

**TYPICAL GENERIC SPECIFICATION**  
**VERTICAL TURBINE CAN PUMPS WITH VHS MOTORS**

**GENERAL**

The Contractor shall provide and install \_\_\_\_ ( ) vertical turbine, product lubricated, lineshaft turbines water pumps as described below, which are manufactured by Flowserve and supplied by Smith Pump Company, Inc. in Waco, Texas or pre-approved equal.

**PERFORMANCE REQUIREMENTS**

Number of units  
Design Flow (GPM)  
Total Head (Feet)  
Minimum Bowl Efficiency (%)  
Max. NPSHr @ Design (Feet)

Secondary Flow (GPM)  
Total Head (Feet)  
Minimum Bowl Efficiency (%)  
Max. NPSHr (Feet)

*(Min / Max)* Shut-Off Head (Feet)  
*(Max / Min)* Motor Rating (BHP)  
Maximum Speed (RPM)  
Bowl Shaft (minimum)  
Line Shaft (minimum)  
Min. Column Pipe diameter (in)  
Max. Length between lineshaft bearings (ft)  
Depth of barrel (ft)  
Minimum barrel O.D. (in)

**OPERATING CONDITIONS**

The pumping units shall be designed and capable of operating satisfactorily based on the conditions stated in this section and shall not overload the motor throughout the pump operating range.

**PUMP DESIGN**

A. GENERAL

The pumps shall be the vertical turbine type, having product lubricated shaft bearings, impellers, column, and shaft connected to a vertical hollow shaft induction motor.

## B. PUMP BOWLS

Casting shall be of ASTM A-48 Class 30 or better cast iron free of blow holes, sand holes or other detrimental defects. The bowls shall be capable of withstanding hydrostatic pressure equal to 150% the pressure at the design head operating condition or 125% of the pressure at shutoff head, whichever is greater. The bowl will be supplied with a top discharge case that is machined to accept the specified size column pipe. Bowl bolting to be 18-8 stainless steel. Bronze (ASTM B-584-C932) bowl wear rings shall be provided.

## C. IMPELLERS

The impellers shall be of the enclosed type of cast low zinc bronze (ASTM B584-C836 or C876), which are statically and dynamically balanced. They shall be fastened to the shafts with stainless steel tapered bushings so that they will be held securely for either normal pumping or reverse rotation. Pumps with bowls larger than 18" shall use keys to secure the impeller to the shaft. Bronze (ASTM B-584-C932) impeller wear rings shall be provided on all enclosed impellers.

## D. PUMP and LINE SHAFTING

Design of pump shafts shall comply with AWWA Specification E101 for Vertical Turbine Pumps to handle the torque and down thrust imposed on the shaft by the pump. Straightness and machining tolerances of shafts shall comply with requirements of AWWA E101.

The pump shaft shall be of Type 416 Stainless Steel pump shaft quality (PSQ) and shall have a bronze bearing above and below each impeller. All bowl bearings shall be ASTM B505-932 bronze.

Line shafting shall be Type 416 Stainless Steel pump shaft quality (PSQ) and shall be turned, ground, and polished. The line shaft shall be coupled with stainless steel couplings which shall be designed with a safety factor of 1-1/2 times the shaft safety factor and shall have left-handed threads to tighten during pump operation. Line shaft larger than 2-11/16" shall utilize ring and key type design with no threaded fasteners.

## E. DISCHARGE COLUMN PIPE (flanged)

The column pipe shall be standard weight conforming to Table 2 of AWWA Specifications E101 and shall be connected by flanges and stainless steel bolting. The column pipe shall be heat stress relieved after welding and prior to machining. Bearing spacing shall be provided at 5 feet maximum intervals. The maximum water velocity in the column pipe along the shaft shall be 12 ft/sec and the head losses in the column pipe shall not exceed 5 ft of head / 100 ft of pipe at the design flow conditions. Column pipe 14" and smaller shall use bronze "drop-in" spiders with rubber "pop-in" bearings. Column pipe larger than 14" shall use welded-in spiders with stainless steel bearing supports. All column pipe

shall be heat stress relieved after welding and prior to machining. The flanges shall have machined registers on each end which are concentric within 0.005" of each other. Columns with welded in spiders shall have the bore of the spider concentric within 0.005 of the register on the same end. The flange faces shall be parallel within 0.005 in. The bearings for the welded in spiders shall be bronzed back, (*Viton / Nitrile*), fluted bearings.

#### F. PUMP DISCHARGE HEAD (Fabricated steel)

The pump discharge head shall be fabricated using low carbon steel A53Gr B pipe and A36 steel or better. Pump discharge head shall be suitable for mounting on a barrel flange with o-ring seal. The base flange shall have the same bolt hole pattern as the top flange of the barrel. The bottom of the head shall be machined with a register to accept the top column pipe. The discharge flange is 150# flat face as shown on plans. The head shall be machined to accept a cast iron, bleed-off stuffing box. A bronze split follower and split lantern rings shall be required. The packing shall be as manufactured by Rains-Flo Sealing Systems, no equal. Two steel hinged coupling guards shall be provided with openings for removal of packing, packing gland and coupling.

The motor plate shall be machined with a register to align the motor to the stuffing box and bottom register. All registers shall be concentric within 0.005" and the motor plate shall be parallel to the bottom plate within 0.005". The discharge head shall be heat stress relieved after welding and prior to machining. The head shall be blasted and coated as described in the painting section.

### **VORTEX SUPPRESSOR / BASKET STRAINER**

Each new pump shall have a vortex suppressor / basket strainer installed on the pump's suction. The vortex suppressor / basket strainer shall be constructed to meet the following requirements:

1. Performance requirements:

Approach velocity: 3.0 feet per second, maximum, at runout flow

Net open area: 65 percent

2. Design requirements:

Configuration: Basket-type with solid bottom plate and four internal straightening vanes.

Screen: 0.120 inch woven wire cloth on 5/8" centers

3. Materials:

Wire cloth to be Type 316 stainless steel material.

All other materials to be Type 304 stainless steel with a minimum thickness of 3/16".

4. Mounting:

Bolted to the pump suction bell using 5/16" minimum diameter 18-8 SST bolts and shall hold the weight of the basket and prevent the basket from spinning.

## **SUCTION BARREL**

### A. Pump Suction Barrel (Pump Cans) – fabrication

Prefabricated steel pipe suction barrels shall be provided as shown on the plan sheets. Suction barrels with anticipated flows greater than 3000 GPM shall have internal straightening vanes and an inlet pipe splitter plate, as required by Hydraulic Institute's latest standards. Suction barrels shall be constructed of low carbon steel A53Gr B pipe and A36 steel or better. Mill test reports will be furnished, if requested. Suction barrels wall thickness and top flange thickness are shown below. All suction barrels (24" and larger in diameter) shall have the top flange shipped loose, with jack bolts to assist in leveling, for field leveling & welding. Each top flange shall have a drilled and tapped bolt pattern that is equal to a standard 150# flange. These holes shall straddle centerline of the can inlet. The top surface shall have a minimum surface finish of 125 RMS and include an o-ring groove with minimum surface finish of 32 RMS. A Buna N o-ring is included for sealing purposes. A gasket will not be acceptable. The barrel inlet shall be as shown on the plan sheets and shall be flanged with an AWWA C207-94 Class D steel flange. A vertical splitter plate shall be provided in the inlet pipe the entire length of the inlet. The bolting to attach the discharge head to the suction barrel will be 18-8 SS and furnished by the pump manufacturer. The barrel length shall be as shown on the plan sheet and shall have a bottom cap plate in equal thickness to the top flange. Four (4) evenly spaced, 3" x 3" x 3/8" angles shall be welded every 5-6 feet to the outside diameter on the barrel as concrete embedment points. A 1" hole will be in each angle to assist the installing Contractor in mounting and aligning the suction barrel. The barrel shall be fitted with two (2) 3/4" coupling to serve as a vent for the barrel.

The suction barrel shall be blasted and coated as described in the painting section. The coating must meet the requirements of the United States Environmental Protection Agency for potable water applications.

<b><u>Suction Barrel</u></b> <b><u>Outside Diameter</u></b>	<b><u>Top Flange</u></b> <b><u>Thickness*</u></b>	<b><u>Barrel Wall</u></b> <b><u>Thickness*</u></b>
16" – 24"	1-1/2"	.375"
30"	1-3/4"	.375"
36"	2-3/8"	.375"
42" – 60"	2-1/2"	.375"

\*Min Values

### B. Pump Suction Barrel (Pump Cans) – Installation

The top flange shall be leveled to within .002 of an inch per foot of diameter of the flange. The top flange shall be seal welded inside and outside to the top of the barrel. The

installing Contractor must install and maintain through backfill the suction barrels so that the barrel pipe is plumb to within .015 inches per foot of length.

Stainless steel anchor bolting shall be provided by the contractor. The minimum thickness of the concrete foundation which supports the barrel during installation is six (6) inches. The entire suction barrel is to be encased in concrete from the cap plate to the bottom of the top flange.

The contractor shall provide a millwright and a welder to level and weld the top flanges to the barrels. The Millwright "must" use a machinist level to verify the levelness. A carpenter's level will not be acceptable. Once the top flange is level, seal welded inside and outside, and the coating repaired, the Contractor shall form up and pour a housekeeping foundation around the top of the barrel. The top 2" shall have non-shrink epoxy grout poured to the underside of the top flange. The contractor shall run piping from the couplings out beyond the concrete pad and cap with a pet cock.

The pump manufacturer shall verify the flange levelness prior to grouting and pump installation. After welding, the coatings must be repaired per the coating manufacturer's recommendations.

### **MOTOR (Hollow shaft)**

Electric motors for driving pumping units shall be the minimum horsepower and maximum speed as stated above, vertical hollow shaft, air cooled, squirrel cage induction type and shall be designed for 480V, 3 phase, 60 Hz for motors up to 250 hp and 4160V, 3 phase, 60 Hz for motors over 250 hp.

All motors shall be premium efficient and comply with NEMA MG-1 Table 12-12 as mandated by DOE EISA Energy Efficiency Regulations. The motor's minimum nominal full load efficiency is \_\_\_% and a three-quarter load efficiency that is equal to or greater than the full load efficiency. If the motor is not energized by a VFD, the motor shall have a full load power factor of 83% or greater and correctable to 95% with PFCC. Power factor correction capacitors (PFCC) are sized by the motor manufacturer but provided by the contractor.

Horsepower rating of motors shall be equal to or greater than the total horsepower requirement of the pump when operating at any head between shutoff and run-out, including power requirements for bowl assembly, column and line shaft bearing loss, and motor thrust bearing loss from pump thrust, but no less than previously stated HP. Motors shall have a service factor of 1.15.

Motors shall be designed in accordance with applicable provisions of the NEMA Standard Publication for Motors and Generators, MG1, with subsequent revisions thereto, all subject to modifications and additions as herein set forth.

Motors shall be NEMA (*Weather Protected Type 1 or 2 / TEFC*) construction for outdoor installation in accordance with NEMA MG-1 and include a non-reverse ratchet.

Motors for use with VFDs must be inverter duty, have both bearings insulated, if frame size allows, and include a grounding ring / brush on the drive end of the motor.

Motors for use with mechanical seal shall have steady bushings installed.

Rotors shall be balanced within an amplitude peak to peak of 0.003 inches in any direction.

Motor windings shall be full Class F insulated. Motors shall operate continuously at rated voltage and frequency at 40 degree C. ambient temperature, with a temperature rise not to exceed 80 degree C. when operating at 100% of the rated horsepower.

The motor shall be provided with six (6) 100 ohm platinum winding resistors and two (2) 100 ohm platinum bearing resistor for monitoring the temperature. The leads will terminate within separate conduit box.

The locked rotor torque and breakdown torque shall not be less than that shown in NEMA MG1-12.37 and MG1-12.38 and shall be NEMA Code Letter "G" or better.

Motor bearing shall be designed for the maximum loads imposed by the pump and motor and shall be selected for a 5 year minimum life, and a 25 year average life, in accordance with A.F.B.M.A. life and thrust values when operating at the primary design condition.

The motors will be supplied with 120 VAC space heaters and the leads will terminate within separate conduit box. The main power conduit box shall exceed the minimum size as specified by NEMA.

The motors shall receive a non-witness short commercial test and test reports must be provided. A complete test shall be performed on one motor of each rating at the manufacturer per IEEE Standard 112; method B or F is acceptable. A certified noise level test shall be performed on one motor of each rating at the manufacturer per ANSI 12.51 and NEMA MG-1. On motors with VFDs, the motor vendor shall provide an unwitnessed reed critical frequency test on one motor of each HP rating. Certified test reports shall be provided to the Engineer for approval prior to shipment on the motors.

Approved motors are Nidec (U.S. Electrical Motors), TECO and General Electric Motors.

## **SHOP PAINTING**

The interior surfaces of the suction barrel shall be shop-cleaned by grit blasting to near white, SSPC-SP10. The exterior surfaces of the suction barrel, bowl assembly, discharge head, & column pipe shall be shop-cleaned by grit blasting to near white, SSPC-SP10. The interior/exterior of the suction barrel and the exterior of the bowl assembly & column pipe shall receive two coats of TNEMEC Series 140 Pota-Pox Plus Self-Priming Polyamide Epoxy for a total dry thickness of 7-9 mils. Finish color to be Tank White. The exterior of the discharge head shall be shop-primed, only, with one (1) coat of Tnemec

140-1255 Beige Pota-Pox to 4 mils DFT. The Contractor will finish coat the discharge head in the field. Equipment nameplates shall be non-corrosive metal and shall be left unpainted so that the information stamped thereon remains clearly legible.

## **ANALYSES**

The pumping unit manufacturer shall perform both lateral and torsional critical speed analyses on the assembled pumping units to identify and ensure:

1. That the first lateral critical speed is at least 20 percent above or below the operating speed of the pumping unit over the entire operating speed range defined;
2. On constant speed applications, that no torsional natural frequencies occur within a range extending from 20 percent below to 20 percent above the operating speed of the pumping unit over the entire operating speed range defined; and
3. On constant speed pumping units, that any blade excited resonant frequency shall be no closer than plus or minus 20 percent of the natural frequency of any part of the installed assembled pumping unit over the entire operating speed range defined.
4. On VFD applications, both Goodman & Gerber fatigue analyses will be performed on the shaft to verify shaft fatigue strength is acceptable.

## **FACTORY PUMP TESTING**

Each bowl assembly will receive a non-witness hydrostatic test in accordance with Hydraulic Institute Standards and the parameters set forth above.

Each bowl assembly will receive a non-witness performance test in accordance with Hydraulic Institute Standards. The bowl must be tested at design point, maximum run-out point, shut-off head, and other points as necessary to meet Hydraulic Institute Standards.

All test reports will be provided to the Engineer for review & approval prior to shipment from the manufacturer's facility.

## **SPARE PARTS**

One set of packing for each pump shall be provided at the time of start-up.  
One gallon of touch up paint shall be provided to the contractor at installation.  
Adequate motor oil shall be provided to complete start-up.

## **MANUFACTURER'S REPRESENTATIVE**

The Equipment Manufacturer shall furnish the services of a competent technical representative, or representatives, who shall have had experience in the installation and operation of the equipment which is being furnished under this contract. This service is to

insure proper installation and adjustment of the equipment. The pump manufacturer shall provide a certificate of proper installation.

### **ACCEPTANCE TESTS**

Upon completion of installation of equipment, an acceptance test to verify the satisfactory operation of each unit shall be conducted. The test shall be conducted in a manner approved by and in the presence of the Engineer. Units shall be checked for excessive noise, alignment, vibration, general operation, etc. The pumping unit shall be operated throughout its full range of operating heads, recording pump discharge pressure, and motor voltage and current. The units must perform in a manner acceptable to the Engineer before final acceptance will be made by the owner.

### **WARRANTY**

The pumping unit shall be warranted against defects in material and workmanship for 18 months after delivery or 12 months after start-up which ever is longest. The motor shall be warranted for 2 years after start-up and final acceptance by the Owner.