SECTION 11215

VERTICAL TURBINE PUMPS

# GENERAL

## WORK INCLUDED

### This section includes materials, testing, and installation of vertical turbine water pumps.

## RELATED WORK

### Section 01300: Shop Drawings and Submittals

### Section 01400: Quality Control

### Section 01610: Product Requirements

### Section 01650: Product Delivery, Storage and Handling Requirements

### Section 01700: Execution Requirements

### Section 09800: Painting and Coating

### Section 15000: General Piping System and Appurtenances

## SYSTEM DESCRIPTION

### Furnish and install complete operating pumping system including pumps, motors and necessary appurtenances required by Contract Documents.

### Furnish and install anchor bolts and all appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with manufacturer’s installation requirements and compliance with applicable building codes and standards.

### Pump control system control variables shall be as required in Section 16480, Low Voltage Motor Control Center, of these specifications.

## QUALITY ASSURANCE

### Factory testing shall include the following

| **Item** | **Test for** | **Test Standard (ASTM or other test standard)** | **Frequency** | **First test paid for by** | **Retests paid for by** |
| --- | --- | --- | --- | --- | --- |
| Pump and motor assembly | Compliance with purchase order | Verify impeller, motor rating and electrical connections comply with Contract Documents | 1 each pump assembly | Contractor | Contractor |
| Motor no load current, full load current, winding resistance and high potential | NEMA Standards | 1 each motor | Contractor | Contractor |
| Lineshaft Straightness | ANSI B58.1 | 1 each lineshaft | Contractor | Contractor |
| Dynamic Balance | NEMA Method MGI 12.06 | 1 each pump assembly | Contractor | Contractor |
| Motor Heater |  | 1 each pump assembly | Contractor | Contractor |
| Test run to verify wear ring clearances and establish correct rotation and mechanical integrity | Test run | 1 each pump assembly | Contractor | Contractor |
|  | Certified Pump Curve | Witnessed running test per AWWA E101 and Hydraulic Institute Standards | One 30-minute test to prepare six-point curves for each pump assembly. On variable speed pumps, test each pump and prepare six-point curves at four 100 rpm increments. | Contractor (Includes lodging and travel expenses for 4 personnel from Owner’s and/or Design Engineer’s offices.) | Contractor (Includes lodging and travel expenses for 4 personnel from Owner’s and/or Design Engineer’s offices.) |
|  | Vibration/ Balancing | Witnessed running test with vibration analyzer per Hydraulic Institute Standards. |  |  |  |

### Testing shall be performed after final connection of the pump and motor and after completion of static and dynamic balancing.

### Where adjustable frequency drives are used, the project VFD shall be tested with the assembled project pump and motor to guarantee compatibility.

### If vibration levels fall outside of acceptable limits established by the Hydraulic Institute (HI), shut down the pump and correct for vibration before further testing. Vibration readings in factory may not be representative of the readings in the field. Pumping unit shall be field balanced if readings are outside the acceptable limits of the HI.

### Witness testing is required and shall be scheduled at least two weeks in advance of test dates.

## REFERENCES

### ASTM A36 Carbon Structural Steel

### ASTM A48 Gray Iron Castings

### AWWA E101 Vertical Turbine Pumps, Lineshaft and Submersible Types “Section A-6 Factory Inspection and Tests”

### Hydraulic Institute Standards

### NEMA Standards

## SUBMITTALS

### Furnish the following submittals.

| **Submittal** | **Description** |
| --- | --- |
| Shop Drawings | Required for pumps including, suction inlets, bowls, impellers, drive assemblies, shafts, bearings, seals, columns, shaft guards and discharge heads per Equipment Shop Drawing requirements of Sections 01300 and 15010. Show fabrication, assembly, foundation and installation requirements. |
| Required for motor and motor controls under Electrically Controlled Equipment Shop Drawing requirements of Sections 01300 and 15010. |
| Required for anchor bolts. Show placement, embedment, and edge distances as required by UBC. Show projections from concrete. |
| Catalog Data | Required per Catalog Data requirements of Sections 01300 and 15010. |
| Installation Instructions | Required per Installation or Application Instruction requirements of Sections 01300 and 15010. |
| O & M Instructions | Required per Operation and Maintenance Instruction requirements of Sections 01300, 01820 and 15010. |
| Certificate of Compliance | Submit pump system certification per Certificate of Compliance requirements of AWWA E101 and Sections 01300 and 15010. |
| Submit coating system certification per Certificate of Compliance requirements of Sections 01300 and 15010. |
| Manufacturer’s Statement of Responsibility | Required per Manufacturer’s Statement of Responsibility requirements of Sections 01300 and 15010. Include statement that the pumps installed comply with the Contract Documents. |
| Test Record Transcripts | Before shipping pumps, submit certified six-point pump curves for factory tests per Foundry or Test Record Transcript requirements of Sections 01300 and 15010. Where variable speed drives are provided, submit certified six-point pump curves in four 100 rpm increments throughout the operating range of the pump. Include a written report stating the date and location that the pumps were tested and certifying in accordance with AWWA E101 that the certified pump curves are accurate and comply with the specifications. |
| Before shipping pumps, submit certified vibration test report stating that pump and motor assembly has been tested and vibration falls within limits allowed by Hydraulic Institute Standards |
| Motor Data | Required per Motor Data requirements of Section 15010. Include mounting details |
| Testing procedures | Submit written test procedures in advance of all pump tests. |
| Warranty | Furnish 5-year 10,000 hour warranty from date of final acceptance for all units. Warranty shall bear appropriate identification numbers. |

## DELIVERY, STORAGE AND HANDLING

### Refer to Section 01650 for delivery storage and handling requirements.

### Manufacturer’s instruction and warranty requirements for delivery, storage and handling of pumps shall be strictly followed.

## UNIT PRICES

### Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto.

# MATERIALS

## ACCEPTABLE MANUFACTURERS

### Manufacturers shall be Goulds Xylem, Peerless Pump Company, Floway, American Marsh, or DISTRICT approved equal.

## pump MATERIALS

### Pumps shall comply with the requirements of Section 01610 Product Requirements.

### Pumps and attached motors shall be constructed of materials that conform to AWWA E101.

### Pumps and attached motors shall be rated for continuous duty and shall operate smoothly throughout their specified pumping range without surging, cavitation or vibration.

### Pumps shall be designed to operate safely in the reverse direction or rotation should fluid return through the pump at shutoff.

### Castings shall be free from blow holes, sand holes and all other flaws and shall be accurately machined and fitted to close tolerances.

### Lubrication of the well shaft shall conform to the following requirements:

#### Product Lube/Open Line Shaft

##### 10’ Column and shaft sections and bearing spacing

#### Water Flush/Enclosed Line Shaft

##### 20’ column and shaft sections with 5’ bearing spacing (enclosing tubes)

#### Oil Lube/Enclosed Line Shaft

##### 20’ column and shaft sections with 5’ bearing space (enclosing tubes)

### Pumps and motors shall be constructed of the following materials:

| **Item** | **Material** | **Specification** |
| --- | --- | --- |
| Vertical Turbine Pumps | Varies by part | AWWA E101 Table 1 |
| Suction and Discharge Flanges | Cast Iron | ANSI B16.1 Class 125 |
| Steel | ANSI B16.2 Class 150 |
| Pump Bowls | Stainless Steel 304 | Class 30 |
| Bowl Lining | Vitreous enamel |  |
| Impellers | Stainless Steel or Bronze | 316SS or Aluminum Bronze |
| Wearing Rings on Bowls and Impellers | Bronze & Stainless Steel |  |
| Column Pipe | Steel | ASTM A53 Grade A or ASTM A120; specify minimum wall thickness |
| Column Pipe Lining | Fusion Bonded Epoxy | AWWA and NSF requirements |
| Bowl Shaft | Stainless Steel | AISI Type 416 |
| Line Shaft | Stainless Steel | AISI Type 416 |
| Line Shaft Couplings | Stainless Steel | AISI Type 416 or 410 |
| Line Shaft Bearing Guide | Bronze or Neoprene | Bronze for enclosed lineshaft and Neoprene for open lineshaft |
| Discharge Head | Cast Iron | ASTM A48 Class 30 |
| Fabricated Steel | ASTM A36 |
| Motor Frames | Cast Iron | NEMA MG-1 |
| Motor Terminal Boxes | Cast Iron | ASTM A48 |
| Fasteners, bolts, cap screws, anchor bolts, nuts, washers and all external hardware | Stainless Steel | AISI Type 316 |
| Nameplates | Stainless Steel | Type 316 permanently attached to pump frame and motor frame with information impressed or embossed into plate |

### Pump nameplates shall show manufacturer’s name, model and serial number, rpm, horsepower, impeller diameter, capacity, head rating and NPSHR.

### Motor nameplates shall show manufacturer’s name model and serial number, rpm, horsepower, voltage, phase, full load current, locked rotor KVA code, motor type, frame, insulation class, centigrade degree rise and motor connection diagram.

### Provide duplicate nameplates to the Owner for each pump and motor provided.

### The following product design criteria, options and accessories are required for pumps:

| **Item** | **Description – Domestic Pumps (Each One)** | | | | |
| --- | --- | --- | --- | --- | --- |
| Pump Design Criteria |  | **Q (gpm)** | **TDH (ft)** | **Efficiency** | **HP** |
| **Shutoff** |  | xxx min | n/a | n/a |
| **A** | xxx | xxx | xx% min | xx max |
| **B (BEP)** | xxx | xxx | xx% min | xx max |
| **C** | xxx | xxx | xx% min | xx max |
| Net Positive Suction Head Available NPSHA | * XX ft. min. | | | | |
| Pump Speed | * XXXX rpm | | | | |
| Suction Can | * ¼"-wall thickness steel minimum * Provide XX inches between bottom of suction bell and invert of suction can. | | | | |
| Bowls | * Suction case shall be bell mouthed, properly veined to permit uniform entrance of fluid into impeller eye. * Provide one bearing on each side of every impeller * Suction case bearing shall be fully enclosed and protected from sand and abrasives. * Lower guide shall support weight of impeller and shaft when dismantling pump. | | | | |
| Impellers | * Enclosed type * Accurately fitted, dynamically balanced and secured to impeller in such manner that impellers cannot loosen in service but can be manually removed without damaging the bowl shaft. | | | | |
| Mechanical Seals | * AES Type | | | | |
| Column Pipe | * XX” wall thickness with welded steel flanges * Size column pipe to limit head loss to less than 5 feet per 100 feet at rated BEP capacity of pump * Constructed of interchangeable sections not over 5 feet long | | | | |
| Lineshaft | * Enclosed for well pumps, open for sump or can pumps * Constructed of interchangeable sections not over 5 feet long * Designed per AWWA E101 and ANSI B58.1 for expected full load horsepower, torque and thrust * Upper end of lineshaft shall be machined to allow adjustment of impeller setting to properly center impellers in bowls. | | | | |
| Lineshaft Couplings | * Threaded, machined from solid bar stock | | | | |
| Bearing Guides | * Space at 5-foot maximum intervals | | | | |
| Discharge Head | * Above ground * Design discharge head to withstand all loads due to thrust or weight of hanging elements. * Design for 150% of pump discharge pressure at shutoff. * Provide lifting lugs designed to permit lifting of assembled pump, column, discharge head and motor. * Provide access to shaft couplings and mechanical seal with hinged guard plate. * Provide drilling and tapping for air release valve on suction can and for pressure gauge connection. | | | | |
| Headshaft Coupling | * Provide spacer coupling for VSS motors or Threaded for VHS motors | | | | |
| Static and dynamic balance/ Finite Element Analysis for VFD applications. | * Required for all rotating elements after motor has been mounted on pump for shipping. Mass and rotating moment of inertia shall be such that resonant harmonics do not occur within the normal operating speed range. Ratio of rotative speed to critical speed of pumping unit or components thereof shall be less than X.X or more than X.X. | | | | |
| Guards | * Provide hinged guard plates over all exposed couplings, drives and shafts in compliance with requirements of State of California Department of Industrial Relations, Division of Safety | | | | |

| **Item** | **Description – Fire Flow Pump** | | | | |
| --- | --- | --- | --- | --- | --- |
| Pump Design Criteria |  | **Q (gpm)** | **TDH (ft)** | **Efficiency** | **HP** |
| **Shutoff** | 0 | xxx min | n/a | n/a |
| **A** | xxxx | xxx | xx% min | xxx max |
| **B (BEP)** | xxxx | xxx | xx% min | xxx max |
| **C** | xxxx | xxx | xx% min | xxx max |
| Net Positive Suction Head Available NPSHA | * XX ft. min. | | | | |
| Pump Speed | * XX rpm | | | | |
| Suction Can | * ¼"-wall thickness steel minimum * Provide XX inches between bottom of suction bell and invert of suction can. | | | | |
| Bowls | * Suction case shall be bell mouthed, properly veined to permit uniform entrance of fluid into impeller eye. * Provide one bearing on each side of every impeller * Suction case bearing shall be fully enclosed and protected from sand and abrasives. * Lower guide shall support weight of impeller and shaft when dismantling pump. | | | | |
| Impellers | * Enclosed type * Accurately fitted, dynamically balanced and secured to impeller in such manner that impellers cannot loosen in service but can be manually removed without damaging the bowl shaft. | | | | |
| Mechanical Seals | * AES Type | | | | |
| Column Pipe | * X/X” wall thickness with welded steel flanges * Size column pipe to limit head loss to less than 5 feet per 100 feet at rated BEP capacity of pump * Constructed of interchangeable sections not over 5 feet long | | | | |
| Lineshaft | * Enclosed for well pumps or open for sump or can pumps. * Constructed of interchangeable sections not over 5 feet long * Designed per AWWA E101 and ANSI B58.1 for expected full load horsepower, torque and thrust * Upper end of lineshaft shall be machined to allow adjustment of impeller setting to properly center impellers in bowls. | | | | |
| Lineshaft Couplings | * Threaded, machined from solid bar stock | | | | |
| Bearing Guides | * Space at 5-foot maximum intervals | | | | |
| Discharge Head | * Above ground * Design discharge head to withstand all loads due to thrust or weight of hanging elements. * Design for 150% of pump discharge pressure at shutoff. * Provide lifting lugs designed to permit lifting of assembled pump, column, discharge head and motor. * Provide access to shaft couplings and mechanical seal with hinged guard plate. * Provide drilling and tapping for air release valve on suction can and for pressure gauge connection. | | | | |
| Headshaft Coupling | * Provide spacer coupling for VSS motors or Threaded for VHS motors | | | | |
| Static and dynamic balance/Finite Element Analysis for VFD applications. | * Required for all rotating elements after motor has been mounted on pump for shipping. Mass and rotating moment of inertia shall be such that resonant harmonics do not occur within the normal operating speed range. Ratio of rotative speed to critical speed of pumping unit or components thereof shall be less than X.X or more than X.X. | | | | |
| Guards | * Provide hinged guard plates over all exposed couplings, drives and shafts in compliance with requirements of State of California Department of Industrial Relations, Division of Safety | | | | |

### The following product design criteria, options and accessories are required for pump motors:

| **Item** | **Description** |
| --- | --- |
| Motors | * Squirrel cage induction type 460V/3-phase/60Hz * Premium efficiency * Continuous duty * [Vertical hollow] or [solid shaft] * Non reverse ratchet * NEMA Design B Temperature Rise * Rated for operation at [40°C] or [50°C] * 1.15 service factor * Insulate and brace windings for full voltage operation. * Provide automatic reset normally closed thermal protection switch per Spec 16150. * Motor nameplate horsepower shall not be exceeded anywhere on the pump curve. * Pumps and motors shall be dynamically balanced, tested and shipped as a unit. * Heater required for condensation. |
| Motor Bearings | * AFBMA B-10 life of 50,000 hours * Grease lubricated, prelubricated at factory * Bearings shall be locked and braced to prevent shaft movement and to withstand high thrust loads in all directions. * Use angular contact ball thrust bearings, spherical roller thrust bearings or plate thrust bearings as needed to meet required thrust loads and bearing life. |
| Motor Enclosure | * Totally Enclosed Fan Cooled required * Cast iron |
| Motor Terminal Boxes | * Suitably gasketed and bolted with adequate space for connections * Permanently mark motor leads in agreement with connection diagram. |

# EXECUTION

## PREPARATION

### Make field measurements needed to install pumps before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

## INSTALLATION

### Install pumps in accordance with the requirements of Section 01700 Execution Requirements, according to manufacturer’s installation and warranty requirements. Manufacturer’s requirements for installation, application, connection, erection, maintenance, operating, cleaning, conditioning and startup of products shall be strictly followed.

### Pumps shall be furnished and installed by the Contractor at the location shown on the Plans and Submittals.

### Install pumps to tolerances recommended by manufacturer. Unless otherwise shown, install pumps true and level using precision tools, gauges and levels.

### Refer variances between manufacturer’s installation instructions and Contract Documents to Owner’s Representative.

## FIELD QUALITY CONTROL

### Field testing shall conform to Section 01820 and also include the following:

| **Item** | **Test for** | **Test Standard**  **(ASTM or other test standard)** | **Frequency** | **First test paid for by** | **Retests paid for by** |
| --- | --- | --- | --- | --- | --- |
| Pumps and Motors | Field performance test to demonstrate compliance to Contract Documents and Manufacturers’ printed Literature | Hydraulic Institute Standards, ANSI/HI 9.6.4. Tests shall be witnessed by pump supplier’s factory authorized representative who shall certify that installed pumping system complies with Contract Documents and manufacturer’s warranty requirements. | See Section 01820 | Contractor | Contractor |
| Installation, Vibration & Leakage | Visual inspection of finished installation | 1 inspection | DISTRICT | DISTRICT Contractor |
| 11 month Warranty Inspection | Demonstrate compliance to Contract Documents and Manufacturers printed Literature | 1 test | DISTRICT | Contractor |

### Provide services of factory authorized representative on-site to witness and inspect startup of pump operation. Before startup, check all equipment for proper lubrication, alignment, rotation, freedom from excessive vibration. Factory authorized representative shall notify Contractor and Owner of any irregularities of installation which might render the manufacturer’s warrantee null and void.

### Conduct field performance test in presence of Owner’s Representative and Owner’s personnel after at least 24 hours of field operation have occurred to pre-test the system.

### In the event that field performance tests show excessive vibration or fail to demonstrate compliance with the requirements of the Contract Documents or the certified curves furnished, the Owner or DISTRICT shall have the right to decline acceptance of the failing pumps and require the Contractor to replace them.

## FIELD TRAINING OF OWNER’S PERSONNEL

### In addition to the above, provide services of pump manufacturer’s factory authorized representative on-site for a minimum of eight man-hours (travel time excluded) to provide classroom instruction of DISTRICT’s personnel in proper recommended lubrication, operation and maintenance procedures as well as procedures for proper lockout out of each energy source.

### The following handouts shall be provided by the manufacturer’s factory authorized representative to all attendees during classroom instruction:

##### Listing of any actions (or inactions) by the DISTRICT which would render the manufacturer’s warranty null and void.

##### Written description of proper lubrication procedures.

##### Written list of all required scheduled maintenance including recommended service intervals to ensure warrantee remains valid and to ensure equipment remains functional.

##### Written description of procedures for lockout of each energy source.

**END OF SECTION**