump log book, starting with the first operational test/date, including any faults, or corrections made. The log book, or a similar hard back log book, with identical information is to be left in the controller for maintenance personnel to track weekly tests, problems, and maintenance performed. The log book will assist OBO/PE/DE/ADB/FPE Technicians, and Fire Marshal inspections and tests. Advise the Project Director in advance of scheduled test times, and provide OBO/PE/DE/ADB/FPE a minimum of 45 days advance notice.

1. Piping Tests: Prior to proceeding with fire pump operating tests, complete hydrostatic tests to confirm water tight installation of pressurized piping systems at 1380 kPa (200 psi), for two hours. Test suction piping at minus one-half atmosphere, to confirm absence of negative pressure (air), leakage into the system during operation. A two hour, 1380 kPa, (200 psi) , hydrostatic test is also acceptable. The test shall be witnessed by the Project Director, or representative appointed by the Project Director, before any suction piping is covered in any manner. Failure to comply may result in excavation of the piping. Comply with applicable standards for hydrostatic testing.

2. Preparations for Equipment Start-up: Prior to field start-up of installed fire pump assemblies, check installations and make the following preparations comply with manufacturer's instructions and recommendations:

a. Test and adjust controls and safeties. Pressure switches MUST be set with certified, liquid filled gauges. Pressure differentials shall be recorded in the fire pump log book.
b. Check motor/engine for proper direction of rotation, and check pump impeller for unimpeded rotation.
c. Check engine coolant fluid level, and adjust to manufacturer's recommended anti-freeze mixture percentages, a minimum of 50% anti-freeze/water.
d. Insure engine oil level is correct.
e. Verify all valves are in their normal position for testing the fire pump.
f. Check to insure pump casing is primed.
g. Adjust stuffing boxes/mechanical seals, and open supply lines.
h. Verify hot-start operation.

3. Assembly Field Tests: Promptly, upon nominal completion of installation work, proceed with operating tests on the fire pump assembly(s); comply with NFPA 20. Perform direct on-site, operation and testing in coordination with the manufacturer's representative. Comply with manufacturer's operating instruction, and demonstrate to the Project Director, OBO/PE/DE/ADB/FPE, and the government's operating personnel, every operational feature and capability of the installed equipment, including accessory elements which make up the systems. All testing, final acceptance, and commissioning of the water reservoir, suction piping, and fire pump assembly are to be performed by the installing contractor, and the pump manufacturer's representative in the presence of OBO/PE/DE/ADB/FPE personnel.

END OF SECTION 15323