

DUPLEX FACTORY-BUILT ABOVE GROUND SELF-PRIMING PUMP STATION

DESCRIPTION

A. Scope:

1. The contractor shall furnish and install one factory built above ground fiberglass reinforced automatic pump station. The station shall be complete with all equipment specified herein, factory installed in a fiberglass reinforced polyester resin enclosure. The principle items of equipment shall include two self priming, horizontal, centrifugal, V-belt motor driven sewage pumps, valves, internal piping, motor control center with heavy duty thermal magnetic circuit breakers, magnetic motor starters, automatic liquid level control system, internal wiring, ventilator and station light.

OPERATING CONDITIONS

A. Pumps:

1. Each self priming pump shall have the necessary characteristics and be selected to perform in accordance with, and subject to the provisions of the paragraph hereafter titled PUMPS.

SYSTEM POWER CHARACTERISTICS

A. Power:

1. Electrical power to be furnished to the pump station shall be 3 phase, 60 hertz, wire, 480 volts, maintained within plus or minus 10 percent. Control voltage shall not exceed 132 volts.

STATION ENCLOSURE

A. Description:

1. The station enclosure shall provide sufficient inside area for maintenance personnel to perform normal operation and maintenance inside, sheltered, and free from foul weather. The enclosure shall consist of a base to support the pumps and a cover that can be moved with lifting. Minimum dimensions of the enclosure shall be seven by ten feet and six feet in height.

B. Materials

1. The station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.
2. Glass fibers shall have a minimum average length of 1 ¼ inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to microorganisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well.
3. The enclosure shall have a K factor of approximately 1.5 Btu/hr/°F/sq. ft./inch. The design of the enclosure shall be such that an electric heater of not more than 3000 watts shall be sufficient to maintain a 90°F differential between station interior temperature and outside air temperature.
4. All interior surfaces of the housing shall be gel coated with a polyester resin. It shall be of suitable thickness and formulated to provide:
 - a. Maintenance-free service
 - b. Abrasion resistance
 - c. Color fastness
 - d. Gloss retention
 - e. Protection from sewage, greases, oils, gasoline, and other common chemicals
5. The outside of the enclosure shall be coated with a suitable pigmented resin, compounded to insure long maintenance-free life.

C. Enclosure Base:

1. Station base shall be constructed with a completely encapsulated structural steel frame for corrosion protection. Frame shall provide adequate structural support for pumps, motors, and piping. The encapsulated frame shall extend to lift points provided and assure adequate strength to resist deformation of structure during shipping, lifting, or handling. The structural steel base shall be completely encapsulated within a molded fiberglass reinforced polyester base shell. Wall thickness shall be a minimum of 3/16 inch and base height a minimum of 5 inches to provide natural drainage of pump station floor to concrete pad. Interior of base shall be filled with a foamed in place rigid polyurethane structural foam. Foam shall be of closed cell type with a minimum density of 2.5 pounds/ft

to give adequate floor support for maintenance personnel and for handling of equipment.

2. Holes through the base shall be provided for air release lines, air bubble lines, suction lines, and discharge lines. Holes for suction and discharge lines shall be provided with grout dams incorporated in a grout retention cavity which the contractor shall fill at installation with suitable grout to seal each pipe-to-base joint against the entrance of hazardous gases from the wet well.
3. Station base shall incorporate a suitable flange designed for securing the pump station to the concrete pad supplied by the contractor in accordance with the station plans.

D. Enclosure Cover:

1. The enclosure cover shall be movable without lifting to permit overhead access to either half of the station interior and shall be completely removable. A hasp and staple locking device shall be provided to secure the enclosure over the station base. Suitable gasketing shall be provided between the enclosure cover, end panels and base for protection from the elements.
2. The enclosure cover shall be provided with hinged fiberglass reinforced access door. Minimum dimensions of the door shall be 27 inches wide by 56 inches high for access by maintenance personnel to station interior. Door shall be minimum $\frac{3}{4}$ inch thickness and hinged with a full-length stainless steel piano hinge to a full perimeter aluminum door casing secured to the enclosure cover. Such door casing shall be furnished with a locking handle connected to a three-point latching mechanism. Latch shall engage door casing at top, side, and bottom for maximum security against vandalism.
3. All mounting hardware for door casing and door must be concealed or of such type as to prevent vandalism with ordinary tools.

E. Ventilation Fan:

1. A shuttered exhaust fan with a minimum capacity of 550 cfm to change the air in the enclosure once every minute, shall be mounted in one end wall. In the wall approximately opposite to this shall be mounted an air intake. Both intake and exhaust openings shall be equipped with a screen and cowl suitable designed to prevent the entrance of rain, snow, rocks, and foreign material. Fan circuit shall be fused, and shall be provided with a disconnect switch.

F. Station Light:

1. An enclosed and gasketed 200-watt light fixture shall be provided. The fixture shall be vapor-tight, universal type. The fixture shall be centrally located to provide adequate light to all parts of the station and shall not constitute a physical hazard to inspection or service personnel. Light circuit shall be fused, and shall be provided with a disconnect switch.

G. Station Heater:

1. Pump station shall be provided with a 1300/1500 watt, 115 volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable.

PUMPS

A. Description:

1. Pumps shall be horizontal, self-priming sewage pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

B. Size: Note: Maximum pump size is 4 inch.

1. Pumps shall have 4" suction connection, and 4" discharge connection.

C. Material:

1. All areas of the pump casing and volute which are exposed to sewage shall be constructed of cast iron of no lesser grade than Class 30.

D. Internal Passages:

1. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of a sphere 3" in diameter, and any trash or stringy material which can pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted. Certified dimensional drawings indicating size and locations of the priming recirculation port or ports shall be submitted to the engineer prior to shipment.

E. Pump Performance:

1. Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

Capacity, in GPM 250

Total Dynamic Head, in feet 65”

Total Dynamic Suction Lift, in feet _____

Maximum Repriming Lift, in feet 25”

Minimum TDH, in feet _____

Maximum TDH, in feet _____

Maximum Static Suction Lift _____

Total Discharge Static Head _____

2. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line free to atmosphere.
3. In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operation at its rated speed in a completely open system without suction valve and with a dray suction leg.

F. Reprime Performance:

1. Pump must be capable of a reprime lift of 25 feet at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above the liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Additional standards under which reprime tests shall be run are:
 - a. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.
 - b. A ten foot length of one inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump station fitted with an air release valve.
 - c. No restrictions shall be present in pump or suction piping which could serve to restrict the rate of siphon drop of the suction leg.

Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 4.5 feet and one 90 degree ell.

- d. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
 - e. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
 - f. Liquid to be used for reprime test shall be water.
2. Certified reprime performance test data, prepared by the pump manufacturer and certified by a registered professional engineer, shall be submitted to the engineer prior to shipment.

G. Serviceability:

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features.

H. Special Tools:

1. No special tools shall be required for replacement of any components within the pump.

I. Cover Plate:

1. The pump must be equipped with a removable cover plate, allowing access to pump interior to permit the clearance of stoppages and to provide simple access for service and repairs without removing suction or discharge piping.

J. Wear Plate and Rotating Assembly:

1. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate. The entire rotating assembly, which included bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.

K. Suction Check Valve:

1. Each pump shall incorporate a suction check valve that can be removed or installed through the removable cover plate opening, without disturbing the suction piping. Sole function of check valve shall be to eliminate

repriming with each cycle. Pumps requiring suction check valves to prime or reprime will not be acceptable.

L. Impeller Clearance Adjustment

1. Means shall be provided for external adjustment of the clearance between the impeller and wear plate. The entire rotating assembly shall move as one unit to enable the clearances to be adjusted. Clearance adjustment by means of moving the shaft, thereby affecting the seal, shall not be acceptable.

M. Spare Parts Kit:

1. There shall be furnished with the pump station the following spare parts:
 - a) One spare pump mechanical seal (complete)
 - b) One cover plate O-Ring.
 - c) One rotating assemble O-Ring.
 - d) One shaft sleeve.
 - e) One set of impeller clearance adjustment shims.

CONSTRUCTION

A. Impeller:

1. The impeller shall be two-vaned, semi-open, non-clog, cast in ductile iron with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew.

B. Seal:

1. The pump shaft shall be sealed against leakage by a mechanical seal. Both the stationary sealing member and mated rotating member shall be of tungsten titanium carbide alloy. Each of the mating surfaces shall be lapped to a flatness of one-half light band (5.8 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads, that will cause deflection, vibration, and axial or radial movement of the pump shaft.
2. The seal shall be lubricated with oil from a separate, oil-filled reservoir. The same oil shall not be used to lubricate both shaft seal and shaft bearings.

3. The seal shall be warranted for a minimum of four (4) years from date of shipment. Should the seal fail within the first year, the manufacturer shall be obligated, upon notification, to furnish a new seal, without charge to owner, f.o.b factory. The cost of replacement seals thereafter will be on a pro-rata basis as follows:

<u>Failure Within</u>	<u>Percentage of New Seal Price</u>
2 Years	25%
3 Years	50%
4 Years	75%

C. Shaft Bearings:

1. The pump impeller shaft bearings shall be anti-friction ball or tapered roller bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Bearings shall be lubricated from a separate reservoir. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

D. Pump Suction and Discharge Spools:

1. Pump shall be equipped with one-piece, cast iron suction and discharge spool, flanged on each end. Each spool shall have one 1 ¼” NPT and one ¼” NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

E. Drain Kit:

1. The pumps shall be provided with a drain kit which consists of a 10’ length of plastic hose with a quick connect female kamlock fitting on one end of the hose and two sets of fittings for pump drains. Each set of fittings for the pump drain shall include a pipe nipple, bushing, bronze gate valve and a quick connect male kamlock fitting.

F. Spare Parts Kit:

1. There shall be furnished with the pump station the following minimum spare parts:
 - a) One spare pump mechanical seal (complete).
 - b) One cover plate O-Ring
 - c) One rotating assembly O-Ring
 - d) One shaft sleeve

- e) One set of impeller clearance adjustment shims

VALVES AND PIPING

A. Check Valve:

1. Full flow type swing check valves shall have cast iron body with flanged ends rated at 125 lbs. Valves shall be fitted with an external lever and spring. Bronze body ring shall be threaded into the valve port. Valve clapper shall be cast iron, bronze face, and shall swing completely clear of waterway when valve is full open. Hinge pin shall be of 18-8 stainless steel construction and shall be utilized with bronze bushings and O-ring seals. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve rating shall be 175 psi water working pressure, 350 psi hydrostatic test pressure.

B. Plug Valve:

1. Each discharge line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the common discharge header. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall have ports designed to pass 3” spherical solids.

C. Air Release Valves:

1. Function:
 - a. Each pump shall be equipped with one automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. Construction:
 - a. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.

3. Serviceability:
 - a. A cleanout port, 3 inches or larger in diameter, shall be provided for ease of inspection, cleanout, and service.
 - b. Valves shall be field adjustable for varying discharge heads.

D. Gauge Kit

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauges shall be graduated -34 to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.
2. Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shutoff valve installed in each gauge line at the point of connection to suction and discharge pipes.

E. Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
4. Bolt holes shall be in angular alignment with $1/2^\circ$ between flanges. Flanges shall be faced and a gasket finish applied that shall have concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of $1/4$ inch apart.
5. Flanged-to-flexible connection devices shall be provided for each suction and discharge connection, to relieve misalignment stresses.

SUPPORT AND THRUST BLOCKS

A. Piping and Valves:

1. All pipes connected to the pump station shall be supported according to good commercial practice to prevent piping loads from being transmitted to pumps. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

DRIVE UNIT

A. Motors:

1. The pump motors shall be horizontal, open drip proof, induction type, with normal starting torque and low starting current characteristics, suitable for 3 phase, 60 hertz, 480 volt, AC electrical current. The motors shall not be overloaded at the design condition or at any head in the operation range as specified. Motors shall be 15 HP, 1750 RPM, 480 volt, open drip proof.
2. Each motor shall be in current NEMA design cast iron frame with copper windings.

B. Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of V-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.
2. Each drive assembly shall have a minimum of two V-belts. In no case will a single belt drive be acceptable. Each V-Belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump.
3. Drive systems with a safety factor of less than 1.5 to 1.0 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.
4. Upon request of the engineer or his representative, the pump manufacturer shall submit power transmission calculations which clearly express the following:
 - a. Ratio of pump speed as related to motor speed.
 - b. Pitch diameter of driver and driven sheaves.
 - c. Number of belts per drive assembly.
 - d. Theoretical horsepower transmission per V-belt, based on performance data published by the V-belt manufacturer.

- e. Center distance between driver and driven shafts.
- f. Center distance and combined arc-length correction factor applied to theoretical horsepower transmission per V-belt.
- g. Service factor applied to established design horsepower.
- h. Safety factor which shall be calculated as the ratio of power transmitted per drive assembly to brake horsepower requirements of the pump.

C. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base and rigidly braced to some fixed part.
3. All metal shall be free from burrs and sharp edges. Structural joints shall be continuous welded. Panels may be riveted to frames with not more than five inch spacing. Tack welds shall not exceed a four inch spacing.
4. The guard shall be primed with a minimum of 1.5 mils of synthetic primer. A finished acrylic enamel coating (minimum 1.5 mils) shall be applied in accordance with Section 3, Color Definitions of ANSI 253.1; 1967, Safety Color Code for Marking Physical Hazards.

D. Finish:

1. The pumps, piping, and exposed steel framework shall be cleaned with industrial grade chemical cleaner. The prime coat shall be a zinc base synthetic primer. The finish coat shall be an automotive grade white acrylic enamel.

ELECTRICAL CONTROL COMPONENTS

A. Panel Enclosure:

1. The electrical control equipment shall be mounted within NEMA 1, dead front type control enclosures fabricated of steel. The enclosure doors shall be hinged and sealed with a neoprene gasket and shall be equipped with captive closing hardware. Control compartments shall include removable

steel back panels on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs.

2. All operating controls and instruments shall be securely mounted and shall be clearly labeled to indicate function.

B. Receptacle:

1. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 Hertz, single phase current, shall be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

MOTOR BRANCH COMPONENTS

A. Mounting:

1. All motor branch components shall be of the highest industrial quality, securely fastened to a removable sub-plate with screws and lockwashers. The sub-plate shall be taped to accept all mounting screws. Self-tapping screws shall not be used to mount any components.

B. Circuit Breakers and Operating Mechanisms:

1. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of _____ amperes at _____ volts. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
2. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position.

C. Motor Starters:

1. An open frame, across-the-line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. Coils shall be epoxy molded for protection from moisture and corrosive atmosphere. The starter assembly shall be equipped with a metal mounting plate for durability. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts and coils shall be easily replaceable without removing the motor starter from its mounted position.

D. Overload Relays:

1. Overload relays shall be of block-type, utilizing melting alloy type spindles, and shall have visual trip indication with trip free operation. Pressing the overload reset lever shall not actuate the control contact until such time as the overload spindle has reset. Resetting the overload reset lever will cause a snap-action control contact to reset, thus re-establishing a control circuit. Overload relays shall be of manual reset only and not convertible to automatic reset. Trip settings shall be determined by the heater element only and not by adjustable settings. Heater elements shall provide NEMA class 20 trip times and shall be selected in accordance with the actual motor nameplate data.
2. An overload reset pushbutton shall be mounted through the door of the control panel in such a manner as to permit resetting the overload relays without opening the control panel door.

E. Phase Monitor:

1. The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by phase reversal, phase loss, voltage unbalance greater than 5% or voltage less than 83% of nominal. A time delay shall be provided to minimize nuisance trips. The motor (s) shall automatically restart when power conditions return to normal.

F. Secondary Surge Arrester:

1. The control panel shall be equipped with a surge arrester to minimize damage to the pump motors and control from transient voltage surges. The arrester shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrester shall be rated (480 volts RMS nominal with a discharge capability of 2000 amps) (650 volts RMS nominal with a discharge capability of 20,000 amps).

OTHER CONTROL COMPONENTS

A. Control Circuit:

1. The control circuit shall be protected by a normal duty thermal-magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.

B. Pump Mode Selection:

1. Pump mode selector switches shall be connected to permit manual start and manual stop for each pump individually, and to select automatic operation of each pump under control of the liquid level control system. Manual operation shall override all shutdown systems, but not the motor overload relays. Selector switches shall be toggle switches meeting Military Standards (MS) for quality. Switch contacts shall be rated 15 amperes minimum at 120 volts non-inductive.

C. Alternator Relay:

1. Pump alternator relay shall be electromechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive.

D. Pump Run Indicators:

1. Control panel shall be equipped with one pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running.

E. Elapsed Time Indicators:

1. Six digit elapsed time indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in “hours” and “tenths of hours”.

F. Sequence Selector Switch:

1. A switch shall be provided to permit the station operator to select automatic alternation of the pumps, to select pump number one to be the lead pump for each pumping cycle or to select pump number two to be the lead pump for each pumping cycle.

G. High Temperature Protection:

1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
2. A thermostat shall be mounted on each pump to detect its temperature, and a magnetic switch shall be supplied for each thermostat. If the pump temperature should rise to a level which could cause pump damage, the thermostat shall cause a magnetic switch to drop out the motor starter. An indicator, visible on the front of the control panel shall indicate that the pump motor has been stopped because of a high temperature condition. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

H. Auxiliary Power Transformer:

1. The lift station shall be equipped with a 3 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal magnetic air circuit breaker, specifically sized to meet the power requirements of the transformer. A mechanical operation mechanism shall be installed on the circuit breaker to provide a means of disconnecting power to the transformer. The operator handle for the mechanism shall be located on the exterior of the control panel, with interlocks which permit the door to be opened only when the circuit breaker is in the “OFF” position.

I. Wiring:

1. The pump station, as furnished by the manufacturer, shall be completely wired, except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
3. All user serviceable wiring shall be type MTW or THW, volts, and shall be color coded as follows:
 - a. Line and Load Circuits, AC or DC power.....Black
 - b. AC Control Circuit Less Than Line Voltage.....Red
 - c. DC Control Circuit.....Blue
 - d. Interlock Control Circuit, from External Source.....Yellow
 - e. Equipment Grounding Conductor.....Green
 - f. Current Carrying Ground.....White
 - g. Hot With Circuit Breaker Open.....Orange

J. Wire Identification and Sizing:

1. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be of 16 gauge minimum, type

MTW or THW, 600 volts. Power wiring shall be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

2. Motor branch conductors and other power conductors shall not be loaded above 60°C temperature rating, on circuits of 100 amperes or less, nor above 75°C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

K. Wire Bundles:

1. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position with undue stress or abrasion on the wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.

L. Conduit:

1. Conduit requirements are as follows:
 - a. All conduit and fittings shall be UL listed.
 - b. Liquid tight flexible metal conduit shall be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
 - c. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
 - d. Conduit shall be sized according to the National Electric Code.

M. Grounding:

1. The pump station manufacturer shall ground all electrical equipment inside the pump station to the enclosure back panel. The mounting surface of all connections shall have any paint removed before making final connections.

2. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

N. Equipment Marking:

1. A permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:
 - a. Equipment serial number
 - b. Supply voltage, phase and frequency
 - c. Current rating of the minimum main conductor
 - d. Electrical wiring diagram number
 - e. Motor horsepower and full load current
 - f. Motor overload heater element
 - g. Motor circuit breaker trip current rating
 - h. Name and location of equipment manufacturer
2. Identification shown on the electrical diagram. Identification label shall be mounted adjacent to the device.
3. Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Marking shall be mounted adjacent to and above the device.

LIQUID LEVEL CONTROL

A. Functional Description:

1. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

B. Type:

1. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

C. Sequence of Operation:

1. The electronic pressure switch shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the “lead pump start level”. When the liquid is lowered to the “lead pump stop level”, the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the “lag pump start level” so that both pumps are operating. These levels shall be adjustable as described below.

D. Automatic Pump Alternation:

1. The level control system shall utilize the alternator relay to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.

E. Electronic Pressure Switch:

1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
2. The electronic pressure switch shall be capable of operating on a supply voltage of 108 volts to 132 volts AC, 60 Hertz, in an ambient temperature range of -18°C (0°F) through +55°C (131°F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water.
3. The electronic pressure switch shall consist of the following integral components: Pressure sensor, display, electronic comparators and output relays.

F. Pressure Sensor:

1. The pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-15 PSI, temperature compensated from -40°C

(-40°F) through +85°C (+85°F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

G. Display:

1. The electronic pressure switch shall incorporate a digital panel meter which, upon operator selection, shall display liquid level in the wet well, and the preset start and stop level for both lead and lag pump. The meter shall be a 3-1/2 digit display calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet.

H. Electronic Comparators:

1. Level adjustments shall be electronic comparator setpoints to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be adjustable, and accessible to the operator without opening the electronic pressure switch or any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment artificial level simulation or introduction of pressure to the electronic pressure switch.

I. Output Relays:

1. Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The “ON” state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

J. Quality Assurance:

1. Each electronic pressure switch shall be subject to a severe environmental test to minimize field failures. The test shall include, but is not limited to a vibration test, exposure to elevate temperatures, and a burn-in under load. Further testing may be conducted at the manufacturer’s discretion.

K. Serviceability:

1. The electronic pressure switch shall be equipped with replaceable plug-in integrated circuits, output relays and fuses. The main circuit board assembly shall be provided with keyed plug-in connections to “off-board”

components permitting main board removal with de-soldering. All printed circuits shall have a conformal coating applied to both sides to protect against moisture or fungus.

L. Independent Lag Pump:

1. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

M. High Water Alarm with Alarm Silence:

1. The electronic pressure switch shall be equipped with an additional electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. In the event that the wet well liquid reaches a preset high water alarm level, the high water output relay shall energize a magnetic switch. The Magnetic switch shall complete a 115-volt AC circuit for an external alarm device. An electrical or mechanical indicator, visible on the front of the control panel, shall indicate that high wet well level exists. The magnetic switch shall maintain the alarm signal until the wet well level has been lowered and the circuit has been manually reset.
2. An alarm silence switch and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the magnetic switch shall provide automatic reset of the alarm silence relay.

ALARM LIGHT (EXTERNAL)

A. Type:

1. The pump station shall be supplied with one 115 volt AC alarm in a vapor-tight fixture with red globe, guard, conduit box, and mounting fixtures. Alarm light and mounting fixtures shall be designed to permit mounting in such a manner that rain water cannot stand or collect in the gasketed area of the fixture, between the base and globe.

B. EPS Spare Parts:

1. The manufacturer shall supply one of each type integrated circuit and one output relay as spare parts.

AIR BUBBLER SYSTEM AND PIPING

A. Air Pumps:

1. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable.
2. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.

B. Air Bell:

1. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.

C. Air Flow Indicator:

1. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

MANUFACTURER'S RESPONSIBILITIES

A. Operational Test:

1. The pumps, motors and controls will be given an operational test in accordance with the standards of the Hydraulic Institute. Recordings of the test shall constitute the correct performance of the equipment at the design head, capacity, and rated speed and horsepower as specified herein.
2. Upon request from the engineer, the engineer or his representative shall be invited to witness the operational test at the manufacturer's facility or other location designated by the manufacturer.

B. Support Literature:

1. The manufacturer of the pump station shall be required to deliver 4 copies of support literature required herein.
2. Installation Instructions:
 - a. Installation of pumping units shall be done in accordance with written instructions provided by the manufacturer.

3. Operation and Maintenance Instructions:

- a. The pump station manufacturer shall supply a complete set of comprehensive written instructions to enable an operator to properly operate and maintain the equipment supplied. Content of the instructions shall assume the operator is familiar with pumps, motors, piping and valves but that he has not previously operated and/or maintained the exact equipment supplied.
- b. The instructions shall be prepared as a system manual applicable solely to the pump station equipment and related devices supplied by the manufacturer, as specified herein. Instructions for any equipment for which the manufacturer has not supplied, but has made mounting or other provisions, shall be provided by others.

4. The instructions shall included, but not be limited to, the following:

- a. Descriptions of, and operation instructions for, each major component of the complete pump package as supplied.
- b. Instructions on operation of the pump and pump control in all intended modes of operation.
- c. Instruction for all adjustments which must be performed at initial startup of pump equipment, adjustments required after the replacement of liquid level control system components, and adjustments as required in the course of preventative maintenance as specified by the manufacturer.
- d. Service instructions for major components not manufactured by the pump station manufacturer, but supplied by him in accordance with the specifications. In such case, the literature supplied by the actual manufacturer shall be incorporated as an appendices.
- e. Electrical schematic diagram of the pump station as supplied, prepared in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits, and interconnections among these circuits. Wire numbers shall be shown on the schematic. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included and details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

- f. Layout drawing of the pump station as supplied, prepared in accordance with good commercial practice, showing the location of all pumps, motors, valves and piping.
5. Operation and maintenance instructions which are limited to a collection of component manufacturer's literature without overall pump station continuity shall not be acceptable.
6. Operation and maintenance instructions shall be specific to the equipment supplied in accordance with these specifications. Instruction manuals applicable to many different configurations of pump stations, and which require the operator to selectively read portions of the manual shall not be acceptable.

MANUFACTURER'S ABILITY TO PERFORM

A. Delivery:

1. Upon request from the engineer, the pump station manufacturer shall provide proof of financial security relative to performance and ability to meet delivery schedules.

B. Experience:

1. When requested by the engineer, the pump station manufacturer shall also provide evidence of facilities, equipment and expertise required to produce the equipment specified herein.

MANUFACTURER'S WARRANTY

A. Material and Workmanship:

1. The pump station manufacturer shall warrant it to be of quality construction, free of defects in material and workmanship. The written warranty shall include specific details described below.

ENCLOSURE

A. Enclosure Warranty:

1. The pump station enclosure shall be warranted for a period of 10 years to be completely resistant to rust, corrosion from moisture, corrosive soils, or physical failures occurring in normal service, without protective coating, when installation is made according to the manufacturer's recommendations.

OVERALL PUMP STATION

A. Equipment Warranty:

1. The equipment, apparatus, and parts furnished shall be warranted for a period of five (1) year, excepting only those items that are normally consumed in service, such as light bulbs, oils grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for the warranty of the station and all components.
2. Components failing to perform as specified by the engineers, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.
3. It is not intended that the manufacturer assume liability for consequential damages of contingent liabilities arising out of failure of any product or parts thereof to operate properly, however caused by or resulting from arising out of defects in design or manufacturer, delays in delivery, replacement, or otherwise.

EFFECTIVE DATE

A. Initial Date:

1. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

CONTRACTUAL OBLIGATIONS

A. Intent of Specifications:

1. These specifications and accompanying drawings specify and show equipment and materials as manufactured by the Gorman Rupp Company which are deemed most suitable for the service anticipated. This is not done, however, to eliminate other products equally as good and efficient. The contractor shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid. The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

B. Substitutions:

1. After execution of the contract, should the contractor desire to substitute equipment other than that specified in the contract, such substitution will be considered for one reason only. That the equipment proposed for substitution is superior in construction and efficiency to that specified in

the contract, and higher quality has been demonstrated by service in a similar installation.

2. In the event the contractor obtains engineer's approval of equipment other than that for which the station was originally laid out, the contractor shall, at his own expense, make any changes in the structures, building or piping necessary to accommodate the equipment, and shall provide as-built drawings to the engineer.
3. It will be assumed that the cost to the contractor of the equipment proposed to be substitute is less than that of the equipment specified in the contract and if substitution is approved, the contract price shall be reduced by an amount equal to the savings.