

## SECTION 11211

### PACKAGED PUMP STATION

#### PART 1 - GENERAL

##### 1.1. DESCRIPTION

###### A. Scope

1. Furnish and install one (1) prefabricated, skid mounted, fully automated, packaged pump station to supply the non-potable water system
2. Pump station to be furnished complete with all equipment, instruments and appurtenances specified herein or required to provide a complete and satisfactory pumping installation
3. Pump speeds to be automatically controlled by VFD
4. Provide manufacturer's field services
5. Furnish and deliver spare parts
6. Prepare and deliver operation and maintenance manuals

###### B. Additional Requirements Specified Elsewhere

1. Section 01010: Summary of Work
2. Section 01340: Shop Drawings, Product Data and Samples
3. Section 01400: Quality Control
4. Section 01600: Materials and Equipment
5. Section 01730: Operating and Maintenance Data

###### C. Related Requirements Specified Elsewhere

1. Section 02615: Ductile Iron Pipe
2. Section 02617: Steel Pipe
3. Section 02641: Valves and Accessories
4. Section 03600: Grout
5. Section 05501: Anchor Bolts and Drilled-In Anchors
6. Section 09900: Painting
7. Division 13: Special Construction
8. Section 15075: Basket Strainer
9. Division 16: Electrical

##### 1.2. QUALITY ASSURANCE

###### A. Source Quality Control

1. All equipment and accessories in the packaged pump station shall be furnished by or through a single manufacturer or supplier experienced in the fabrication of this type of equipment who shall be responsible for the design, coordination and functioning of the complete packaged pumping system

2. Experienced in manufacture of this equipment
  - a. Manufacturer of the pumping system shall have been in the business of manufacturing pumping systems for at least 10 years.
  - b. Manufacturer shall demonstrate ability to provide equipment support after installation consisting of the following services:
    - 1) Telephone support
    - 2) Startup services including installation oversight and operator training
    - 3) On-site service for equipment and process troubleshooting and repair

#### B. Design Basis

1. BoosterpaQ<sup>®</sup> Hydro MPC-E, Grundfos Pump Corporation, Olathe, Kansas
2. Or equivalent
3. Equivalent products of other manufacturers may be accepted subject to compliance with design, function, materials and performance of the specified items

#### C. Reference Standards

1. Hydraulic Institute Standards
2. ANSI – American National Standards Institute
3. ASTM – American Society for Testing and Materials
4. IEEE – Institute of Electrical and Electronics Engineers
5. NEMA – National Electrical Manufacturers Association
6. NEC – National Electrical Code
7. ISO – International Standards Organization
8. UL – Underwriters Laboratories, Inc.

### 1.3. SUBMITTALS

#### A. In accordance with Section 01340

#### B. Shop Drawings and Product Data

1. Complete fabrication, assembly, foundation and installation drawings, together with detailed specifications, wiring diagrams, schematics, control narratives including detailed sequence of operation, pump performance curves and data covering material used, parts, devices, and other accessories forming a part of the complete packaged pump station furnished
2. Submit sufficient data to verify compliance with these specifications and to illustrate construction and assembly of the products
3. Pumps
  - a. Name of manufacturer
  - b. Type and model
  - c. Rotative speed, minimum and maximum
  - d. Size of suction nozzle
  - e. Size of discharge nozzle
  - f. Type of bearings and lubrication
  - g. Type of coupling and assembly details

- h. Accessories
- i. Dimensions
- j. Net weight of pump only
- k. Net weight of pump skid assembly with complete equipment package
- l. Complete performance curves showing capacity versus head, NPSH required, pump and overall efficiency, and brake horsepower
- m. Data on shop painting
- 4. Mechanical seals
  - a. Name of manufacturer
  - b. Type and model
  - c. Materials of construction
- 5. Motors
  - a. Name of manufacturer
  - b. Type and model
  - c. Rated size of motor (hp)
  - d. Motor service factor
  - e. Type of bearings and lubrication
  - f. Temperature rating
  - g. Full load rotative speed
  - h. Net weight
  - i. Efficiency at full load and rated pumping conditions
  - j. Full load current
  - k. Locked rotor current
  - l. Suitability for operation with variable frequency drive; confirm induction rating/suitability
- 6. Data on shop coatings and painting
- 7. List of spare parts

C. Certificate of Compliance

- 1. The coordinating manufacturer or supplier shall verify in writing the following
  - a. Each system component is compatible with all other components of the system
  - b. All equipment and materials are appropriate for the intended service conditions
  - c. All pipe sizes are appropriate
  - d. All devices necessary for a properly functioning system have been provided
  - e. All equipment and materials comply with these specifications with any exceptions noted
  - f. Pumps have been properly installed and are operating within specification tolerances
  - g. All tests have been performed with satisfactory results
    - 1) Refer to Paragraph 3.1 for factory testing requirements

D. Operation and Maintenance Manuals in accordance with Section 01730

- 1. Complete detailed instructions shall be provided for changing the operating parameters of the station. The instructions shall include directions for making the changes and for calibrating and adjusting the equipment after the parameter change

#### 1.4. DELIVERY AND HANDLING

- A. Protect all materials and equipment from damage during handling and delivery
- B. Plug all temporary openings in equipment to prevent entrance of dirt or foreign material
- C. Equipment which rusts or is damaged in any way prior to acceptance by the Owner shall be restored to new condition or said equipment shall be replaced at no additional expense to the Owner

### PART 2 - PRODUCTS

#### 2.1. GENERAL

- A. Pump station shall be a completely skid mounted, vertical, in-line, multi-stage centrifugal pump, variable frequency drive station built by a single manufacturer or supplier
- B. All equipment including but not limited to pumps, motors, piping, valves, instrumentation and control devices shall be mounted on a common structural base to form a complete operating pumping station

#### 2.2. ANCHOR AND ASSEMBLY BOLTS

- A. All anchor and assembly bolts, nuts, and washers shall be furnished by the pump station supplier and shall be stainless steel or hot-dip galvanized in conformity with ASTM A153 and A385

#### 2.3. STATION BASE

- A. General
  - 1. Structurally sound, fabricated base with provisions for the proper mounting and support of all equipment and appurtenances specified herein shall be provided
  - 2. All materials and work shall conform with the applicable provisions of AISC and AISI
- B. Station base shall be fabricated from structural steel shapes and plates conforming to ASTM A36 or from Type 304 stainless steel. Structural components shall be of adequate size and thickness for the structural stresses anticipated. In no case shall components be less than ¼-inch thick. The finished base shall be rigid and shall not deform under installation or operating conditions
- C. Station base shall be suitable for mounting and supporting all parts of the packaged pumping system. Pump mounting plates shall include adequate openings for electrical conduit

- D. The pump station power and control panel and enclosure shall be rigidly mounted on the station base
  - 1. Orient for proper access as shown on the Drawings
  - 2. Locate and position to accommodate code-compliant clear space requirements
- E. Provisions shall be made in the station base for off-loading and handling the station at the site of installation
- F. The packaged skid system shall be constructed to minimize the overall footprint. The maximum skid dimensions shall be 5'-3" wide by 9'-9" long, including the control panel, with a maximum height to the top of the pump of 5'-0"

#### 2.4. SERVICE CONDITIONS

- A. Packaged pump station shall be furnished with four (4) pumping units installed, designated NPP-1 through NPP-4
  - 1. Three pumps shall be designated as duty pumps to meet total pump station capacity requirement of 270 gpm at 100 psi discharge pressure
  - 2. Include provisions in the station's base, piping and controls to expand the pumping system to a fifth pump in the future
- B. Installed in the NPW Room of the Pumping and Disinfection Building
  - 1. Ambient room air temperature range: 50°F – 100°F
- C. Pumped Fluid: Wastewater treatment facility final effluent
- D. Liquid Temperature Range: 12°C – 23°C
- E. Altitude: 5393 feet above mean sea level
- F. A strainer shall be installed upstream of pump station

#### 2.5. PERFORMANCE AND DESIGN REQUIREMENTS

- A. General
  - 1. Performance of each pump shall be stable and free from damaging cavitation, vibration and noise in the normal operating head range
  - 2. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable
  - 3. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided
  - 4. Excessive vibration shall be sufficient cause for rejection of the equipment
  - 5. Vibration displacement (peak to peak) as measured at any point on the machine shall not exceed 2.0 mils and that of the shaft measured at the face of the stuffing box shall not exceed 2.0 mils

- B. Pumping units shall be designed for the following operating conditions when operating at full speed unless otherwise noted
1. Maximum pump operating speed at 60 Hz (design full speed): 3,600 rpm
    - a. Total rated head (feet): 230
    - b. Minimum capacity at rated head (gpm): 90
    - c. Minimum shutoff head (feet): 270
    - d. Maximum shutoff head (feet): 350
    - e. Normal operating head range (feet): 210 – 240
    - f. Minimum efficiency at rated point (%): 60
    - g. Maximum motor nameplate horsepower: 10
    - h. Maximum required NPSH at any point in normal operating head range (feet): 20

## 2.6. PUMPS

### A. Materials

1. Casing and frame: Cast iron
2. Wear ring: Cast iron or stainless steel
3. Impeller: Cast iron or stainless steel
4. Shaft: Carbon steel or stainless steel
5. Shaft sleeve: Stainless steel
6. Bearings: Anti-friction, heavy-duty
7. Base: Cast iron or stainless steel

### B. Fabrication and Manufacture

1. Casing
  - a. Parts to have registered fit for alignment
  - b. Nozzles: ANSI flanged
    - 1) Minimum suction nozzle size: 2"
    - 2) Minimum discharge nozzle size: 2"
  - c. Pipe tapped openings with plugs for draining, priming and venting the casing
  - d. Water passages smooth to permit maximum efficiency
2. Impellers
  - a. One piece casting completely machined on all exterior surfaces
  - b. Statically balanced
  - c. Keyed and locked to shaft with self-locking or pinned nonclog type fastener
  - d. Uniform sections and smooth surfaces free from obstructions, cracks, and porosity on interior water passages
3. Shaft and shaft sleeves
  - a. Shaft completely machined
  - b. Shaft deflection at mechanical seal not more than 0.002" at any operating head
  - c. Sleeve positively locked against rotation and axial movements
  - d. Sleeves sealed to prevent leakage between shaft and sleeve
  - e. Shaft coupling: Cast iron or ductile iron

4. Wearing rings
  - a. Provide renewable wearing rings in casing
  - b. Design clearance at least 1 mil/inch of ring diameter
  - c. Ring positively locked in place
5. Mechanical seal
  - a. Field replaceable
  - b. Metal components: 316 stainless steel
  - c. Stationary face: Silicon carbide with graphite
  - d. Rotary face: Silicon carbide
  - e. Elastomers: Viton or EPDM
6. Bearings
  - a. Antifriction type
  - b. Grease lubricated
  - c. AFBMA B-10 rating of 20,000 hours at specified operating conditions
  - d. Rated for maximum shaft speed
7. Motor
  - a. Totally enclosed fan cooled (TEFC)
  - b. Power: 460 V, 3-phase, 60 Hz
  - c. Service factor: 1.15 minimum
  - d. Insulation: Class F
  - e. Motors to be sized for the elevation at location where equipment is to be installed
    - 1) Sized so that under maximum continuous load imposed by driven equipment the motor nameplate horsepower will not be exceeded
  - f. Motors to be rated for continuous duty

## 2.7. VALVES AND ACCESSORIES

### A. Pump Check Valve

1. Silent check valves shall be installed on the discharge of each pump between the pump discharge and the pump isolation valve
2. Silent operating type that begins to close as the forward flow diminishes and is fully closed at zero velocity preventing flow reversal and resultant water hammer or shock
3. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 5.0 psi
4. All component parts shall be field replaceable without the need of special tools
5. Valve body: ASTM A126 Class B cast iron
6. Seat and disc: Bronze with resilient sealing
7. Compression spring: Stainless steel
8. Pressure rating: 250 psi
9. Check valve shall be as manufactured by Flomatic or equal

### B. Pump Discharge Isolation Valves

1. Pump isolation valves shall be ball or butterfly type
2. Refer to Section 02641 for detailed requirements

### C. Pressure Relief Valve

1. Pilot operated modulating pressure relief valve
2. Valve body shall be ductile iron with 125-lb inlet and outlet flanges and shall be rated for 250 psi
3. Set 10 to 15 psi above operating pressure to relieve when inlet pressure exceeds spring setting on pilot
4. Valve shall be quick opening and slow closing to minimize surging
5. The relief valve shall work solely as a safety for over pressure relief and shall not function as a normal part of the station controls
6. Discharge of relief valve shall be piped back to the UV channel
7. A wye strainer shall be installed in the inlet side of the valve body to provide clean water to the CRL pilot
8. A ball or butterfly type valve shall be installed on the inlet side of the relief valve
9. Relief valve shall be as manufactured by CLA-VAL or equal

### D. Pressure Gauge

1. A pressure gauge shall be mounted on both the suction and discharge headers with a ½-inch isolation ball valve
2. All gauges shall be glycerin silicon filled to reduce wear due to vibration
3. Accuracy shall be within 2%. Gauge diameter shall be 3½" minimum
4. Range shall be at least 50% higher than the highest pressure attainable from the pumps at shutoff head conditions
5. The gauge shall incorporate a stainless steel back and bronze internals
6. Pressure gauge shall be as manufactured by Wika or equal

### E. Hydropneumatic Tank

1. Diaphragm or bladder type tank to maintain system operating pressures at low flows
2. Welded steel tank constructed, tested and stamped in accordance with the ASME Boiler and Pressure Vessel Code
3. Provide charging valve connection with double-seal cap
  - a. Provide air pressure gauge
4. Factory air pre-charged and field adjustable
5. Integral support base for vertical installation
6. Provide isolation ball valves as shown on Drawings
7. Working pressure: 250 psig
8. Diaphragm or bladder: EPDM or heavy-duty butyl
9. System connection size: ¾-inch minimum
10. Tank volume: 53 gallons minimum
11. Tank shall be as manufactured by Amtrol, Inc., or equal

## 2.8. PIPING

### A. General

1. Station piping: Carbon steel or stainless steel, manufacturer's option
2. Fittings and connections: NPT or flanged

3. Refer to Division 2 for detailed pipe and fitting specifications
4. Exterior surfaces of pipe and fittings shall be coated in accordance with the requirements of this section and Section 09900

## 2.9. ELECTRICAL SYSTEM

### A. General

1. Provide complete instrumentation and controls to automatically start, stop and modulate pump speed(s) to smoothly, efficiently and reliably pump variable flow rates at a constant discharge pressure
2. Full alarms and safety features needed to protect the equipment and non-potable water piping system
3. All electrical controls shall be U.L. listed as an Industrial Control Device
4. Power supply: 480V, 3-phase, 60 Hz

### B. Electrical and Control Enclosure

1. NEMA 4 enclosure with integral latches
2. Enclosure shall be constructed of 12 gauge steel minimum
3. Painted as specified in this section and Section 09900
4. All indicating lights, reset buttons, speed potentiometer, selector switches and the operator interface device shall be mounted on enclosure door and be rated NEMA 4X
5. All internal components shall be mounted and secured to the removable back plate assembly
6. Provide additional features and cooling methods as required for proper operation of VFDs and other equipment in previously stated environmental conditions
  - a. Maintain VFD operating environment temperature below 40°C
7. No water line connections shall be permitted inside of the control enclosure
8. VFD status and internal parameters must be viewable without the opening of the enclosure door

### C. Codes

1. Panel with controls shall be built in accordance with NEC and UL standards
2. Pump station including electrical components and enclosure shall be labeled as a complete UL Listed assembly with manufacturer's UL label applied to the pump station
3. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification
4. All adjustments and maintenance shall be able to be conducted from the front of the control enclosure
5. Complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided
6. Main disconnect shall be interlocked with the enclosure door
7. Enclosure shall be lockable
8. Provide surge arrester to protect all electrical equipment from voltage surges on incoming power

#### D. Main Disconnect

1. A non-fusible main disconnect capable of being locked in the Off position shall be provided to completely isolate all controls and motor starting equipment from incoming power
2. Main disconnect shall have a through the door operator, and shall be sized as required for all connected loads
3. Disconnect shall be as manufactured by Cutler Hammer or equal

#### E. Control Power

1. Power for the controls shall be provided by a control power transformer to provide low voltage, single-phase power for the pumping system control operation
2. Control power transformer shall not be used for any external load
3. Control power transformer shall be protected on the primary side by current limiting fuses of adequate size and voltage rating
4. All control components to be protected by time delay circuit breakers of adequate size

#### F. Variable Frequency Drive

1. Variable speed drives may be integral to the pump motor or provided as separate units
2. Refer to Section 16269 for detailed requirements

#### G. Pressure Transducer

1. Pressure transducer shall be utilized for providing all pressure signals for the control logic and indication
2. Pressure transducer shall be a solid-state type with a 4-20 mA output signal
3. Pressure transducer shall be constructed of 316L stainless steel
4. Transducer shall be rated for station discharge pressure and shall provide gauge pressure output, rather than an absolute
5. Pressure transducer shall be as manufactured by Danfoss or equal

#### H. Liquid level Switch

1. Liquid level switch shall be provided for detection of low water levels in the suction manifold pipe
2. Switch shall be solid-state type with 0.5 second delay and dry contact output
3. Switch shall be constructed of 316 stainless steel
4. Switch shall be as manufactured by Omega Engineering, Inc. or equal

#### I. Controller

1. Provide an industrial grade microprocessor-based controller or programmable logic controller (PLC) for complete system automation and control
2. Provide user interface display with a minimum screen size of 3½" x 4½" for field programming and viewing of system status parameters

3. Password protection shall be provided for all system settings and configurations
4. The controller shall provide demand controlled sequential pump start and shutdown through its sensing instruments and programmed safety features
5. All logic for system automation, timing and control of VFD speed shall be handled by the controller
6. Control software shall be parameter driven, fully documented and allow for user-friendly alteration of all operational parameters
7. The primary control parameter for station operation shall be discharge pressure
8. Controller and enclosure shall be completely prewired and factory tested prior to shipment
9. The controller display shall provide the following status items
  - a. Current setpoint value for discharge pressure control parameter
  - b. System status
  - c. Individual pump status
  - d. Individual pump rotative speed (indicated as a percentage %)
  - e. Most recent existing alarm
10. Pump system control programming shall provide, as a minimum, the following field adjustable parameters
  - a. Discharge pressure setpoint
  - b. Low suction pressure warning setpoint (from analog signal, for future use)
  - c. Low suction pressure shutdown setpoint (from analog signal, for future use)
  - d. Pressure transducer configuration (analog signal supply and range)
  - e. Low suction water level/pressure configuration (analog versus digital)
  - f. Low suction water level shutdown setpoint (from digital contact)
  - g. High discharge pressure setpoint
  - h. Low discharge pressure setpoint
11. The controller shall be provided with the following minimum inputs and outputs
  - a. Digital inputs
    - 1) Low suction water level
    - 2) Remote On/Off
    - 3) Spare
  - b. Analog inputs (4-20 mA)
    - 1) Discharge pressure
    - 2) Suction pressure
    - 3) Spare
  - c. Minimum digital outputs for SCADA system monitoring
    - 1) System run status
    - 2) System fault
12. The controller shall be capable of sensing and displaying the following alarm conditions
  - a. High discharge pressure
  - b. Low suction water level
  - c. Low suction pressure warning (for future use)
  - d. Low suction pressure shutdown (for future use)
  - e. VFD fault
  - f. Low discharge pressure
  - g. Loss of control parameter signal (discharge pressure)
  - h. Individual pump fault
  - i. System power loss

13. The controller shall be capable of storing a minimum of 10 alarm instances in memory. All alarm instances shall be time and date stamped for recording
14. The controller shall be provided with the following minimum pilot and control devices
  - a. Individual pump run lights: Green
  - b. Individual pump fault lights: Red
  - c. Individual pump hour meter/run time meter
  - d. System power indicating light: White

## 2.10. SEQUENCE OF OPERATION

- A. The system and controller shall be designed to operate the variable speed pumps to maintain the desired control parameter setpoint, which is system discharge pressure. The controller shall receive an analog signal from the pressure transducer installed on the discharge manifold piping which indicates actual system discharge pressure. As system flow demand changes, the controller will automatically adjust pump speeds to maintain the system discharge pressure setpoint.
- B. When flow demand increases, the operating pump(s) speed will be increased. When the operating pump(s) reaches full speed, an additional pump will be started and will increase in speed until the system discharge pressure setpoint is achieved. When the actual system discharge pressure is equal to the setpoint value, all pumps in operation shall maintain current speed settings.
- C. As flow demand decreases, the operating pump(s) speed shall be reduced to maintain the system discharge pressure setpoint. If the actual system discharge pressure remains above the setpoint with multiple pumps operating, the system will switch off pumps sequentially as fewer pumps are required to maintain the system setpoint.
- D. The system controller shall be capable of switching pumps on and off automatically to satisfy the system demand based on the discharge pressure and programmed setpoint. All pumps in the system shall alternate automatically in their sequence based on demand events (On/Off), time interval or fault event. If the flow demand is continuous and a pump shutdown does not occur, the system controller shall have the capability to alternate the operating sequencing of the pumps at a field adjustable time interval. This time interval shall be a minimum of 24 hours and a maximum of one week.
- E. The system controller shall be provided with a low flow stop function. During periods of low-flow or zero-flow, the controller shall be capable of stopping the operating pump. A low flow condition may be triggered by a separate flow switch signal or through an adjustable pump stop speed initially set at 60% of full speed and an adjustable stop pump timer initially set at 10 seconds. The pump shall remain off until the discharge pressure drops to the start pressure point. The restart of the system following a low flow shutdown shall be automatic.

## 2.11. SPARE PARTS

- A. The following spare parts shall be furnished for each pump

1. One set of gaskets
2. One set of wearing rings
3. One mechanical seal assembly
4. One complete set of pump bearings

## 2.12. PAINTING AND COATINGS

- A. All surfaces to be painted or coated except
  1. Stainless steel
  2. Aluminum
  3. Galvanized
  4. Nickel or chromium
  5. Rubber and plastic
- B. All surfaces to receive prime, intermediate and/or finish painting or coating at the factory
- C. Surface Preparation
  1. Non-immersion service: Steel Structures Painting Council (SSPC) – SP6 Commercial Blast Cleaning
  2. Immersion service: Steel Structures Painting Council (SSPC) – SP10 Near White Blast Cleaning
- D. Painting or Coating System
  1. Manufacturer's standard epoxy coating system, Tnemec Series N69, or equivalent
  2. Use only mercury-free, lead-free, fume-proof paint or coatings
  3. Paint or coatings must be suitable for wet environments
- E. Refer to Section 01600 for additional requirements

## PART 3 - EXECUTION

### 3.1. FACTORY TESTING

- A. All factory testing shall be performed on the complete assembled package pump station by the manufacturer or supplier in factory controlled conditions
- B. Perform all manufacturer's standard battery of tests
- C. Operate station through control scenarios that run all pumps sequentially through increasing demand, then turn off pumps sequentially through decreasing demand to ensure proper speed variation and on/off cycling of pumps
  1. Repeat test cycling through control scenarios a minimum of three (3) times
  2. Minimum total run time for each test cycling of 30 minutes

- D. All tests to have satisfactory results before equipment can be shipped to jobsite
- E. Repeat all tests as necessary until satisfactory results are obtained
- F. Provide written report of all factory testing including any deficiencies, modifications, corrections, etc.

### 3.2. PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 for requirements

### 3.3. INSTALLATION

#### A. Inspection

1. Inspect materials and equipment for signs of damage, pitting, rust, decay or other deleterious effects of storage, transportation, handling, etc.
  - a. Replace or repair any materials or equipment showing such effects to the satisfaction of the Engineer and Owner
  - b. Replace damaged materials or equipment with identical new materials or equipment

#### B. Equipment Installation

1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements and Hydraulic Institute Standards
  - a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner
  - b. Perform all work in accordance with manufacturer's instructions
    - 1) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents
    - 2) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding
  - c. Shimming between machined surface is not permitted
2. Accurately locate anchor bolts
  - a. Refer to Section 05501 for additional requirements
3. Level, plum and align unit into position to fit connecting piping
4. Grout pump base after initial fitting and alignment but before final bolting of connecting piping
5. Take care special care to maintain alignment of components
  - a. Correct any misalignment, noisy operation or other indication of improper setting
6. No strain to be transmitted to the pump connections
7. Test pump connections for piping stresses after final adjustment
  - a. Loosen connections
  - b. If any movement or opening of joints is observed, adjust piping to fit
  - c. Eliminate any stress between pump assembly and connecting piping

8. Remove all grease, dirt, excess paint, etc., from equipment surfaces prior to final acceptance
9. Take precautions, as necessary, to properly protect all equipment from damage
  - a. Installed equipment to be protected from further construction operations

C. Paint and Coatings

1. Recoat all coated surfaces damaged prior to product acceptance to the satisfaction of the Engineer and Owner
  - a. Use paint and/or coating materials identical to those used in the field and by the manufacturer for shop coating
  - b. Utilize surface preparation procedures as specified herein or as may be appropriate for repairs needed

D. Adjustment and Cleaning

1. Perform all required adjustments, tests, operational checks, cleaning and other procedures required for the preparation and performance of startup activities

### 3.4. FIELD TESTING

- A. Ensure all bearings and drive components are properly lubricated
- B. Make all necessary initial adjustments to put equipment into operation
- C. Test pump each unit to verify design operating heads and capacities are achieved
- D. Operate station through control scenarios that run all pumps sequentially through increasing demand, then turn off pumps sequentially through decreasing demand to ensure proper speed variation and on/off cycling of pumps
- E. Verify operational compatibility between instrumentation and system controller
- F. Perform all other manufacturer's standard battery of tests
- G. Equipment: No indication of binding, unusual loads, intermittent operation, vibration or other problems

### 3.5. FIELD QUALITY CONTROL

A. Provide Manufacturer's Field Service

1. Minimum two trips to project site at one-half (½) day each
2. Qualifications of manufacturer's representative
  - a. Authorized representative of the manufacturer
  - b. Experienced in the application and installation of the subject work, materials and equipment
3. Services provided by representative
  - a. Provide guidance regarding proper installation
  - b. Supervise installation of equipment furnished under this section

- c. Inspect, check, adjust and test equipment installed, as required, and approve final installation
  - d. Be present when equipment is placed in operation
  - e. Revisit site as often as required to correct all problems and until equipment installation and operation are acceptable to Engineer and Owner
4. Manufacturer's representative to instruct Owner's personnel in the operation and maintenance of the equipment furnished. Minimum one-half (½) day including classroom and field training. May be combined with startup services
- B. Furnish three (3) copies of written report to Engineer certifying that
1. Equipment is properly installed and lubricated
  2. Equipment is in accurate alignment and balance
  3. Equipment is free from any undue stress imposed by connecting piping, anchor bolts, etc.
  4. Equipment has operated satisfactorily under full load conditions and as specified through full operating range

### 3.6. INSTALLATION, OPERATION AND MAINTENANCE DATA

- A. Coordinate preparation, presentation and use of Operation and Maintenance Manual at installation check, startup and operator training
- B. Refer to requirements of Section 01730
- C. Preliminary and Final Manuals Required
  1. Printed and electronic media

END OF SECTION