General

Submersible pumps shall be of a centrifugal chopper design intended for services requiring a combined chopping and pumping action on fluids with entrained solids. The integral pump/motor units shall be designed to operate at a continuous full load duty completely submerged in liquid without the need for external cooling.

The nameplate ratings of the motor shall be based on 40^0 C ambient environment. The pump motors shall be designed to withstand 200 psi differential water pressure at all seal locations. Heat transfer shall be accomplished by convection through the stator wall to the surrounding media. Designs that incorporate cooling jackets are not considered equal to the equipment described in this specification and shall not be acceptable.

Pumps shall be Hayward Gordon CHOPX Series, or approved equal.

Performance

Pumps shall be sized to meet the following design criteria:

A. Fluid Properties:
Fluid _____ S.G
Viscosity _____ Temp
Solids % _____ Solids Type/Size _____/_____

B. Pump Characteristics:
Capacity _____ TDH
Suction Head _____ NPSHA
Minimum Disch. Size_____ Motor RPM
Max. Pump RPM _____ Motor HP _____

C. Pump Efficiency:
To minimize operational power costs, the minimum hydraulic efficiency of the pump at the design duty point shall be _____% and shall be no less than _____% at the Best Efficiency Point at the selected pump's RPM.

Pump Construction

A. Casing: The pump casing will be constructed of ASTM A48 Cast Iron (*Optional: High Chrome Iron 450 BHN minimum, 316SS, or CD4MCU*). Flanged suction and discharge connections shall conform to the requirements of ANSI B16.1, Class 125. The casing backplate shall have a spiral cutting groove on the surface that is in close clearance to the rear flange of the impeller.

B. Impeller: The pump impeller shall be an open type with sharpened vane edges incorporated into the rear of the impeller which provides cutting action against the backplate spiral groove, preventing fouling behind the impeller. Primary chopping/conditioning of materials shall be accomplished by the action of the sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings with a set clearance between the impeller and cutter bar of .010" to .015" on pumps with less than 14" diameter impellers or .020" to .030" on pumps with 14" diameter or larger impellers. Impeller shall be constructed of cast alloy steel case hardened to minimum Rockwell C60 (*Optional: High Chrome Iron 450 BHN minimum, 316SS, or CD4MCU*) and shall be dynamically balanced.

C. Cutter Bar: The casing will be fitted with a replaceable suction plate with cutter bars constructed of cast alloy steel case hardened to minimum Rockwell C60 (*Optional: High Chrome Iron 450 BHN minimum, 316SS or CD4MCU*). The surface of the suction plate facing the impeller shall have multiple radial cutting slots to prevent binding of material between it and the impeller vanes.

D. Upper Cutter: The area behind the impeller shall be protected from fouling by the cutting and expulsion action of sharpened vane edges in the rear of the impeller sweeping across the spiral grooves in the casing backplate.

E. Deflector Nut: The impeller shall be secured to the shaft using a deflector nut made from 420 Stainless Steel hardened to 400 BHN. The nut shall be designed to protrude in front of the cutter bars and deflect stringy materials and prevent binding.

F. Shaft: The motor/pump shaft shall be one-piece and shall be constructed of 416 Stainless Steel.

G. Bearings: All bearings shall be rated for a minimum L_{10} life of 100,000 hours at 25% of the flow at the best efficiency point (BEP). Bearings shall be permanently lubricated with a premium moisture resistant grease containing rust inhibitors and shall be suitable for operation over a temperature range of –25 ^{0}C to +120 ^{0}C.

H. Shaft Seals: Two independent, tandem mounted, mechanical face type seals shall be provided to isolate and protect the air-filled motor from the pumped media. The inner and outer seal shall be separated by an oil filled chamber. The oil chamber shall act as a barrier to trap moisture and provide sufficient time for a planned shutdown.

The lower seal faces shall be Tungsten Carbide vs. Tungsten Carbide. The upper mechanical seal shall be constructed of a carbon rotating face and a ceramic stationary face. All other seal components shall be 316SS. Mechanical seals shall be readily and commercially available from third party sources other than the pump and motor manufacturer.

I. Moisture Protection System: A dual (2) probe sensing system shall be provided to detect the presence of moisture within the motor. The moisture sensing probe leads shall terminate at a separately supplied conductance relay located in the control panel which shall provide an alarm in the event of moisture intrusion. The sensing relay shall either be provided or approved by the pump/motor manufacturer.

J. Cable Entry System: The power and control cable entry system shall be designed to provide a positive, leak-free seal to prevent liquid from entering the air filled motor housing. The design shall incorporate provisions which prevent moisture from wicking through the cable assemble even in the event that the cable jacket has been punctured. All cable shall be type SEOW-A and U.L. listed for the intended submersible service.

The power and control cable entry into the lead connection chamber shall be encapsulated for positive moisture sealing. A Buna-N cable grommet shall be provided in addition to the epoxy sealed leads. Compression type grommet fittings employed as the primary sealing system shall neither be considered equal or acceptable. Separate power and control cables shall be provided to prevent false sensor warnings.

K. Electrical: Submersible motors shall successfully operate under power supply variations per NEMA MG1-14.30. Motors shall be NEMA Design B with torque and starting current in accordance with NEMA MG-12. The submersible motors shall be of an air-filled, high efficiency design with copper windings and shall be rated for continuous full load operation. The motor construction shall be of explosion proof, TENV-TEXP design and capable of being certified for use in Class 1, Groups C & D hazardous locations by either Factory Mutual (F.M.) or Underwriters Laboratories (U.L). Motors to be capable of running for 15 minutes in air (unsubmerged).

Motors shall be capable of withstanding up to 15 starts per hours and shall have a minimum 1.15 service factor. Motors suitable for VFD (inverter) operation shall have a turndown ratio of 10:1 at a service factor of 1.0.

The insulation system shall be Class F minimum, utilizing materials certified per IEEE 117, and shall be rated at a temperature of 155^{o} C. Two (2) normally closed, automatic reset, thermostats shall be connected in series and embedded in adjoining phases of the stator windings.

L. Guide Bracket & Rail System: The pump shall be provided with a guide system to allow easy removal without entering the wet well. The main base fixture shall be bolted to the floor and shall include a 90 degree Cast Iron elbow and mounts for two galvanized steel rails of standard schedule 40 pipe. The base fixture shall be designed to receive the connecting pump slide bracket without the need for bolts, nuts, or clamps. The pump discharge will connect to a Cast Iron slide bracket (*Optional: Bronze for non-sparking design)* that seals against the base fixture by the weight of the pump.

M. Recirculator (Optional): A recirculator nozzle shall be provided for recirculation of the pit contents prior to discharge. The recirculator nozzle will be adjustable a minimum of 180 degrees horizontally and 70 degrees vertically. The recirculator system shall incorporate a valve assembly to direct discharge flow either to the nozzle or the discharge flange. The valve body will be ASTM A48 Class 30 Cast Iron with 316SS valve disk which incorporates a Graphalloy bushing to ensure smooth, low friction operation. The operating levers shall not require the use of a thrust collar below the mounting plate to maintain the assembly. The nozzle is to be self contained in the housing eliminating the need for field setting of collars.

N. Linear Actuator (Optional for recirculator): An electrically operated ball screw linear actuator shall be provided to position the valve for pumpout or mixer/recirculator operation. The actuator will operate on 1/60/110V AC power with 25% duty cycle and will be capable of producing 500 lbs. of actuation force. The actuator shall have a freewheeling feature to prevent over travel at the end of the stroke and shall incorporate a weatherproof motor enclosure. Timer relays (by others) are required to control the actuator and to set the valve position.