

# Packaged Lift Station Specification

## General

### 1. Description

- 1.1. Contractor shall furnish all labor, materials, equipment and all performance of work necessary or incidental to furnish and install a pre-fabricated fiberglass reinforced polyester (FRP) lift station. The lift station shall be a completely factory-assembled unit, including pumps, hardware, and controls. Installation shall only require minor adjustments and field assembly. Packaged FRP Lift Station shall be **Automated Flow Systems model AFS-STN-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-\_\_\_\_-EXT**, as supplied by Power Pump and Electric Supply, or engineer approved equal. Bidders seeking approval for or equal products must submit the following information to the engineer 15 days prior to bid date: lift station shop drawings, pump curve, pump construction and materials, pump electrical data, pump and slide rail drawings, control panel wiring diagram, and control panel component cut sheets.

### 2. Submittals

- 2.1. The Packaged Lift Station manufacturer shall provide the following submittal information: lift station shop drawings, pump curve, pump construction and materials, pump electrical data, pump and slide rail drawings, control panel wiring diagram, and control panel component cut sheets.

### 3. Operation and Maintenance Manuals

- 3.1. The Packaged Lift Station manufacturer shall supply an O&M binder which shall include lift station data and drawings, pump manuals, control wiring diagram and manual.

### 4. Delivery and Handling

The contractor shall coordinate with the manufacture to have the Packaged Lift Station delivered to the project site. After delivery, the contractor shall insure that the control panel and electrical cables are protected from precipitation or submergence.

## Products

### 1. Fiberglass Reinforced Polyester (FRP) Wet Well and Valve Vault

- 1.1. Unless otherwise indicated, the plastic terminology used shall be in accordance with definitions given in American Society for Testing and Materials (ASTM) designation D833.
- 1.2. Materials
  - 1.2.1. The resin used shall be of a commercial grade and shall either be evaluated as a laminate by test or determined by previous service acceptable for the environment.
  - 1.2.2. The reinforcing material shall be a commercial grade of glass fiber having a coupling agent which will provide a suitable bond between the glass reinforcement and the resin.
  - 1.2.3. The laminate shall consist of an inner surface, an interior layer, and an external layer of laminate body.
  - 1.2.4. The inner surface shall be free of cracks and crazing with a smooth finish. This may be a gelcoat surface or reinforced with a glass surface veil.



BOISE, ID  
208.585.9338  
208.585.9338 FAX

COEUR D'ALENE, ID  
888.809.6778  
208.664.2133  
208.667.8775 FAX

SPOKANE, WA  
800.359.9416  
509.534.5616  
509.535.6539 FAX

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- 1.2.5. A minimum of one tenth of an inch of the laminate next to the inner surface shall be reinforced with not less than 20 percent or more than 30 percent by weight of noncontinuous glass strands having fiber lengths from .5 to 2.0 inches.
- 1.2.6. The exterior layer of the wall laminate shall be of construction suitable for the service intended and contain sufficient glass by weight to provide the aggregate strength necessary to meet the tensile and flexural requirements. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. Hand work finish is acceptable; however enough resin shall be used to prevent fiber show.
- 1.2.7. The vault wall must be designed to withstand collapse based on the assumption that saturated soil exerts hydrostatic pressure of 120 lb/cu ft. The vault wall laminate must be constructed to withstand or exceed two times the actual imposed loading on any depth of basin.

## 1.3. Construction and Penetrations

- 1.3.1. Vault top flange shall have an outside diameter at least four inches larger than the nominal diameter.
- 1.3.2. Vault bottom shall be constructed of solid fiberglass laminate. The bottom diameter shall be at least four inches larger than the nominal diameter. The flange shall be constructed to provide anti-flotation countermeasures. The contractor shall place concrete around the anti-flotation flange, if specified by the project engineer.
- 1.3.3. Perpendicular vault penetrations shall be made using rubber grommets up to and including four inch pipe size. Penetrations larger than four inch, or that are not perpendicular to within ten degrees, shall be made using a GeoFlex<sup>®</sup> boot, or by casting a PVC hub directly into the vault wall.

## 1.4. Access Hatch

- 1.4.1. The access hatch shall have a 1/4 inch thick, mill finish, extruded aluminum frame. The door panel shall be 1/4 inch aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf. Door shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open arm with aluminum release handle. Door shall close flush with the frame. Hinges and all fastening hardware shall be T-316 stainless steel. Unit shall lock with a non-corrosive locking bar and have a non-corrosive handle.
- 1.4.2. The access hatch shall be attached to the FRP vault top flange using series 300 stainless steel fasteners.

## 1.5. Hardware

- 1.5.1. All fasteners and hardware shall be series 300 stainless steel, aluminum, fiberglass reinforced polyester, or other approved non-corrosive materials suitable for the intended application.
- 1.5.2. Float switch bracket shall be fabricated using series 300 stainless steel. The bracket shall provide a support for the specified float switches and provide strain relief. The bracket shall include a stationary bracket and a removable bracket so the floats may be easily removed for servicing and inspecting.
- 1.5.3. Splice boxes shall be provided for pump power cords and float switches as specified on the drawings. Unless specified otherwise, one explosion proof splice box shall be pro-



**BOISE, ID**  
208.585.9338  
208.585.9338 FAX

**COEUR D'ALENE, ID**  
888.809.6778  
208.664.2133  
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**SPOKANE, WA**  
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vided for the pump power cords. Another Nema 4X splice box shall be provided for the float switches. Both splice boxes shall have individual conduit connections to the control panel.

## 2. Pumps

2.1. Each pump shall be a non-clog submersible centrifugal Hydromatic model \_\_\_\_\_ rated at \_\_\_\_ hp, \_\_\_\_ volts, \_\_\_\_\_ phase, \_\_\_\_\_ rpm. The pump shall produce \_\_\_\_\_ gpm at \_\_\_\_ ft TDH. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall have a service factor of 1.20. The pump shall be capable of handling a 3" solid.

2.2. The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 30.

### 2.3 Electrical Power Cord

2.3.1. The electrical power cord shall be STW-A, water resistant 600 volt, 60° C, UL and CSA approved and applied dependant on amp draw for size.

2.3.2. The pump shall be triple protected with a compression fitting and two epoxy potted areas at the power cord entrance to the pump.

2.3.3. The cord cap assembly, where bolted to the connection box assembly and the connection box assembly bolted to the motor housing, shall each be sealed with a Buna N rubber O-ring on a beveled edge to assure proper sealing.

### 2.4. Motor

2.4.1. The stator, rotor and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class H insulation, and a dielectric oil-filled motor, Nema B design. Further protection shall be provided by winding thermal sensors. Because air-filled motors do not dissipate heat as efficiently as oil-filled motors, air-filled designs shall not be accepted.

2.4.2. The pump motor shall be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped. The pump shall not require cooling water jackets or cooling fins.

2.4.3. Stators shall be securely held in place with a removable end ring and threaded fasteners so they may be easily removed in the field without the use of heat or a press. Stators held by heat shrink fit shall not be acceptable. No special tools shall be required for pump and motor disassembly.

### 2.5. Seals

2.5.1. The pump shall have two mechanical seal, mounted in tandem, with an oil chamber between the seals. John Crane Type 21, BF1C1, seal shall be used with the rotating seal faces being carbon and the stationary seal faces to be ceramic. The lower seal shall be replaceable without disassembly of the seal chamber and without the use of special tools. Pump-out vanes shall be present on the backside of the impeller to keep contaminates out of the seal area.

2.5.2. The pump shall be equipped with a seal leak detection probe and warning system. This shall be designated to alert maintenance personnel of lower seal failure without having to



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208.585.9338  
208.585.9338 FAX

COEUR D'ALENE, ID  
888.809.6778  
208.664.2133  
208.667.8775 FAX

SPOKANE, WA  
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take the unit out of service for inspection or requiring access for checking seal chamber oil level and consistency.

2.5.3. Units equipped with opposed mechanical seals shall not be acceptable.

## 2.6. Impeller

2.6.1 Impeller shall be of the two-vane, enclosed non-clogging design and have pump-out vanes on the front and back sides of the impeller to prevent grit and other materials from collecting in the seal area. Single vane impellers which cannot be easily trimmed and which do not maintain balance with wear are not acceptable.

2.6.2. Impellers shall be dynamically balanced.

2.6.3. The impeller shall be threaded shaft or tapered shaft and key driven. Straight end shafts shall not be acceptable.

## 2.7. Casing

2.7.1. The casing shall be of the end suction volute type having sufficient strength and thickness to withstand all stress and strain from service at full operating pressure and load. The casing shall be of the centerline discharge type equipped with an automatic pipe coupling arrangement for ease of installation and servicing.

2.7.2. A volute case wearing ring shall be provided to minimize impeller wear. The wear ring shall be series 230 brass. The wear ring shall be easily replaceable in the field.

## 2.8. Testing

2.8.1. Commercial testing shall be required and include the following:

2.8.1.1. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase and hertz.

2.8.1.2. The motor seal and housing chambers shall be megged for infinity to test for moisture content of insulation defects.

2.8.1.3. Pump shall be allowed to run dry to check for proper rotation.

2.8.1.4. Discharge piping shall be attached, the pump shall be submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.

2.8.1.5. The pump shall be removed from the water, megged again, dried and the motor housing filled with dielectric oil.

## 3. Discharge Elbow and Slide Rail System

3.1. A discharge elbow shall be furnished with each pump. The discharge elbow shall rest squarely on the floor of the wet well vault and be securely fastened using series 300 stainless steel fasteners.

3.2. The base elbow shall be equivalent to the nominal pump discharge size.

3.3. A hydraulic operated sealing flange, complete with Buna N rubber diaphragm type sealing gasket, shall be mounted on each pump discharge. When the pump is activated, the resulting dis-



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208.585.9338  
208.585.9338 FAX

**COEUR D'ALENE, ID**  
888.809.6778  
208.664.2133  
208.667.8775 FAX

**SPOKANE, WA**  
800.359.9416  
509.534.5616  
509.535.6539 FAX

charge pressure shall force the diaphragm seal against the flange face of the discharge elbow providing a leak proof seal. When pressure is removed, the diaphragm shall relax so that there is no mechanical connection to the discharge, and the pump with the hydraulic sealing flange may be easily removed. Units using total flange-to-flange connection which could corrode together shall not be acceptable.

- 3.4. The slide rail used to direct the pump in proper alignment with the stationary discharge piping shall be of a single slide rail design. The single rail shall be a non-corrosive, non-sparking, FRP pultrusion formed in the shape of an H-beam. Dual rail or single rail systems utilizing metal material such as galvanized or stainless steel piping shall not be acceptable.
- 3.5. The slide rail system shall allow the pump to be automatically connected to the discharge elbow without need for personnel to enter the wet well vault. Sealing of the pump to the discharge elbow shall be accomplished by a single down and in motion of the pump.
- 3.6. The pumps shall be supplied with a lifting system. The system may be a stainless steel bail and stainless steel chain, stainless cable, or a grab link mechanism using stainless steel hardware and nylon guide rope. The system supplied must be sized to safely lift the pump.

## 4. Discharge Piping and Valves

- 4.1. All discharge piping and fittings shall be Schedule 80 PVC / Cast or Ductile Iron (design engineer must specify). Piping sizing and configuration shall be constructed as illustrated on the project plans.
- 4.2. The gate valves shall be all cast or ductile iron bodied with 125 lb ANSI flanged ends. Valves shall have a resilient wedge with a non-rising stem.
- 4.3. The check valves shall be all cast or ductile iron bodied with 125 lb ANSI flanged end. Check valves shall have a full opening swing style clapper. The clapper shall swing completely clear of the waterway when fully open, permitting full flow through the valve equal to the nominal pipe diameter. The clapper shall include a resilient seat. The clapper shall be mechanically coupled to an external lever and weight.

## 5. Control Panel

### 5.1. General Description and Qualifications

- 5.1.1. Provide a complete lift station control panel with solid state programmable controller, motor starters, operator interface devices, and appurtenances installed in a single NEMA 4 enclosure, Automated Flow Systems™ SL series or approved equal.
- 5.1.2. The pump control panel shall be manufactured at a facility meeting U.L. Standard 508a for industrial controls. Manufacturer shall have at least five years experience manufacturing similar products. All components shall be products of reputable manufacturers.

### 5.2. Construction And Functionality

#### 5.2.1. Operator Interface Devices

- 5.2.1.1 All operator interface devices shall be located on the panel dead front unless otherwise indicated. Each device shall be labeled according to its function and the designation of any associated equipment.
- 5.2.1.2. The Hand-Off-Auto (HOA) switch shall be NEMA 4X, watertight type



**BOISE, ID**  
208.585.9338  
208.585.9338 FAX

**COEUR D'ALENE, ID**  
888.809.6778  
208.664.2133  
208.667.8775 FAX

**SPOKANE, WA**  
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with detachable contact blocks, Idec HW series or approved equal. One H-O-A switch shall be supplied for each pump. Each H-O-A switch shall be labeled according to function and designation of the associated pump.

- 5.2.1.3. Pilot lights shall be NEMA 4X, watertight type with 120VAC LED 1 amp and colored lens, Idec HW series or approved equal. Push button switches shall be used where required. Each pilot light shall be labeled according to function, as listed below.

Name	Color	Features
Liquid Level Alarm	Red	High or low level Solid high level Flashing low level Auto-reset Audio Push-to-silence
Pump 1 Run	Green	
Pump 2 Run	Green	
Pump 1 Seal Failure	Amber	Push-to-reset
Pump 2 Seal Failure	Amber	Push-to-reset
Main Power	Blue	

- 5.2.1.4. The liquid level pilot light and audio alarm shall activate upon determination of a high or low water alarm condition and remain activated until such time as the high or low water alarm condition has cleared. The liquid level audio alarm shall be of molded case waterproof design with epoxy encapsulated solid state electronics, mounted through the bottom of the enclosure, Floyd Bell MW series or approved equal. The audio alarm and pushbutton pilot light shall be wired to an alarm silence relay. Pressing the pushbutton pilot light during an alarm condition shall silence the audio alarm while keeping the pilot light illuminated.

- 5.2.1.5. The pump running pilot light shall be illuminated when the associated pump starter is engaged.

- 5.2.1.5. The pump seal failure fault pilot light shall be illuminated when the associated pump seal failure sensor relay is energized. The pump seal failure fault pilot light shall remain illuminated until the fault has been acknowledged. Operating the pushbutton shall acknowledge and reset the pump seal failure fault.

## 5.2.2 Programmable Logic Module

- 5.2.2.1 The programmable logic module shall have, as a minimum, the following features:
- liquid crystal display for viewing of input/output status, elapsed run times, cycle counters, and alarm counters
  - Programming keys to allow adjustment of user set points without use of a portable computer
  - non-volatile storage of control program and parameters on internal



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208.585.9338  
208.585.9338 FAX

COEUR D'ALENE, ID  
888.809.6778  
208.664.2133  
208.667.8775 FAX

SPOKANE, WA  
800.359.9416  
509.534.5616  
509.535.6539 FAX

## EEPROM

- EEPROM card port to facilitate easy changes of panel functions. The programmable logic module shall be programmed to provide the following functions as a minimum:
- determination of liquid level based on digital inputs from float switches
- determination of pump start failure fault based on digital input from the current monitor relay
- delay timers to prevent pumps from starting or stopping simultaneously
- digital outputs for pump on/off to control pumps in lead/lag alternating fashion
- digital output for liquid level audio alarm and pilot light for high or low level condition
- user selection for pump alternation, Pump 1 lead or Pump 2 lead

## 5.2.3. Float Switches

- 5.2.3.1 Liquid level will be determined based on digital inputs from external float switches. Provide one set of terminals for connection to each float switch. Float switch terminals shall be wired to the programmable controller to provide digital inputs for low water alarm / redundant off, pump(s) off, lead pump on, lag pump on / high water alarm (optional – lag pump on, high water alarm).

## 5.2.4. Relays

- 5.2.4.1. General-purpose relays shall have 10A contacts and standard bases with DIN rail mounted sockets, Idec RH series or approved equal.
- 5.2.4.2. The seal failure sensor relay shall be a DIN rail mounted SPDT conductivity based liquid level control with adjustable sensitivity and LED indicator, Crouzet NR series or approved equal. One seal failure sensor relay shall be provided for each pump. The seal failure sensor relay shall be wired to terminals facilitating field connection to the seal failure sensor probes. In the event of water in the seal cavity the seal failure sensor relay shall change states, energizing the pump seal failure fault pilot light.
- 5.2.4.3. Current sensor relay shall be a solid state self-powered go-no go monitor. The relay shall detect the presence of AC current to the motor. The relay shall be a Diversified Electronics model CMG, or approved equal.
- 5.2.4.4. The intrinsically safe relay(s) shall utilize a current and voltage limited circuit to determine float switch status and relay that status to the programmable logic module via an electromechanical output. Provide Pepperl+Fuchs transformer isolated barriers or approved equal.



**BOISE, ID**  
208.585.9338  
208.585.9338 FAX

**COEUR D'ALENE, ID**  
888.809.6778  
208.664.2133  
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- 5.2.5. Automatic Alarm Dialer/Data Logger (optional) shall be equipped with 8 inputs capable of either digital or analog operation. The unit shall be capable of reporting to up to 32 destinations in any combination of voice, fax, paging, or e-mail. Built in data logging capabilities shall have the ability to store up to 32,000 time stamped records for activity reports and trending. All data shall be stored in non-volatile memory. Software for real-time monitoring, analyzing stored data, generating reports, and processing alarms shall be included. Provide Phonetics Sensaphone 2000 or approved equal.
- 5.2.6. Automatic Alarm Dialer (optional) shall be equipped with 8 inputs capable of either digital or analog operation. The unit shall be capable of reporting to up to eight 32-digit phone numbers and play a message up to 1 minute in length specific to that input. Messages can be recorded locally or remotely with a total message time for all 8 inputs of eight minutes. Provide a Viking K-2000-DVA or approved equal.
- 5.2.7. Motor Starters
- 5.2.7.1. Contactor for motor starting shall be IEC rated with 120-volt coil. Select contactor appropriate for the hp, volt, phase motor being started. Provide Sprecher-Schuh or approved equal. Provide one contactor for each pump. Overload relay shall be solid state type with adjustable trip setting, selector for automatic or manual reset, visible trip indication, trip test, and manual reset button, Sprecher-Schuh or approved equal. Provide one overload relay for each pump. A normally closed contact shall be wired in series with the contactor coil.
- 5.2.7.2. Over load relay (optional) shall be Motor Saver model 777 (or 77C for single phase). Provide one overload relay for each pump. A normally closed contact shall be wired in series with the contactor coil.
- 5.2.8. Power Distribution
- 5.2.8.1. Provide non-fusible main disconnect switch with internal operator sized to match the current requirements of the pump control panel loads. The disconnect shall be a rotary cam style, ABB OT series, or approved equal.
- 5.2.8.2. Provide non-fusible combination disconnect / generator transfer switch (optional) with internal operator sized to match the current requirements of the pump control panel loads. The disconnect shall be a rotary cam style, ABB OT series, or approved equal.
- 5.2.8.3. Molded case thermal magnetic circuit breakers shall be DIN rail mounted, cable in / cable out type. Breakers shall be provided with arc chutes on each pole. Breakers shall be provided with thermal and magnetic trip mechanisms on each pole. Two and three pole breakers shall be common trip. Provide one breaker for each pump power circuit, one breaker for control power and one breaker for enclosure lighting, heating, cooling and convenience receptacle (as required). The circuit breakers shall be Cutler Hammer, ABB, or ap



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208.585.9338  
208.585.9338 FAX

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888.809.6778  
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- proved equal.
- 5.2.8.4. Fuses shall be of the type and amperage required for adequate protection of panel components. Fuses shall be provided to protect panel components as recommended by the component manufacturer. All fuses shall be installed in compatible fuse blocks. Fuses shall be Bussman or approved equal.
- 5.2.8.5. Control power transformer (optional) shall be panel mount, epoxy encapsulated core and coil type, Acme AE series or approved equal. Size control power transformer as required to provide 120-volt power for internal control circuits, as well as any lighting, heating, ventilation or convenience receptacle that may be required by this specification. In no case shall the control power transformer be rated less than 100VA.
- 5.2.8.6. Provide a high capacity varistor style surge arrester (optional). The surge arrester shall be a one-position, rail mountable surge voltage arrestor. The surge arrestor shall be an Intermatic AG series, or approved equal.
- 5.2.8.7. Provide terminals for all control circuit wire terminations for both field wiring and internal wiring. Terminals shall be capable of terminating two #14 AWG stranded wires. Terminals shall be equipped with labeling devices designed specifically for use with provided terminal blocks. Terminals shall be Pheonix UK6N terminal blocks or approved equal.
- 5.2.8.8. Provide terminal blocks for all power circuit wire terminations for both field wiring and internal wiring. Provide adequate terminals for all internal secondary circuits as well as tap off points for external circuits being fed from the panel power circuit. Terminals shall accommodate one conductor per opening and be touch safe. Power distribution blocks shall be Farraz FSPDB series or approved equal.
- 5.2.8.9. Provide molded plastic wireways for all wiring in the panel. Wireways shall be complete with covers. Wireways shall be manufactured by Panduit or approved equal.

## 5.2.9. Equipment Enclosure and Accessories

- 5.2.9.1. The pump control panel enclosure shall be rated NEMA 4 and formed of 14 or 16 gauge steel with continuously welded seams (ground smooth). Enclosures shall be of dead front design and have a stud mounted back plane for mounting of control components.
- 5.2.9.2. Provide enclosure heater (optional) for protection against condensation and low temperatures. Heater shall have resistive heating element with adjustable thermostat, continuously running ball bearing fan and anodized aluminum housing. Provide wattage and voltage appropriate for enclosure size and installation environment. Enclosure heater shall be Hoffman D-AH series or approved equal.

5.2.10. All internal connection wires shall be numbered at each end using pre-printed heat shrink sleeve markers.



**BOISE, ID**  
208.585.9338  
208.585.9338 FAX

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888.809.6778  
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5.2.11. External or flush mounted devices shall be labeled with engraved laminated phenolic name plates secured with permanent pressure sensitive adhesive. Internal labels shall be white polyester permanent pressure sensitive tape printed with black thermal transfer lettering. Where operator interface devices are grouped according to associated equipment it shall be permissible to provide one label for each group of devices, i.e. an H-O-A switch, pump running pilot light, and elapsed time meter for pump #1 could be grouped together and identified with one label reading "PUMP 1".

## Execution

### 1. Installation

- 1.1. The excavation shall be prepared according to the project drawings. A properly compacted base shall be provided.
- 1.2. The contractor shall place the packaged lift station into the excavation using care not to damage the assembly from lifting stresses or impacts.
- 1.3. If required, pour a concrete anti-flotation ring as shown on the project drawings.
- 1.4. Backfill with suitable materials and compaction.

### 2. Start-up and Training

- 2.1. The initial start-up shall be performed by an authorized representative of the packaged lift station supplier. The representative shall inspect the installation, supervise the start-up, and instruct the owner's personnel in the proper operation and maintenance procedures for the entire packaged lift station. The contractor shall advise the project engineer and representative two weeks prior to commencing start-up. Four hours shall be allowed for start-up and training. If the system is not operational the contractor shall be responsible for rescheduling and additional costs for representative to return.



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