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**SECTION 11300****SUBMERSIBLE SEWAGE PUMPS****PART 1 - GENERAL****1.01 SCOPE**

- A. Furnish, install, and test the combined assembly, submersible motor and pumping units and appurtenances, as indicated on the Drawings and as herein specified.
- B. The work shall include all equipment, controls, accessories and appurtenances necessary to provide a complete operating system. All Work shall conform to all requirements for installation, materials, and equipment, approvals of State, local, Underwriter's Laboratories, Incorporated, or other applicable codes, whether or not called for in detail on the drawings or in these specifications.
- C. Electrical wiring and starting equipment shall be as shown on the drawings, as specified herein and as specified in Division 16. The pump control panel, although specified in Division 16, shall be provided by the pump manufacturer, for single source responsibility.
- D. The complete pumping system for each station shall be provided by a single supplier for single-source responsibility. The complete pumping system includes guide rails, brackets, base elbows, pumps and control panel.
- E. Furnish and install a diaphragm protected pressure gauge assembly on the discharge of each submersible pumping units in the Valve Vault, as indicated on the Drawings and as herein specified.

**1.02 RELATED WORK**

Section - 01010	Summary of Work
Section - 01340	Shop Drawings, Product Data and Samples
Section - 02501	Piping
Section - 02502	Valves
Section - 02507	Prime and Tack Coats
Section - 02600	Piping
Section - 05200	Miscellaneous Metal (including Wet Well and Valve Vault Access Hatches)
Section - 09900	Protective Coatings
Division 16	Electrical Work

**1.03 REFERENCE STANDARDS**

- A. Hydraulic Institute Standards, latest edition.
- B. All construction and installation to conform to the Florida Building Code, electrical, mechanical, concrete, etc.
- C. National Electric Code, NEC, including Class 1 Group C/D Atmosphere Requirements.

**1.04 SUBMITTALS**

- A. Shop Drawings in accordance with Section 01340.
- B. Pump station drawing submitted in shop drawings shall reflect all pertinent details and specifications as described within, with location plan.
- C. Factory certified shop performance test curves in accordance with Section 01340.
- D. Certification of factory service representative that equipment has been installed to manufacturer's recommendations and is ready for start-up.
- E. Four (4) customized set of Operation and Maintenance Manuals (in 3 ring binders) in accordance with Section 01340.

**1.05 WARRANTY REQUIREMENTS**

- A. All equipment supplied under this Section shall have a base warranty from the Contractor and each equipment manufacturer covering a period of one year from start up and acceptance for beneficial use. Warranty period for each station's equipment shall commence on the date of start up and acceptance for beneficial use.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the basic warranty period, it shall be repaired at no additional cost to the Owner.

**1.06 ADDITIONAL WARRANTY REQUIREMENTS**

- A. Pumps
  - 1. Concurrent with the basic warranty period specified in paragraph 1.05, the manufacturer shall warrant the pumping equipment for each time period or duration of actual operational running time, whichever occurs first, participating in the cost of repair or replacement, in accordance with the following schedule:

Warranty Period	Time After Start-Up and acceptance for beneficial use of the Pumping Equipment (Months)	Time of Actual Pump Operation (Hours)	Manufacturer's Share of the Cost of Repair or Replacement (Percent)
1	0-18	0 - 3,000.0	100
2	19 - 39	3,000.1 - 6,500.0	50
3	40 - 60	8,800.1 - 10,000.0	25

2. The warranty shall cover defects in workmanship and material and cover all costs for both labor and parts required to inspect and repair pumping equipment delivered to the pump manufacturer's authorized repair and maintenance service center.

During the basic warranty period required by Paragraph 1.05 and Warranty Period One, the manufacturer shall be responsible for removing and re-installing the pumping equipment in the wet well. The manufacturer shall be responsible for removal and re-installation of the pump power and control cables and all transportation or shipping costs for delivery of the pumping equipment to a service center and return to the pump station site during warranty period number one. If warranty service is required after warranty period number one, the manufacturer shall be responsible for all transportation or shipping costs for delivery of the pumping equipment to the service center and return to the site.

3. The manufacturer's obligation under this warranty shall be to repair or replace the defective pumping equipment at the pro-rated share of cost stated above, exclusive of any shipping costs for which the manufacturer is responsible, as stated above.

**B. Control Panels and Starters**

Warranty requirements for control panels, starters and any other associated electrical equipment are specified in Division 16 of these Specifications.

**C. Guide Rail Systems, and Other Accessory Equipment**

The manufacturer shall repair and/or replace defective guide rail systems, other accessory items, or any of their defective components which are supplied under this Specification at no additional cost to the Owner during the basic one year warranty period. Extended warranty requirements for time periods, after the expiration of the basic warranty period specified in Paragraph 1.05 shall not be applicable to the guide rail system, and other accessory items.

D. Agreement to Warranty Conditions

1. The Contractor shall, as a part of the required shop drawing and product submittal data, deliver a certified statement of agreement to the above listed conditions of warranty for equipment and materials to be supplied and installed under this Section of the Specifications. If this statement is not submitted, the equipment shall not be approved for use in the Work.
2. Warranty of equipment must be by the pump manufacturer. Warranty agreements by the manufacturer's local supplier shall not be acceptable, except for removal, shipping and re-installation efforts.
3. As required herein, a typewritten or printed copy of the product warranty(ies), including the above provisions and applicable dates of commencement and expiration of each warranty period, shall be supplied with other required product data.

**1.07 MANUFACTURER'S RECOMMENDATIONS**

Where installation procedures or any part thereof are required to be in conformance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to the installation.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS AND RATING DATA**

- A. Pump shall be Model 6VCX, as manufactured by F.E. Myers, Ashland Ohio, or Model 150 DLFU 637 as manufactured by Ebara International Corp., Rock Hill, SC. Or approved equal.
- B. Rating Data:

Number of Pumps	3
Electrical Service Characteristics	460V, 3 Ph, 60 Hz.
Pump Suction by Discharge Size (inches)	6 Nominal Dia.
Minimum Sized Sphere that will pass thru the impeller without clogging (inches)	3

Characteristics with Initial Impeller:

Design Point:	
Flow	1,140 gpm
TDH	117 feet
Appx. Shut Off Head, Min.	137 feet
Max. Motor Synchronous Speed	1,750 rpm
Motor Brake Horse Power, minimum	60 HP
Motor Service Factor, minimum	1.0
Run Out on Curve: Max. Flow @ 70 Ft. TDH	1,500 gpm
Output at Periods of Low Force Main Usage:	
Max. Flow @ 64 Ft. TDH	1,330 gpm

Output at Periods of Maximum Force Main Usage and 2 Pumps On @ PS 8, Each Pump	
Min. Flow @ 137 Ft. TDH	500 gpm
Clear Opening of Wet Well Access Hatch (feet)	8 across x 4 long

Characteristics With Largest Future Upgraded Impeller that Will Not Overload the 60 HP Motor or Cause Cavitation Anywhere on Its Curve:

@ 1,140 GPM Design Point, Minimum TDH	117 feet
Appx. Shut Off Head, Min	165 feet
Output at Periods of Low Force Main Usage	
Max. Flow @ 58 Ft. TDH	2,400 gpm

- C. Pump and motor shall be UL, FM (or approved equal agency) certified to be explosion proof in a Class 1, Division 1, Group D environment, as defined by the National Electrical Code.
- D. It is the intent of this specification that the pump shall be upgradable by simply increasing the impeller size. For this reason, the specified motor is larger than is required by the initial rating point and impeller.

## 2.02 GENERAL

- A. The sewage pumps shall be submersible type, non-clog, centrifugal pumps suitable for pumping raw unscreened sewage. Each unit shall consist of a pump with a submersible motor, a discharge connection, and guide rail. Each pump shall be arranged to automatically clamp the pump discharge to the discharge connection when the pump is lowered along the guide rail. Pumps shall be designed for operating in a potential sewer gas environment. Pumps must be physically sized to allow triplex installation and successful operation in the diameter wet well and top slab/access hatch indicated on the plans and the above table. Contractor shall field verify all dimensions.
- B. The pump operation must approximate the design point at near-optimal efficiency and be able to operate at the high end of the specified operating range for both volume and head and be able to operate safely at the low end of the range. The required horsepower shall not exceed the motor rated horsepower over any portion of the operating range.
- C. Pump shall be provided with a stand base designed to support the weight of the pump and stresses imposed thereon by vibration, shock, and all possible direct and eccentric loads. The base shall be attached by stainless steel, drilled-in expansion-type anchor bolts.
- D. All rotating parts shall be statically and dynamically balanced.
- E. All normal maintenance shall be permitted without breaking piping or motor connections.
- F. Pump connections shall be flanged, ANSI Class 125 pound flanges, minimum.

- G. All mating surfaces where watertight sealing is required shall be machined and fitted with rubber O-rings.
- H. The required net positive suction head shall not exceed the available net positive suction head at any point in the operating range, including run out condition.
- I. A guide rail system shall allow connection of the pump to the discharge pipe by gravity. Sealing shall be accomplished automatically by the weight of the pump against the mating flanges. The pump manufacturer shall guarantee no significant leaks at the discharge connection. If a replaceable O-ring is utilized to affect the pump discharge show to base elbow seat seal, such O-ring shall be securely attached, via a dovetailed groove, to the pump portion and not to the base elbow portion.
- J. Pumps shall meet or exceed Design Specifications at all points on the curve, and shall be capable of continuous operation at shut-off or run-out condition at the low end of the head range indicated in the above listed table, without thermally overloading the motor or causing pump vibration or cavitation.
- K. Unit shall be provided with an adequately designed cooling system permitting partially operation without external jackets, fans or other external mechanical cooling.
- L. Access Frame and Guides:
  - 1. The access frame and covers (hatches) are specified under Section 05200.
  - 2. Provide an upper guide pipe holder and level sensor cable holder. The guide member shall be stainless steel and shall be furnished with upper brackets for attachment to the top slab of the wet well, and lower guide holders, which shall be integral with discharge connection.
- M. All pumps shall be equipped with the necessary accessories, including stainless steel lifting attachments, cable, and hardware.
- N. All electrical work shall comply with NEC and local codes and standards.
- O. All nuts, bolts and miscellaneous fasteners installed within the pump station wet well or valve box shall be 316 stainless steel.

### 2.03 MATERIALS

- A. Pumps shall be the standard configuration of the specified manufacturer and model with the options and requirements specified in this Section:
  - 1. Myers Model 6VCX:
    - a. The motor stator shall be equipped with three (3) thermal sensor switches embedded in the end coils of the stator winding. These shall be connected in series and shut the pump down should temperature exceed 140 degrees C. Reset shall be automatic.
    - b. Motor and seal assembly shall be equipped with a complete moisture detection system.

2. Ebara Model 150 DLFU 637

- a. The motor stator shall be equipped with three (3) thermal sensor switches embedded in the end coils of the stator winding. These shall be connected in series and shut the pump down should temperature exceed 140 degrees C. Reset shall be automatic.
- b. Motor and seal assembly shall be equipped with a complete moisture detection system.

B. Miscellaneous Items.

a. Attachment and Anchor Bolts:

1. All attachment bolts and anchor bolt shall be of ample size and strength for the purpose intended and shall be 316 stainless steel.
2. All anchor bolts shall be set in accordance with the manufacturer's instructions.

b. Data Plates shall be of stainless steel suitably attached to the pump with stainless steel fasteners and shall contain:

1. Manufacturer's Name.
2. Pump Size and Type.
3. Serial Number.
4. Speed.
5. Impeller Diameter.
6. Design Capacity and Head.
7. Other Pertinent Data.

c. The pump shall have an approved primer and a polyamide epoxy protective coating, minimum 17 mils DFT, for operation in raw sewage, and brackish infiltration into the sewer lines.

**2.04 MOTOR AND APPURTENANCES**

- A. Squirrel-cage, induction, shell type design, 1.15 minimum service factor. UL listed, explosion proof for Class 1 Division 1, Groups C and D.
- B. Designed for continuous duty, capable of sustaining a minimum of eight (8) starts per hour.

- C. The Stator shall be equipped with three (3) thermal sensor switches embedded in the end coils of the stator winding. These shall be connected in series and shut the pump down should temperature exceed 140 degrees C. Reset shall be automatic.
- D. Motor and seal assembly shall be equipped with a complete moisture detection system.
- E. Pump motor cable:
  - 1. Cable shall be one piece, sufficiently long to reach from pump to control panel, as indicated on Drawings, plus ten additional feet of slack, minimum
  - 2. No junctions within the wet well, whether above or below the waterline, will be acceptable.

#### **2.05 LIQUID LEVEL SENSORS:**

- A. Liquid level controls shall include mercury switch level sensors in corrosion and shock resistant plastic casing suspended on flexible cables. The sensors shall be supported by 316 stainless steel brackets. The floats shall be capable of being disconnected and replaced by means of a gas and moisture tight connector.
- B. Required functions are as shown on the Drawings and in the Electrical specification of Division 16.

#### **2.06 GUIDE RAILS, LIFTING CHAINS, CABLE HANGER AND ANCHOR BOLTS**

- A. Furnish one (1) guide rail system for each pump to permit raising and lowering the pump. Guide rails shall be of adequate length to extend from the lower guide holder on the pump discharge connection to the upper guide holder mounted on the access hatch frame. Guide rails shall be of 304 stainless steel. Provide stainless steel intermediate supports, as needed.
- B. Lifting chains shall be made of Type 304 stainless steel. Each chain shall come equipped with two (2) stainless steel bolts for connecting chain to pump's lifting handle.
- C. Cable hanger shall be constructed of Type 304 stainless steel.
- D. Anchor bolts shall be manufactured of Type 316 stainless steel.
- E. The pump shall be supplied with a cast iron base elbow assembly. The seal of the pump at the discharge flange is to be accomplished by simple downward linear motion of the weight of the pump guided to and pressing against the discharge connection.

#### **2.07 PERFORMANCE FACTORY SHOP TESTS**

- A. General
  - 1. Pumps shall be factory tested by the pump manufacturer in compliance with Hydraulic Institute Standards. All tests shall be certified correct by the manufacturer, as to procedures and results

2. The pump manufacturer shall possess, or have readily available access to suitable testing facilities adequate for performing the shop tests required hereinafter. If an alternate manufacturer is proposed, as part of the shop drawing submittal, the Contractor shall submit a description of the proposed manufacturer's testing facilities, including hydraulic, mechanical, electrical and instrumental elements. The description shall cover initial and periodical calibration provisions for all instruments. The descriptive matter may contain illustrative photographs, drawings and such other matter as may be appropriate to describe said tests.

**B**     Performance Tests - Pump:

1. The pump shall be given a performance test during which the pump shall be run at normal rated speed over the specified range of the rate of flow and then held at shutoff head for at least one minute and at the rating point for 30 minutes.
2. Each pump shall be started with the casing filled with water and against shutoff head, to prove that the motor will reach and maintain synchronous speed. Such test shall show that the pump has the general characteristics of the head, efficiency, horsepower and such other properties as appear on the approved curves submitted as required herein. Such test shall also prove the specified head, efficiencies, horsepower and other properties at the rating point. Such test shall also establish that the pump is free from overheating, cavitation and excessive vibration over the specified range of the rates of flow.
3. Electrical starters and other control equipment necessary for testing shall be furnished by the pump manufacturer. All instruments used shall be calibrated to industry standards.
4. Ampere, Kw input and voltage readings shall be recorded at each data point (flow, TDH)

**C**     Test Results

The manufacturer shall submit a shop test report, containing method, equipment and results for approval. The pump test shall follow the format recommended by the standards of the Hydraulic Institute. The Contractor shall note therein that submission of the shop test results and written notification by the Engineer of his acceptance thereof is necessary before equipment can be shipped to the site. The number of copies required shall be similar to that for shop drawings.

**2.07 PRESSURE GAUGE ASSEMBLIES**

- A. Each pressure gauge not specified in other sections of this specification shall be direct mounted, cast aluminum case, with a 42" diameter dial and furnished with a clear glass crystal window, 2" shut-off (isolation) valve, and a bronze pressure snubber. Provide diaphragm seals between shut-off (isolation) valve and pressure gauge on all wastewater lines. All gauges shall be weatherproofed. The face dial shall be white finished aluminum with jet-black graduations and figures. The face dial shall indicate the units of pressure being measured (e.g., feet of water, inches of mercury, psi(g), etc.) or be dual scale. Each pump discharge line shall be furnished with gauges sized 0 to 160 feet or range as shown on the Drawings. Pressure gauges shall be equal to Model 500

as manufactured by H.O. Trerice Company, Detroit, Michigan; Marshalltown Instruments, Marshalltown, Iowa; US Gauge, Ashcroft or equal.

- B Diaphragm seals shall be installed on pressure gauge connection to all wastewater and chemical lines or where shown on the Drawings, to protect pressure switches used to monitor pressures on wastewater and chemical lines. The diaphragm shall be "thread attached" to both piping and pressure switches. Diaphragm seals shall be constructed of cadmium-plated carbon steel, except for the lower housing which shall be specifically chosen according to the fluid pressure being monitored. Diaphragm seals shall have a flushing connection and be Type SB by Mansfield and Green; No. 877 Trerice; Marshalltown; or equal.
- C. After the pressure gauge and snubber have been filled, mounted on the diaphragm seal and calibrated, they shall be safety wired together to prevent relative rotation that will alter the calibration.

### **PART 3 - EXECUTION**

#### **3.01 DELIVERY, STORAGE AND HANDLING**

Material delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling. Material shall not be stored on the ground and shall be stored in accordance with the manufacturer's recommendations. The insides of pipe and fittings shall be kept free from dirt and debris. Gasket and plastic materials shall be kept protected from exposure to direct sunlight over extended periods. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar material required to install the pipes shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf or pot life. Storage facilities for plastic pipe, fittings, joint material and solvents shall be classified and marked in accordance with NFPA No. 704, with classification as indicated in NFPA Nos. 49 and 325M. Material shall be handled in such a manner as to insure delivery to the trench in a sound, undamaged condition. Pipes shall be carried to the trench, not dragged.

#### **3.02 INSTALLATION**

- A. The equipment shall be installed by the Contractor in accordance with the manufacturer's drawings and instructions and shall include:
  - 1. Furnishing all special tools necessary to disassemble, service, repair and adjust the equipment.
  - 2. Providing one (1) year's supply of all recommended lubricants.
- B. Manufacturer's Service Representative shall provide competent personnel for a minimum period of one (1) day in one (1) trip to:
  - 1. Check installation of equipment.
  - 2. Provide start-up of equipment.
  - 3. Run specified tests.

4. Train plant personnel in operation and maintenance of his equipment.
- C. All wet wells shall be cleaned of any and all debris by a jet vac prior to starting pumps and/or accepting station by the Contractor with City representative present.
- D. Pressure Gauge Assemblies: Pressure gauges shall not be installed until after the time of pump field testing unless otherwise requested by the Owner.

### **3.03 FIELD TESTING, START-UP AND ADJUSTING EQUIPMENT**

#### **A. General**

After all pumps have been completely installed and working under the direction of the Contractor, conduct, in the presence of the Engineer, such tests as are necessary to indicate that pumps conform to the Specifications. Field tests shall include all pumps included under this Section. The Contractor shall supply all electrical power, labor, equipment and incidentals required to complete the field tests.

Prior to acceptance, an operational test of the pump and control system be performed to determine if the installed equipment meets the purpose and intent of the Specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally to otherwise defective; is in safe and satisfactory operating condition and conforms with the specified operating characteristics. Field testing and start-up shall consist of the following:

- (1) Preliminary Field Test.
- (2) Running Test.
- (3) Final Test.

Where successful results allow, it is intended to run the tests consecutively, so that the entire sequence may be expeditiously completed. The Contractor shall adhere to provisions contained herein for proper testing and start-up of the equipment and shall follow the Engineer's and equipment manufacturer's recommendations for testing. The Contractor shall be completely responsible for all testing and the furnishing of required manpower, energy and suppliers to accomplish testing start-up as outlined herein. The Contractor shall provide the necessary test equipment and instrumentation, recently calibrated to industry standards. The Engineer's will be the sole judge of whether equipment of facilities pass tests and will direct the Contractor to continue testing until tests prove successful.

Systems tests shall be made in conjunction with other related systems which shall, as much as is practical, be tested together.

Tests shall be made with clean water. Test shall demonstrate satisfactory service under specified operating conditions.

All systems shall be tested by the Contractor and witnessed by the Engineer to prove that the equipment and appliances are properly installed, meet their operating criteria and are free from defects, leaks, overheating, overloading and undue vibration. During this phase of testing, the manufacturer's representative for each piece of equipment shall be present as called for in these Specifications or as required.

The Contractor shall furnish all labor, lubricants, water, light, power and all other materials, equipment, hoses and instruments deemed by the Engineer to be necessary and required for the tests. The Contractor shall be completely responsible for testing equipment installed under his Contract. Included shall be the cost of furnishing all personnel required to operate the equipment and supply power whenever the equipment is required to operate.

If the tests are stopped for any reason the Contractor shall protect equipment and structures from damage.

The Contractor shall make all necessary changes, adjustments and replacements at his own expense. The successful operation of the equipment during this test shall not constitute acceptance of the individual pieces of equipment. However, until the equipment has performed satisfactorily during final test, acceptance will not be considered.

If any deficiencies are revealed during any test, such deficiencies shall be corrected and/or the defective equipment replaced and the tests shall be reconducted, all at the Contractor's sole expense.

If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified, at the Contractor's sole expense.

B. Preliminary Field Test:

As soon as feasible after the installation of equipment but prior to the running and final tests, the Contractor shall make preliminary field tests of the equipment and appliances furnished, to assure that the equipment is ready for testing, power is properly hooked up and the rotation of the impeller is correct.

The preliminary field test shall be witnessed by the Engineer. The Contractor shall furnish labor, lubricants, instruments and all other accessories and supplies required to perform the test.

C. Running Tests:

1. General

After installation of the sewage pumps, they shall be given a running test in the presence of the Engineer, during which time they shall demonstrate their ability to:

- a. Operate without vibration or overheating at the specified conditions.
- b. Perform as specified.
- c. Load test, check amperage, phase to voltage test and insulation test.
- d. Flow rate test, during the force main portion of the test, based on timed draw down of the wet well and force main pressure reading.

2. Recirculation

The wet well shall be filled with clear water. The main force main discharge valve shall be closed, the bypass valve partially closed, as needed, and the backpressure on the pump set to maintain, initially, the specified TDH across the pump, as determined by the static head difference between discharge pressure gauge and the

wet well static level. Each pump shall be started and run (discharging into the wet well) for an aggregate successful period of 10 hours. Pump test shall only occur during normal working hours. During this 10 hour test, decrease backpressure at the valve to achieve full load amps on the pumps' motors or the maximum flow recommended by the pump manufacturer for safe operation of the pump. Operate the pump at this rate for a period of 2 hours. Also, briefly close the valve to record the parameters at shut off.

At each setting of the valve, wet well level, etc., simultaneous pressure readings and also voltage and amperage readings shall be taken for each phase. During the 2 hour high flow test, readings shall be taken every 15 minutes otherwise, readings shall be taken every 30 minutes. The rated motor nameplate current and power shall not be exceeded at any point. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels and power consumption. At the completion of the test, manually turn the pump to the "off" position.

Running test shall be performed prior to connecting the southern portion of the on-site force main to the existing force main. The open end of this pipeline shall be temporarily plugged or capped and braced, so that it will not leak or blow off during the running tests.

### 3. Force Main

After successful completion of the Recirculation running test to the wet well and when authorized by the Engineer and Owner, and after the force main installed by Contract No. 2 has been successfully installed and accepted by the Owner, and after the Contractor has connected the northern portion of the on-site force main to this SE 5<sup>th</sup> Avenue force main, the Contractor shall completely fill the force main to the existing force main on SW 2<sup>nd</sup> Avenue, open the force main discharge valves, close the bypass valve and pump to the western force main system (if available) and conduct the next test. Data shall similarly be taken during this test, as well.

Duration of the Running Test to the western system shall be for at least three (3) wet well full to empty cycles.

### E. Final Tests:

Operate the pumps, as needed, to set up and verify all pump control functions, manual and automatic, as shown on the Drawings and as specified in Division 16.

The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to the following tests:

1. That the quick release lift-out feature functions properly and allows the pump to be raised and lowered without draining the wet well.
2. That all units have been properly installed and are in correct alignment.
3. That units operate without overheating or overloading any parts and without objectionable vibration.

4. That there are no mechanical defects in any of the parts.
5. That the pumps can deliver the specified pressure and quantity of flow.
6. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations and proper level alarm functions.

E. Motors:

The Contractor shall check all motors, to the extent practical, for correct clearance and alignment and for correct lubrication, in accordance with the manufacturer's instructions. The Contractor shall check the direction of rotation of all motors and reverse connections, if necessary.

F. General

1. All defects revealed by or noted during the tests shall be corrected or equipment replaced promptly at no additional expense to the Owner.
2. Contractor shall furnish all labor, piping, equipment and materials necessary for conducting the tests.
3. In case the Contractor is unable to demonstrate to the satisfaction of the Owner that the units will satisfactorily perform the service required, the units may be rejected. Contractor shall remove and replace the equipment at his own expense.
4. Prior to acceptance by the City, four (4) as-built shop drawings, curves, details and assembly and maintenance instructions books shall be submitted.

**END OF SECTION**