

**SECTION 11311**  
**HORIZONTAL SPLIT CASE PUMPS**  
Revised April 3, 2015

**PART 1: GENERAL**

**1.01 SCOPE OF WORK**

- A. Furnish all labor, materials, equipment and incidentals required and install **Two (2)** horizontal split case pumping units equipped complete, as shown on the drawings and as specified herein. **Pump construction shall meet the Clean Water Act of 2014.**
- B. Horizontal split case pumps. Each unit shall be furnished with a pump and driver. Drivers are to be mounted on a structural steel heavy-duty base and connected to the pump with a flexible coupling.
- C. All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this specification or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation, and maintenance of the equipment.
- D. The Contractor shall require the pump and motor manufacturer to coordinate his design with the supplier of the variable frequency drives. (If VFD's are required)

**1.02 RELATED WORK**

- A. Concrete work and the installation of anchor bolts are included in Division 3; however, anchor bolts for these units shall be furnished under this Section.
- B. Field painting is included in Section 09900
- C. Electrical work except as hereinafter specified is included in Division 16100.
- D. Valves, mechanical piping, piping appurtenances, pipe hangers, and pipe supports are included in Sections 02665 & 15094.

**1.03 SUBMITTALS**

- A. Shop drawings and product data, in accordance with Section 01340, shall include the following:
  - 1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
  - 2. Certified foundation, pump support, and anchor bolt plans and details.

3. Schematic electrical wiring diagram and other data as required for complete pump installation.
4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detail specifications.
5. Total weight of pumping unit.
6. A statement of guarantee that the critical speed analyses as required under Paragraph 1.05E have been completed and that the specified limitations will be met.
7. A schedule of the date of shop testing and delivery of the equipment to the job site.
8. A statement that the pump will function properly as installed with respect to the suction piping layout as shown on the drawings.

B. Design Data

1. Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, head, brake horsepower, efficiency and guaranteed net positive suction head required (NPSHR). Variable speed curves shall be provided showing at least four speeds plotted equally from maximum rpm to minimum RPM. Minimum RPM shall be no less than that required to obtain minimum flow. Curves shall show the full-recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.

C. Test Reports

1. Certified motor test data as described in Electrical specifications, if any.
2. Tabulated data for the drive motors including rated HP, full load RPM, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and KW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply from the variable frequency drives to be furnished without affecting their design life for bearings or windings.
3. Description of pump factory test procedures, equipment, and a copy of final report when available.

D. Operation and Maintenance Data

1. Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications. The maintenance instructions shall include trouble shooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

#### **1.04 REFERENCE STANDARDS**

- A. Design, manufacturing and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:
1. American Gear Manufacturers Association (AGMA)
  2. American Institute of Steel Construction (AISC)
  3. American Iron and Steel Institute (AISI)
  4. American Society of Mechanical Engineers (ASME)
  5. American National Standards Institute (ANSI)
  6. American Society for Testing and Materials (ASTM)
  7. American Welding Society (AWS)
  8. Anti-Friction Bearing Manufacturers Association (AFBMA)
  9. Hydraulic Institute Standards (current edition)
  10. Institute of Electrical and Electronics Engineers (IEEE)
  11. National Electrical Code (NEC)
  12. National Electrical Manufacturers Association (NEMA)
  13. Occupational Safety and Health Administration (OSHA)
  14. Steel Structures Painting Council (SSPC)
  15. Underwriters Laboratories, Inc. (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

#### **1.05 QUALITY ASSURANCE**

- A. To assure unity of responsibility, the pumps, motors and sole plates, shall be furnished and coordinated by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, variable speed drives, sole plates, and controls as specified.
- B. The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in

the production of such equipment. A single manufacturer shall furnish units specified herein. The equipment furnished shall be designed, constructed, and installed to operate satisfactorily when installed as shown on the drawings.

- C. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.
- D. The pump manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components, including soleplate(s), if any, of the assembled pumping unit mounted on a fabricated steel baseplate, to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.
- E. Pumps shall operate without vibration over a 80-100% speed range, as long as within this speed range the pump performance curve intersects the system curve at a stable operating condition for the pump supplied. The pump manufacturer shall perform both lateral and torsional critical speed analyses to identify and ensure that (a) the first lateral critical speed shall be at least 25 percent above the maximum pump speed, and that (b) no torsional natural frequencies occur within a range extending from 25 percent below to 25 percent above the specified operating speed range and that (c) any blade excited resonant frequency shall be no closer than plus or minus 25 percent of the natural frequency of any part of the installed assembled pumping unit. Prior to manufacture, a statement shall be forwarded to the Engineer indicating that the required analyses have been made and that the specified limitations will be met.
- F. Vibration, when measured in the direction of maximum amplitude on the top of the pumps and the top of the motor bearing housing, shall not exceed the peak to peak displacement and maximum peak velocity level listed in the Hydraulic Institute Standards (current edition), at any speed within the specified operating speed range.

#### **1.06 SYSTEM DESCRIPTION**

- A. Two split case pumps, motors and structural steel bases.
- B. Each pumping unit will start, change speeds, and stop in accordance with pre-set level control program as shown in the drawings and specified herein.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during shipment. Store equipment in accordance with the manufacturer's instruction.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

- D. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. No shipment shall be made until approved by the Engineer in writing.
- G. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if prelubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings, which are not prelubricated, shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of installation and start-up by the application of Exxon Rust-Ban No. 392, or equal treatment.

**1.08 MAINTENANCE**

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.
- C. Furnish the following spare parts for each size pump.

	<u>Quantity</u>	<u>Item</u>
1.	1	impeller
2.	1 set per pump	replaceable elements for shaft couplings
3.	1 set per pump	radial and thrust bearings
4.	1 set per pump	shaft sleeve with keys, nuts, O-rings
5.	1 set per pump	Set of Packing
6.	1 set per pump	pump casing gaskets

**PART 2: PRODUCTS**

**2.01 GENERAL**

- A. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, controls, and appurtenances such as, but not limited to, couplings, guards, and gauges.
- B. The pumps, motors, drives, and controls shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially constructed to meet the Specifications. Ample room and facilities shall be provided for inspection, repairs, and adjustment.
- C. All necessary foundation bolts, nuts, and washers shall be furnished and shall be Type 316 stainless steel.
- D. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed, and all other pertinent data. As a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.

**2.02 CONDITIONS OF OPERATION**

- A. **The pumps shall be as manufactured by Fairbanks Morse (basis of design), or prior approved equal.** The pumps within each service type shall be identical in every respect with all parts interchangeable.
- B. Each pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curves as appended.

<b>Hampton Point</b>	<b>1000 GPM</b>
Pump Model-Fairbanks Morse	4"-2823A
Service:	Water
No. Of pumps:	2
Duty:	1
Standby:	1
Maximum Temperature (degree F):	90
Design capacity (gpm):	1000
Design total head (TH) (ft):	150
Minimum efficiency at design point (percent):	78%
Minimum shut-off head at max speed (ft):	190

Minimum head at runout (ft):	119
Minimum efficiency at runout capacity:	70%
NPSHR at maximum runout capacity (ft):	20
Maximum speed (rpm):	1780
Minimum capacity at runout head (gpm):	1200
2nd design point capacity (gpm):	600
2nd design point head (ft):	178
2nd design point efficiency (%):	70%
Non-overloaded motor HP:	60
Minimum pump casing suction diameter (in):	6"
Minimum pump casing discharge diameter (in):	4"

Where total head (TH) is referred to in conjunction with the specified discharge requirements, it shall be understood to consist of the sum of the pressure head plus the velocity head, in feet, at the discharge nozzle of the pump minus the pressure head and the velocity head at the suction nozzle of the pump. The efficiency of the pump shall be understood to be based upon total head as just defined.

The pumps shall operate throughout the entire operating range, within the vibration limits specified in Paragraph 1.05F.

### 2.03 PUMP CONSTRUCTION

#### A. Impeller

The impeller shall be enclosed type, double suction made of **Nickel Aluminum Bronze ASTM B148 AL958**. The impeller shall be hydraulically and dynamically balanced. The waterways through the impeller will have extremely smooth contours to provide maximum efficiency. The impeller is to be balanced and secured axially along the shaft-by-shaft sleeves and nuts and secured to the shaft through precision fit full-length key. The impeller hub shall have sufficient metal thickness to allow machining for installation of impeller wear rings.

#### B. Casing

The casing shall be made of close grain cast iron A48 CL30 having a minimum of 40,000-psi tensile strength, a nominal wall thickness of (see table) and suitable for 150 psig-working pressure when 150 lb. ANSI drilled discharge flange is used. Casing shall withstand a minimum of (see table)psi hydrotest. The casing shall consist of upper and lower castings containing the volute and the suction passages. Casing shall be a single volute( double volute on the Spring branch pump) type split along the horizontal shaft centerline with flat-faced suction and discharge flanges. Casing shall be line bored to assure concentricity and angular alignment. The upper and lower half casings shall be accurately machined and doweled for bolting together and to permit easy removal and accurate replacement of the upper half for inspection and maintenance. The upper half casing shall be completely removable without disturbing the suction or discharge piping.

Suction and discharge connections shall be sized to reduce hydraulic friction losses and to reduce turbulence and pipe noise. All suction and discharge flanges shall be designed

for straight through nut and bolt flange connections with 125# suction ANSI drillings. Tapped and plugged holes shall be provided for primary, vents, drains and gauge connections on the suction and discharge sides.

C. Casing Rings

The casing rings shall be made of **416 SS**, and shall be installed and locked into position.

D. Impeller Rings

Impeller rings shall be made of **316 SS**, and mounted on the impeller hubs to provide renewable clearance and be locked into position.

E. Shaft

The shaft shall be made of A311 Grade B, 1141 steel sized to provide a minimum amount of shaft deflection. The shaft shall be reversible to provide for field change to opposite rotation, if required. **Shaft Sleeves shall be 416 SS**

F. Shaft Assembly

Minimum shaft diameter

<b>Hampton Point</b>	<b>1000 GPM</b>
1. At impeller	2.000"
2. At sleeve	1.995"
3. At thrust bearing	1.575"
4. At radial bearing	1.575"
5. At Coupling	1.500"
6. Center to Center of Bearings	24.81"

The pump shaft shall be high-strength alloy steel with a minimum 100,000 PDI tensile strength and 75,000-PSI yield strength of sufficient diameter to carry the maximum loads imposed and to prevent vibration and fatigue. The shaft shall be accurately machined along its entire length and precision ground at bearing locations. A renewable straight shaft sleeve made of 416 SS, 190-241 BHN and shall protect the shaft where it passes through the stuffing box.

G. Bearings

The bearings shall be single row and double row thrust bearings of the grease lubricated ball type, selected to carry radial and thrust loads imposed on them

H. Bearing Housing

The bearing housing shall assure positive alignment of the rotating element. The housing shall provide a fit for the inboard bearing that allows freedom for thermal expansion

while the outboard bearing shall be clamped in place to take all of the thrust loads and keep the rotating element in its proper axial location. Housing shall be doweled in place.

I. Lubrication

The bearing housing shall be provided with tapped and plugged openings for draining and flushing out old grease and addition of new grease.

J. Stuffing Box

The stuffing box shall be machined into the casing, designed for use with packing, with bronze split glands and stainless steel bolting.

K. Pump weight and Dimensions

Hampton Point	<b>1000 GPM</b>
1. Case Thickness	0.570"
2. Working pressure	250 psi
3. Hydro Pressure	375 psi
4. Min Pump weight	765 lbs.
5. Min Impeller weight	50 lbs.
6. Min Impeller Eye Area	24.72 in <sup>2</sup>
7. Min Suction Size	6.0 in.
8. Min Discharge Size	4.0 in.

L. Rotation

The rotation of the pump shall be chosen during the shop drawing review process.

M. Each pump shall be provided with glycerin-filled suction and discharge pressure gauges with a 1/4-in NPT inlet and 4.5-in dials. A 316 stainless steel, oil filled diaphragm with a 1/2-in NPT inlet and 1/4-in flushing tap, with T-cock, shall be installed on each gauge. The suction gauges shall be of the compound type to indicate both vacuum and pressure and be graduated to read 15-psi positive pressures and 30-in mercury negative pressures. The discharge gauges shall be graduated from 0 to 60 psi. The pressure gauges shall be equal to Figure 1980 Solfrunt standard gauges, Model 150000-4 series, manufactured by Amtek, U.S. Gauge Division. The diaphragm seals shall be equal to Model MGS0103102 seals manufactured by Amtek, Mansfield & Green Division. The gauges shall be connected to the pump suction and discharge. All fittings and cocks shall be red brass.

N. Structural Base

The structural base shall be sufficiently rigid to support the pump and driver and shall be steel. **Bent form bases are not acceptable.**

- O. The natural frequency of the assembled pump and its supporting structure shall be at least 25 percent higher than the maximum pump speed.

#### **2.04 PUMP DRIVE SYSTEM**

- A. Each pump shall be driven by a horizontal squirrel-cage induction electric motor with a maximum horsepower and speed as specified under Paragraph 2.02B and with TEFC Hostile Duty enclosure, winding temperature detectors, and shall meet all the requirements of the electrical specifications.
- B. The driver shall be mounted and supported by a fabricated steel baseplate
- C. The pump motors shall be suitable for driving the pumps continuously over the entire pumping range. The pump manufacturer shall furnish the pump motors. Motors shall be rated for inverter duty.

#### **2.06 DESCRIPTION OF SYSTEM OPERATION**

- A. Variable Speed Pumping System (**If Required**)
  - 1. A pumping rate controller shall be provided for operation of the four pumping units. The pump; motor drive and control system shall consist of an A.C. adjustable, frequency drive controller for each of the four motors. The pumping rate controller is specified under Division 13.
  - 2. The A.C. adjustable frequency drive controller shall respond to the control system specified under Division 13 to automatically start, change speeds and stop pumps in accordance with the wet well level control program described herein.

#### **2.07 SHOP TESTS**

- A. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.
  - 1. A complete test report for each pump, including certified characteristic curves of the pump, consisting of at least all information required in Paragraph 1.05, except for NPSH testing, and certified copies of the hydrostatic test report, shall be submitted and approved by the Engineer before the pumps are shipped.
  - 2. The tests shall be performed with pump in vertical position.
- B. Each pump being furnished under these specifications shall be factory tested in accordance with the latest edition of the Hydraulic Institute Standards. Certified copies of the Hydrostatic Test Report shall be supplied prior to conducting a pump performance test. Notification of such test and a list of test equipment and procedures shall be furnished to the Engineer at least ten working days before the schedule test date.

1. Each pump shall be tested and data recorded at its operating conditions of service as listed in Paragraph 2.02. In addition, the pumps shall be tested and data recorded at shut-off head. Sufficient test point readings shall be made to establish complete head flow capacity, efficiency and brake horsepower curves for each pump.
  2. All gauges and other test instruments shall be calibrated within 30 days of the scheduled test and certified calibration data shall be provided. All Venturi flow meters shall be calibrated within two years of the scheduled test and certified calibration data shall be provided.
- C. Pump motor tests as specified in **electrical specifications** shall be submitted for approval by Engineer prior to shipping, if required.

### **2.11 SURFACE PREPARATION AND SHOP PRIME PAINTING**

- A. Each piece of equipment in the pumping system including pump, motor, and gear shall be prepared shop-primed as specified in **Section 09900**. The shop primer shall be compatible with the finished paint. Field painting is included in **Section 09900**.

### **3.01 PREPARATION**

- A. Coordinate with other trades, equipment, and systems to the fullest extent possible.
- B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified.

### **3.02 INSTALLATION**

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer's recommendations and setting plans.
- B. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 4 person-days to insure that the work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representatives shall specifically supervise the installation and alignment of the pump with the driver, the grouting, and the alignment of the connection piping and the installation of the field-installed mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
- C. Connection of piping to pumps shall be done in presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.

- D. A certificate from each equipment manufacturer shall be submitted stating that the installation of his/her equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

### **3.03 FIELD TESTS**

- A. In the presence of the Engineer, such tests as necessary to indicate that the pumps, motors, and variable speed drive generally conform to the efficiencies and operating conditions specified shall be performed. A thirty-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the Specifications, corrective measures shall be taken or the pump shall be removed and replaced with a pump, which satisfies the conditions specified. All test procedures shall be in accordance with Hydraulic Institute Standards certified results of tests shall be submitted. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing.
- B. After installation and as soon as conditions permit full speed operation, retain the services of a qualified independent mechanical testing firm to perform a detailed vibration signature analysis of each unit, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. A written report shall be submitted including a sketch of the unit indicating thereon where and in which direction the vibration readings were taken and recorded showing (a) peak to peak displacement, in mils, (b) frequency and (c) peak velocity level, in inches per second. The report shall contain a complete analysis of their findings, describing any problems encountered, if any, probable cause and specific recommendations for any required corrective action.
- C. If required, take corrective action and the units shall be retested to ensure full compliance with the specifications. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.
- D. The analysis indicated in Paragraph 3.03B shall be repeated six months after signature testing. A report shall be prepared comparing the results of the six-month tests with the results of the signature tests. Significant worsening of the vibration, to be determined by the Engineer, during the six-month tests shall require corrective action and retesting.

END OF SECTION