SECTION 11175

pumps, general

# GENERAL

## WORK OF THIS SECTION

### Specifies the general requirements for pumps, pumping appurtenances and special tools and spare parts.

### The Work also includes coordination of design, assembly, testing and installation.

### The Work of this Section applies to the Work of all specific pump Sections

## REFERENCE CODES AND STANDARDS

### Specifications and standards shall comply with Section 11000 and the following standards: AISI 1045 Steel

#### ASTM A48 – Standard Specification for Gray Iron Castings

#### ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

#### ASTM A216 – Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service

#### ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

#### ASTM A278 – Standard Specification for Gray Iron Castings for Pressure- Containing Parts for Temperatures Up to 650°F (350°C)

#### ASTM A322 – Standard Specification for Steel Bars, Alloy, Standard Grades ASTM A395 Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

#### ASTM A470 – Standard Specification for Vacuum-Treated Carbon and Alloy Forgings for Turbine Rotors and Shafts

#### ASTM A536 – Standard Specification for Ductile Iron Castings

#### ASTM A 576 – Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality ASTM A743 – Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion-Resistant for General Application

#### ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

#### ASTM B271 – Standard Specification for Copper-Base Alloy Centrifugal Castings

#### ASME B73.1 – Standard Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process

#### ASME B73.2 – Standard Specifications for Vertical In Line Centrifugal Pumps for Chemical Process

#### ASTM E448 – Standard Practice for Scleroscope Hardness Testing of Metallic Materials

#### AWWA E101 – Vertical Turbine Pumps - Line Shaft and Submersible Types

#### AWWA E102 – Submersible Vertical Turbine Pumps

#### AWWA E103 – Horizontal and Vertical Line-Shaft Pumps

#### HI 1.6 – Centrifugal Horizontal Pump Tests

#### Hi 2.6 – Centrifugal Vertical Pump Tests

#### HI 3.6 – Rotary Pump Tests

#### HI 9.6.3 – Centrifugal and Vertical Pumps, Allowable Operating Region

#### HI 9.6.4 – Rotodynamic Pumps for Vibration Measurements and Allowable Values

## DEFINITIONS

### Terminology pertaining to pumping unit performance and construction shall be in accordance with the nomenclature and definitions of the Hydraulic Institute Standards and of AWWA E series standards, as applicable.

## SUBMITTALS

### Submittals shall comply with Sections 01300 and 11000 and shall include the following:

#### Manufacturer’s pump curves showing performance characteristics with pump and system operating point plotted and Net Positive Suction Head Required (NPSHR) curve where applicable.

#### Manufacturer’s recommended operating range for stable and efficient operation and prevention of surge, cavitation and vibration, including critical speed and mass elastic system analysis. For centrifugal pumps, on the pump curves shall be indicated Best Efficiency Point (BEP), Preferred Operating Region (POR) and Acceptable Operating Region (AOR) as defined in the HI 9.6.3 Centrifugal and Vertical Pumps

#### Electrical data including control wiring and motor data.

#### Device wiring diagrams and panel arrangement and wiring diagrams. Panel data shall include complete device list with manufacturer’s names and proof of certification.

#### Structural design calculations signed and sealed by a registered Professional Civil/Structural Engineer in the State of California for each equipment anchoring system. See Section 11000, paragraph 2.03 B. & C. requirements.

## O&M MANUAL

### In addition to the requirements of Sections 01660 and 11000, the following shall be submitted in compliance with Section 01300:

#### Manufacturer’s written guarantee that pumping equipment operates with efficiencies, heads and flow ranges indicated and meets vibration and critical speed limitations indicated.

## SERVICES OF MANUFACTURER

### Services of manufacturer shall be provided in accordance with Section 11000 and as indicated in specific pump sections and in compliance with Sections 01680 and 01660.

## FACTORY TESTING

### **Performance Curves:** Centrifugal pumps shall have a continuously rising curve from the run out toward the shut-off head and in no case the required horsepower at any point on the performance curve shall exceed the rated horsepower of the motor, unless otherwise specified on specific pump Sections. The rated condition of the pump shall lie to the right of the best efficiency point on the pump curve.

### **Equipment Testing:** Pumps and motors shall be factory tested as follows:

#### Pump Systems:

##### Tests shall be performed in accordance with the Hydraulic Institute standard for centrifugal horizontal (HI 1.6), centrifugal vertical (HI 2.6), rotary (HI 3.6), and reciprocating pumps, and test data shall be recorded.

##### Tests shall be performed on all project pump and motors of sizes 5 hp and larger. Prototype model tests will not be acceptable. Pump systems VFD driven shall be factory test with manufacturer’s shop VFD.

##### For pump systems smaller than 5 hp, standard manufacturer test shall be acceptable.

#### Test data shall include the following:

##### All units: Test results shall be recorded on data sheets, complying with the Hydraulic Institute, and data sheets shall be signed, dated, and certified.

###### Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.

###### Test curves shall cover the full range of operation from shutoff to maximum capacity.

###### Each plot shall show pump serial number, model number, impeller trim, project specific tag number as shown in the contract documents, manufacturer representative name, address and contact information’s (phone and e-mail).

##### Constant speed units:

###### Hydraulic test with a 5 equally spaced readings between shutoff head and pump maximum allowable capacity.

##### Variable speed units:

###### Hydraulic test at maximum and minimum expected operating speeds with 5 equally spaced readings between shutoff head and maximum allowable capacity.

##### Certified pump curves shall be included in the submittal showing head versus flow; efficiency versus flow; brake horse power versus flow; net positive suction head required (NPSHR) versus flow, best efficiency point (BEP), recommended operating region (ROR) and acceptable operating region (AOR).

##### Certification that the pump hp demand will not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve, unless otherwise stated on the specific pump section.

#### **Factory Tests of Motors:** Pump electric motor shall be tested in compliance with Section 16460.

#### **Factory Witnessed Tests:** Pumps and motors 150 hp and larger shall be factory tested as complete, assembled units and witnessed by the OWNER and OWNER’S REPRESENTATIVE, at the option of either. The Contractor shall be responsible for cost of travel and lodging for OWNER’S REPRESENTATIVES (three persons) to witness the test in accordance with Section 01400, Paragraph 1.03 D.

#### In the event of failure of any pump to meet any of the above requirements or efficiencies, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and such pump shall be retested at no additional cost to the OWNER, until found satisfactory.

#### The Contractor shall submit a sketch of the proposed test setup, along with a description of the proposed testing procedure to the OWNER’S REPRESENTATIVES for acceptance at least 10 weeks in advance of the proposed test date. No tests shall be performed until the test procedure is approved by OWNER’S REPRESENTATIVES. In addition, the Contractor shall furnish the OWNER’S REPRESENTATIVES with at least 28 calendar days advance written notice of the date and location of the performance tests.

#### Test results (both test logs and performance curves) shall be signed and certified by a registered Professional Engineer.

#### Upon completion of testing, curves shall be produced showing pump performance (head, efficiency, power, manufacturer standard NPSHR, best efficiency point (BEP), recommended operating region (ROR) and acceptable operating region (AOR) at full speed and predicted performance at speeds required to meet all other indicated operating conditions. Test logs and curves shall be provided to the OWNER’S REPRESENTATIVES as product data. The pumps shall not be shipped until authorized, in writing, by the OWNER’S REPRESENTATIVES. Final acceptance of the equipment will depend on satisfactory operation after installation.

## PUMPS WARRANTY

### Pumps warranty shall be in compliance with Section 11000 and specific section requirements.

# PRODUCTS

## GENERAL

### **General:** Pumping equipment shall comply with Section 11000.

### The Contractor shall provide all external VFD’s (if equipment is provided with its own control panel, the VFD shall be provided by equipment manufacturer and shall be installed in the control panel) in compliance with Section 16455, unless otherwise specified in the equipment specification section. The Contractor shall coordinate with Pump and VFD manufacturers for matching the pump/pump motor and VFD based on the type of loads, electric motor and VFD.

### **Combinations of Equipment:** Pumping equipment shall be new, of current manufacture, and shall incorporate all necessary mechanisms, couplings, electric motor and drives, appurtenances, and mounting.

### **Quality:** Where two or more units of the same type and/or size are indicated, the units shall all be manufactured by the same manufacturer.

### **Tools:** Tools shall comply with Section 11000, Paragraph 2.18, and shall include one pressure grease gun for each type of grease required for pumps and motors.

### **Spare Parts:** Spare parts shall include for each pump group of like units one complete set of seals, packing, gaskets, wear rings, and all parts indicated in individual pump Sections.

### **Nameplates:** Nameplates shall comply with Section 11000 Paragraph 2.19 and shall indicate rated head and flow, impeller size and pump speed.

## MATERIALS

### **General:** Materials used in the pumping equipment shall be suitable for the intended application and shall be free from defects. Pumps shall be protected with coatings in accordance with Section 09800. Unless otherwise indicated, pump materials shall conform to the following requirements:

#### **Cast Iron Pump Casings and Bowls:** close grain gray cast iron conforming to ASTM A48 (with 2 to 3 percent nickel added for raw sewage applications).

#### **Ductile Iron Pump Casings and Bowls (where indicated):** shall be ductile cast iron conforming to ASTM A395 or ASTM A536 (as specified on the pumps individual specification Sections) with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics.

#### **Pump Impellers:** Cast iron, ductile iron, bronze, or stainless steel.

#### **Stainless Steel Pump Shafts:** Type 400; Type 316 for sewage applications.

#### **Miscellaneous Stainless Steel Parts:** Type 316.

#### All bolts dimensions shall comply with ASME B18.2.1 and bolts’ material shall comply with ASTM A193 B8M Class 2 stainless steel AISI 316; all nuts’ dimensions shall comply with ASME B18.2.2 and nuts’ material shall comply with ASTM A194 8M stainless steel AISI 316.

## ACCESSORIES

### **Solenoid Valves:** Pumps shall include solenoid valves and pressure/flow switches installed at the inlet of water, oil lubrication, and cooling water connections. Union connections shall be provided both upstream and downstream for ease of valve replacement. Solenoid valve electrical ratings shall be compatible with the motor control voltage or as indicated. Solenoid valves shall be as specified in Section 15112.

### **Pressure Gauges:** Pressure gauges shall be installed at pump suction and discharge lines except sump pumps and hot water circulating pumps. Pressure gauges shall comply with Section 13320 and shall be mounted at locations selected to minimize the effect of vibrations.

### **Pump Suctions:** Compound gauges shall be installed at pump suctions and where subject to shock or vibrations, the pressure gauges shall be wall-mounted or attached to channel floor stands and connected to the pump by means of flexible connectors.

### **Variable Speed Drives:** Where indicated, variable speed drives, drive motors, speed control equipment, and accessories shall comply with Section 16455.

### **Local Control Panels:** The NEMA rating of local control panels shall comply with the area designations of Section 16050, unless indicated otherwise. Local control panels shall conform to the requirements of Section 16050 – Electrical Work, General; Section 16120 – Wires and Cables; 16485 – Unit Control Panels.

### **Lifting Eyes:** Pumps shall be provided with the appropriate lifting eyes to permit removal and/or disassembly.

### **Motors:** Electric motors shall be provided in accordance with the requirements of Section 16460.

## PUMP REQUIREMENTS

### Pumps shall comply with the following:

#### **Lubrication:** Except as otherwise indicated, line shaft bearings of vertical turbine, mixed flow, and propeller pumps shall be process water (PRW)-lubricated and pumps with enclosed line shafts shall have PRW or oil-lubricated bearings and seals.

#### **Handholes:** Handholes on pump casings or suction spools shall be designed to follow the contours of the casing to avoid any obstructions in the water passage.

#### **Vortex Suppressors:** Pumps shall include vortex suppressors as shown on the drawings.

#### **Drains:** Gland seals, air valves, and cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor drain, with Type 316 stainless steel tubing/pipe.

#### **Grease Lubrication:** Bowl bearing of vertical propeller, mixed-flow, or turbine pump, (other than deep well pumps), may be grease lubricated, in lieu of water lubrication subject to ENGINEER’s approval. Manufacturer shall furnish a stainless steel tube designed for lubrication of bottom bearing.

#### Mechanical Seals:

##### Mechanical seal shall be of a non-destructive (non-fretting) type which requires no wearing sleeve for the shaft. Shafts for pumps with mechanical seals shall be furnished with no reduction in size through the seal area. Mechanical seals shall be cartridge type in compliance with each specific section, AESCURC or AESSCUSI as applicable. Metal parts shall be Type 316 stainless steel-. Rotary faces shall be tungsten carbide. Stationary faces shall be ceramic or silicon carbide.

##### Submersible and immersible pumps mechanical seal shall be cartridge one piece tandem type, as specified in the individual equipment section.

##### Mechanical seals for overhung shaft, constant speed pumps and split case, centrifugal pumps shall be cartridge self-aligning, single rotary type.

##### Mechanical seals for variable speed, overhung shaft pumps shall be cartridge double balanced, self-aligning type.

##### Boxes for mechanical seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for installation of clean water barrier fluid supply piping.

#### Mechanical Seal Flushing:

##### Mechanical seal flushing flow/pressure, valve and instruments specified and/or shown for the proposed pumps are in accordance with the best of information available at the moment of design. The Contractor shall provide mechanical seal flushing system per selected pump manufacturer recommendations.

### Bearing Temperatures: Where possible, the bearing temperature at the worst loading condition and ambient temperature shall not exceed 150 degrees F. Where this is not possible, all exposed bearings shall be effectively shielded with permanent metal safety guards to prevent accidental contact by operators.

# EXECUTION

## GENERAL

### Unless otherwise indicated, execution of Work, including by not necessarily limited to fabrication, equipment protection, installation, field testing, protective coatings, lubricants, and cleaning, shall comply with Section 11000.

## INSTALLATION

### Installation shall comply with the manufacturer’s written instructions and Section 11000, Part 3.

## FIELD TESTING

### Field testing shall be provided in accordance with Section 11000 and as indicated in this Section and specific pump Sections.

### All pumping units shall be field tested after installation to demonstrate proper operation, without excessive noise, vibration, cavitation, or overheating of bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer, who shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and shall witness the following:

#### Startup, checking, and operation of the equipment over the entire speed range. The vibration shall be within the amplitude limits recommended in the Hydraulic Institute HI 9.6.4 Standard latest edition and vibration amplitude shall be recorded at a minimum of 4 pumping conditions which have been reviewed by the OWNER’S REPRESENTATIVES. Equipment manufacturer shall certify proper installation prior to start-up.

#### Documentation of pump performance by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head, for at least 4 pumping conditions at the respective pump rpm. Each power lead to the motor shall be checked for proper current balance.

#### Determination of bearing temperatures by a contact-type thermometer. A running time of at least 60 minutes shall be maintained for this test, unless liquid volume available is insufficient for a complete test.

#### Ensure that electrical and instrumentation testing complies with Divisions 13 and16 Sections.

END OF SECTION