

SECTION 33 32 00

PULL-UP SUBMERSIBLE SOLIDS-HANDLING PUMP STATION

PART 1. GENERAL

1.01 The Pull-Up Submersible Solids-Handling Pump Station shall consist of: precast-concrete wet well, submersible pumps, precast-concrete dry valve vault, control panel, security fence and other related accessories. Precast-concrete and security fence are specified in separate sections of the specification. This specification includes the supply of 2 pull-up submersible solids-handling pumping unit(s), UL Listed for explosion proof Class I, Division 1, Groups C and D hazardous locations. The pumps shall be clockwise rotation and connect to the discharge piping when lowered into place and their controls.

1.02 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.
- B. Unit responsibility. Pump(s), complete with motor and all other specified accessories and appurtenances, shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components.
- C. The pull-up submersible solids-handling pump(s) and motor(s) specified in this section shall be furnished by and be the product of one manufacturer.
- D. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program.
- E. Pump(s) are to be engineered and manufactured under the certification of ISO-9001:2000.

1.03 PERFORMANCE

- A. The pump(s) shall be designed for continuous operation and will be operated continuously under normal service.
- B. OPERATION CRITERIA (Fairbanks Morse D5430MV)

	Flow (GPM)	TDH (ft.)	Max. Pump Speed (RPM)	Max. Solids Passage	Max. Shutoff Head (ft.)	NPSHR @ Rated Condition (ft.)
2-PUMPS PARALLEL	400	28	1155	2.5		5.5
1-PUMP	300	25	1155	2.5		

- C. Net positive suction head available at the centerline of the pump impeller is 4 feet at 350 GPM.
- D. Liquid pumped is STORMWATER with a maximum temperature of 75 deg. F.

PART 2, PRODUCTS

2.01 PUMPS

A. Manufacturers

- 1. Pump(s) shall be the product of Fairbanks Morse Pump, Flygt, ABS, or approved equal.
- 2. Manufacturer shall have installations of like or similar application with a minimum of 5 years service for this pump size.

B. Design

1. Rotation

- a. The pump will be clockwise rotation when viewed from the driver end looking at the pump.

2. Impeller

- a. Impeller shall be of the balanced non-clogging type matched to its constant velocity equalizing pressure volute and be made of close-grained cast iron conforming to ASTM A48 CL30. It shall be of one-piece construction, single suction, enclosed (bladeless)(two-vane), radial flow design with well-rounded leading vanes and then tapered toward the trailing edge for a circular flow pattern to prevent the accumulation of solids and stringy material.
- b. The clearance between the impeller outside diameter and cutwater shall be capable of passing a 2.5" sphere.
- c. The impeller is to be balanced and secured to the shaft by means of a bolt, washer, and key. The arrangement shall be such that the impeller cannot be loosened from torque in either forward or reverse rotation.
- d. Wiper vanes on the back impeller shroud are not allowed.
- e. Impeller shall be trimmed to specifically meet the conditions of operation.

3. Volute/Casing

- a. Volute is to be cast with extra thick walls made of close-grained cast iron conforming to ASTM A48, Class 30. It is to be one-piece, constant velocity equalizing pressure (except 4"5435MV which is specifically designed with a circular volute to minimize radial loads at low flows) with smooth fluid passages large enough to pass any size solid that can pass through the impeller.
- b. The volute shall have an integral tapered suction inlet area to direct flow to the impeller eye and have a centerline-flanged discharge. Volute discharge shall be minimum 8" diameter as measured on the inside diameter of the discharge flange opening.

- c. A sliding bracket assembly shall be a part of the pumping unit constructed so that when lowered to the discharge base/elbow, the knifing action of the vertical metal-to-metal seal provides a self-cleaning, non-clogging, non-sparking UL Listed explosion-proof assembly.
4. Wear Rings
- a. Wear rings shall be provided on both the impeller and fronthead so that clearances can be maintained throughout the life of the rings and minimize recirculation.
 - b. Impeller wear rings shall be of the axial- or face-type.
 - c. Fronthead wear rings shall be of the axial- or face-type.
 - d. Wear rings shall be attached to the impeller and fronthead using an interference fit and Loctite.
 - e. Wear rings shall be stainless steel, with the impeller wear ring approximately 50 Brinell softer than the fronthead wear ring.
 - f. Wear ring clearance adjustment shall be attained through impeller adjustment shims.
5. Guide Rail/Bracket
- a. Two rails shall be provided to guide the pump when being raised or lowered in the sump and mount on the discharge base/elbow. Single rail or cable guide systems are not acceptable.
 - b. The rails shall align the pump with the discharge elbow as it is lowered into place.
 - c. A ductile iron upper rail guide bracket shall be furnished to support and align the rails at the top of the sump. For all rail lengths greater than 20 feet, a stainless steel intermediate rail guide bracket shall be included.
6. Discharge Base
- a. The installation shall include a rigid discharge base-elbow to support the total weight of the pumping unit.
 - b. The base is to be bolted directly to the floor with the 90 degree elbow having a 125 lb. ANSI flange discharging vertically.
7. Motor
- a. Pump(s) shall be driven by completely sealed, electric submersible squirrel cage induction motors with a maximum NEMA nameplate rating of 5 HP, 1.15 service factor, 1155 RPM, 230 volts, 3 -phase, 60 Hertz. The motor nameplate horsepower rating should exceed the brake horsepower requirements of the specified head and capacity conditions and have a minimum full load efficiency of 72 %.
 - b. Submersible equipment shall be UL Listed for Class I, Division 1, Groups C and D explosion-proof hazardous locations as defined by the National Electric Code. All electrical parts shall be housed in an air-filled (or oil-filled in 210 frame construction) cast iron, watertight enclosure which is sealed by the use of O-rings and rabbeted joints with extra large overlaps.

- c. The stator winding and lead shall be insulated with moisture-resistant Class F insulation for continuous duty in 40 degree C ambient. The motor shall be designed for continuous duty capable of ten (1) starts per hour. Automatic reset, normally closed thermal overloads shall be imbedded in the motor windings to provide overheating protection. Motor winding thermostats must be connected to an electric controller per local and state codes and the National Electric Code.
 - d. Motor shaft shall be one-piece, 416 stainless steel. Carbon steel shafts or shaft sleeves are not acceptable. Rotor is to be dynamically balanced to meet NEMA vibration limits; all external hardware is to be stainless steel.
 - e. Cable leads are to enter at the top of the motor, and are to allow the cable-to-motor connection to be accomplished in the field without soldering. All power and control lead wires are to be double sealed as it enters the motor in such a manner that cable-wicking will not occur. This sealing system shall consist of a rubber grommet followed by epoxy that is high in adhesive qualities and has a low coefficient of expansion. Each cable wire is to have a small section of insulation removed to establish a window area of bare wire and each wire is to be untwisted and surrounded by epoxy potting material. A cable strain relief mechanism shall be an integral part of this sealing system. Cable sealing system shall be capable of withstanding an external pressure test of 1200 PSI as well as a cable assembly pull test as required by Underwriters Laboratories. Singular grommet or other similar sealing systems are not acceptable. Motor shall be supplied with 30 feet of multi-conductor type "SOW-A" or "W" power cable and control cable. Cable sizing shall conform to NEC specifications and be UL Listed.
 - f. Power and control leads shall be terminated on a sealed terminal board. The terminal board and its bronze lugs shall be O-ring sealed.
8. Shaft Seal Arrangement
- a. Pump(s) shall be provided with two separate tandem-mounted mechanical seals to prevent the pumped liquid from entering the rotor/stator cavity area to ensure reliability of operation. The upper and lower seals are mounted to rotate in the same direction.
 - b. The lower mechanical seal mating surfaces are to be immersed in an oil bath, sealing the pump volute chamber from the oil cavity. Oil in this cavity shall also lubricate the upper mechanical seal faces. Seal faces of both the upper and lower mechanical seals shall be held in contact by independent polymeric elastomer bellows, which act as a spring mechanism. Seals require neither maintenance nor adjustment, but shall be easily inspected and replaced. Pressure generated by the pump assists in sealing the mating surfaces of the lower seal.
 - c. Component material for the upper seal shall consist of a composite elastomer body, carbon steel snap ring, Buna-N O-ring, carbon rotating face and ceramic stationary face. Lower seal component construction shall include a composite elastomer body, stainless steel clamp and set

- screws, Buna-N O-ring, silicon carbide rotating face and tungsten carbide stationary face.
- d. Two moisture detection probes shall be installed so that they will detect moisture in either the seal or stator cavity measuring resistivity between the probes. They shall be wired internally to the control cable connection at the top of the motor. Float type devices located in the rotor/stator area or single probe-to-ground moisture detectors measuring continuity are not acceptable. O-ring sealed inspection plugs shall be provided in the mechanical seal oil chamber for ease of inspection, draining and filling of oil.
9. The pump shall rotate on a grease lubricated-for-life thrust bearing (oil lubricated in 210 frame) and grease lubricated radial bearing (oil lubricated in 210 frame) with a minimum L10 life of 50,000 hours. Lower shaft bearings shall be locked in place to prevent shaft movement and to take thrust loads.
 10. Fits and Hardware
 - a. All machined bolts, nuts, and capscrews shall be stainless steel and be of the hex-head type and will not require the use of any special tools.
 - b. A heavy-duty stainless steel lifting bail shall be included and be of adequate strength to lift the entire pump and motor assembly.
 11. Testing
 - a. A certified factory performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition.
 - b. Results of the performance tests shall be certified by a Registered Professional Engineer and submitted for approval before final shipment.
 12. Pumps shall be manufactured by companies whose management system is registered to ISO-9001:2000.

2.02 CONTROL PANELS AND ELECTRICAL

A. General – Description of Work

1. The Contractor shall provide and install all hardware, software, labor, materials and equipment required to provide a complete control panel. The control panel shall be located 4 feet from the wet well.
2. A single Manufacturer shall have provide all motor control, alarm and control components, the controls shall not be assembled on site. The system supplier shall be a UL 508 certified facility and shall be regularly engaged in the manufacture of controls for the municipal water and wastewater industry with a minimum of ten years of experience.

B. Design and Operation

1. The basic operation of the pumps shall be as a pump-down, lead/lag, common off system with alternator and alarms as required by the pump manufacture for warranty. The panel shall accommodate connection of floats with the following functions: High Level, Lead Start, Lag Start, Stop.
2. Each pump shall be controlled through a "Hand-Off-Auto" selector switch.
 - Hand: Pump shall be demanded and shall run continuously until the selector switch is turned to Off or Auto.
 - Off: Pump shall not be demanded.
 - Auto: Pump shall be controlled by the floats in the wetwell. A demand for each pump shall be delayed through adjustable time delay relays with a range of 0.1 to 10 seconds. Initially, the time delay for the first pump demand shall be set at 8 seconds, with required additional pump demand time delays being staggered 8 seconds apart. Operation of the lag pump(s) shall not be demanded on the lead demand float.

C. Alarms

1. The alarm system shall operate individual pilot lights as described under General Control Panel Equipment, and a common general alarm for the external horn/light (as indicated by asterisk *) upon the following faults:
 - High Wetwell Level *: A contact from the high level float shall indicate a high level alarm condition. This alarm shall automatically reset.
 - Pump Fail (No Pressure)*: A time delay shall begin when the pump is demanded. If the pump pressure switch does not indicate pressure prior to the time expiring, a "NO FLOW" alarm shall exist. This alarm shall latch and prevent the pump from running. Alarm annunciation shall remain on until manually reset.
 - Pump Seal Fail: A pump seal failure shall be annunciated by the individual pilot light. This all shall not stop the pump from running.

D. Equipment

1. The enclosure shall be NEMA 12 basic construction modified with a dripshield to have a NEMA 3R rating, and shall have a swing-out inner door and separate subpanel. A standard NEMA 3R enclosure shall not be acceptable. Enclosure shall be constructed from 12 gauge 304 stainless steel with a #4 finish. All hardware on the exterior of panel shall be stainless steel. Exterior door shall be held shut with padlockable, 3-point door latch shall be Austin #48-5655ssx, or equal. Inner door shall be held shut with latch, Emka wingknob #1000-u78 and cam #1000-50, or equal. All doors shall be mounted to the enclosure with continuous hinges. Exterior door shall be gasketed to provide a watertight seal to the enclosure. Subpanel and inner door shall be 12 gauge mild steel primed and painted white. All control switches, pushbuttons, elapsed time meters, and indicator lights shall be mounted on or through the inner door. All panel wiring and

equipment layout shall be performed per NEMA and JIC specifications. NEC gutter spacing shall be observed. A minimum of 6" additional DIN rail shall be provided for future expansion.

2. The main power distribution block shall be sized for incoming power to the panel, Each pole of the block shall be supplied with a clear cover for operating for operator protection. Power distribution block shall be Gould 63000, 67000, or 69,000 series or approved equal, as required.
3. Provide a silicon oxide varistor surge/lightning suppressor connected to the power distribution block and sized for incoming power. Minimum rating shall be 60,000 amps, 1500 Joules, Suppressor shall be Delta LA series, or approved equal.
4. Phase monitor, where three-phase motors are controlled, provide a plug-in style phase monitor designed to monitor phase loss, under voltage, and phase sequence with a SPDT contact to interrupt all control power in the event of phase loss. Phase monitor shall be supplied with fused protection of the three phase sensing circuit. Phase monitor shall be Diversified Electronics SLA series, Symcom model #250A, or approved equal. Fuseholder shall be three-pole Gould USM-1 series, or approved equal. Fuses shall be fast-acting Gould ATM series, or approved equal.
5. Circuit Breakers – Provide individual, properly sized, thermal-magnetic circuit breaker for each load served. Combination circuit breaker and overload mechanism shall not be allowed. Circuit breakers for motors and other loads shall have a minimum rating of 10,000 AIC (230 vac breakers) or 14,000 AIC (480 vac breakers).

Provide individual, properly sized, thermal-magnetic circuit breaker for each of the following:

- A. Transformer
- B. Each motor load

Provide 1-pole, 15-amp circuit breaker for the following loads:

- A. Control circuit
- B. Panel receptacle/condensation heater/service light.

6. Contactors/Overload Relay – A magnetic across the line horsepower/current rated motor contactor with ambient temperature compensated overload relay shall be provided for each motor load served. Contactor shall be Cutler Hammer CE 15 Series, ABB Series A, or approved equal. Overload relay shall be Cutler Hammer # C316, ABB Series TA, or approved equal.

Pumps 20 HP and larger shall be provided with a reduced voltage solid state starter with overload protection and across-the-line bypass contactor for each motor load served. Solid state starter shall be Cutler Hammer IT series with line side surge protector, ABB PSS series, or approved equal.

7. Transformer – If 120 volt, single phase is not available, a minimum 2KVA dry-type transformer shall be supplied with primary and secondary short circuit protection. Control power shall be 120 volt. Control circuit shall be connected so that a power outage of any duration does not require manual re-start of system.
8. Fuseholder and Fuses – Provide a Fuseholder and fuse for the control circuit, minimum rating 5 amps (ampacity not to exceed relay contact rating). Fuseholder for control fuses shall be fingersafe with neon light indication for a blown fuse. Control fuse Fuseholder shall be Gould USM-1 series, Entrelec, or approved equal.
9. Terminal Blocks – Numbered terminal blocks shall be supplied for all field terminations. Current capacity of terminal strips shall be equal to the load served. Terminal blocks shall be suitable for minimum 12 AWG wire at not less than 300 volts. Terminal Blocks for control interface shall be Entrelec model 115116.07, or approved equal.
10. Interior Service Light – Provide an interior florescent service light w/ safety lens fastened to the top of the enclosure with two position “Off/On” selector knob to control. Incandescent light fixtures shall not be acceptable. Light shall be mounted without penetrating the panel outer skin with screws or fasteners.
11. Entry Switch – An entry switch shall be mounted in the panel, which shall close a contact wired to the telemetry unit when the exterior door of the enclosure is not closed. Switch shall be Microswitch #1AC2, or equal.
12. Receptacle – Provide a 15-amp GFI duplex receptacle connected to a separate circuit breaker, as described elsewhere, and mounted on the control panel inner door.
13. Condensation Heater – Provide a 100 watt, 120 vac silicone rubber self adhesive condensation heater mounted on a flange with integral 40 degree thermostat. Heater shall be Watlow #020100C1-EV11B, or approved equal.
14. Alternator – Provide an automatic alternator for alternating pump operation on successive automatic cycles. Relay shall incorporate LED position indicators and a toggle switch to select pump @1 or pump #2 as the lead pump, or to allow automatic alternation. Alternator shall be Diversified Electronics ARB series, or approved equal.
15. Relays – Relays shall be general purpose plug-in relays with standard mounting configurations. The relay shall have the number of poles as shown on the drawings with neon indicating lamp and test button integral to each relay, Relay contact rating shall be minimum 5 amps.
16. Time Delay Relays – Time delay relays shall be dial or DIP switch selectable, and shall have a contact rating of not less than 10 amps. Switch settings shall be labeled on the relay. Time delay relays shall be Diversified Electronics TB series, or approved equal.
17. Selector Switches – Selector switches shall be 30 mm oil tight type with lever operators and 10 amp contacts. Knob operators shall not be acceptable. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 vac and 10 amps. Control switches shall be

Cutler Hammer Series E34, or approved equal. Contact blocks shall be Cutler Hammer type 10250T. Provide selector switches for the following locations (per pump where applicable).

Pump "Hand-Off-Auto" Three-position

18. Pilot Lights – Pilot lights shall be push-to-test, oil-tight industrial units utilizing 120 volt bulbs (unless otherwise specified). Lenses shall be colored as shown on the drawings. Control panel lights shall be modular construction as manufactured by Cutler Hammer E34RPB, or approved equal. Contact blocks shall be Cutler Hammer type 10250T, or approved equal. LED type lights shall not be acceptable. Provide pilot lights for the following functions (per pump where applicable).

High Level	Red
Pump Run	Green
Pump Fail	Red
Pump Seal Fail	Amber

19. Pushbuttons – Pushbuttons shall be oil-tight industrial units. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 vac and 10 amps. Control panel pushbuttons shall be modular construction Cutler Hammer Series E34, or approved equal. Provide pushbuttons for the following locations

Alarm Horn Silence
Pump Fail Reset

20. Elapsed Time Meter – Provide an elapsed time meter for each pump controlled. Meter shall be 6-digit, non-resettable, reading in hours and tenths of hours. Elapsed time meter shall be Fourth Dimension, or approved equal.
21. Seal Fail Relay – Provide a conductance actuated moisture sensing relay for each submersible pump controlled with field adjustable sensitivity. Specialized relay/sensors, if required by the pump manufacture, shall be supplied to the panel manufacture by the pump manufacture prior to panel construction. Seal Fail Relay shall be Diversified Electronics, Syrelec, or approved equal.
22. Alarm Light – Provide a red strobe light mounted on the top, exterior of the enclosure. Minimum rating shall be 105 Joules at 70 flashes per minute. The strobe light shall be fully sealed to prevent water from entering the enclosure and be attached by mounting screws from inside the enclosure to prevent tampering.
23. Alarm Dialer – Provide a 4-channel automatic alarm dialer mounted in the control panel. Dialer shall be Microtel, or approved equal. The dialer shall be mounted in a 15"x15" space. The following alarms shall be wired to terminal blocks in the control panel, then connected to the dialer:

Wetwell High Level
Pump # 1 Fail
Pump # 2 Fail

Power Failure

24. Ground Buss/Lugs – Provide a ground lug size for incoming power ground near the power distribution block. Provide a ground lug size for pump ground near pump power wire terminations. Provide a ground buss for control equipment grounding, minimum 6 termination points.
 25. Corrosion Inhibitor – Provide a corrosion inhibitor mounted inside the control panel. Corrosion inhibitor shall be Hoffman #A-HCI-5E, or approved equal.
 26. Wiring – Power distribution wiring on the line side of panel fuses or circuit breakers shall be sized for the load served. Minimum 12 AWG. Control wiring shall be minimum #16 gauge SIS type standard wire for internal control panel circuits. All control wires shall be numbered at each termination corresponding to the master wiring diagram with clip-sleeve or heat-shrink type wire markers. Wrap-on or adhesive wire markers shall not be allowed. 120 vac wiring (except for neutrals) shall have red insulation. 120 vac neutral wiring shall have white Insulation. 12/24 vdc wiring shall have blue insulation.
 27. Nameplates – Provide adhesive baked printed nameplates for all internal devices such as contactors, circuit breakers, and relays. Provide engraved phenolic nameplates, black letters on white background, for door-mounted devices such as selector switches, push-buttons, circuit breaker toggles, and pilot lights. Nameplates shall be secured firmly to the panel.
- E. Control Panel Electrical Rack
1. An electrical equipment rack shall be supplied by the manufacture of the control panel for installation by the electrical contractor. The equipment rack shall be constructed of double-back Unistrut™, hot dipped galvanized material with required conduit connecting meterbase, fused disconnect switch, control panel, seal fittings, and FRP (fiberglass reinforced plastic) junction box. If a lightning arrestor for the control panel is specified elsewhere in the control panel specifications, it may be mounted on the exterior of the disconnect switch, in lieu of the control panel, if desired.
 2. All wiring between components on the electrical rack shall be run in galvanized heavy wall conduit, minimum ½” diameter.
 3. All wire shall be not less than 12 AWG standard type THHN/THWN, except control wiring, which may be 14 or 15 AWG stranded type THHN/TUWN. All wiring shall be color by wire insulation.

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