PUMP SPECIFICATION
Vertical, Immersible, Solids handling, Double volute

2.00 PUMP SCOPE

Furnish (Qty) end suction Vertical Coupled Immersible pumps, Cornell Model _____ or approved equal. The pumps shall be designed for continuous operation and constructed as follows to meet the intended service. The pumps shall operate continuously in air or under 30' of submergence water for a period of 2 weeks. Pump shall be as manufactured by Cornell Pump Company of Portland, Oregon, USA or equal and shall be warranted for a period of two full years after date of commissioning, but no later than 30 months after date of shipment.

2.01 Pumps shall be – Vertical Coupled, Immersible.

Design Capacity	____ GPM
Design Total Dynamic Head	____ FT
Maximum Speed	_____ RPM
Min. Efficiency Design Point	___%
Motor HP	_____ NOL
Secondary Capacity	_____GPM
Design TDH	____FT
Min Efficiency Secondary Point	___%
Third Capacity	_____GPM
Design TDH	___ FT
Min Efficiency Third Point	___%
Discharge Size	___ IN
Suction Size	___ IN
Min. Shut Off Head	____ FT

2.02 The pump casing shall be tangential/centerline (choose one) discharge, of back pullout design allowing for removal of the rotating element without disturbing piping connections. The casing shall be constructed of fine grain Cast Iron of ASTM A48 Class 30. All casing sections shall have heavy wall thickness to provide long life under abrasive and corrosive operating conditions. All mating surfaces shall have register fits to ensure proper alignment. Piping connections shall be ANSI 125# flat face drilled flanges on discharge and suction. Flange face surface finish shall be a minimum of 250 micro-inch finish.

2.03 The impeller shall be of heavy section Cast Iron of ASTM A48 Class 30, Two, Three, or Four (choose one)-Port design. Impellers shall be capable of passing a 3" soft solid or larger. Impellers will have back vanes to reduce axial thrust and

lower the stuffing box pressure. Internal vane edges shall be well rounded to present smooth flow. Impeller shall have a straight non-tapered bore, be statically balanced, keyed to the shaft and further secured with a Stainless Steel washer and a Stainless Steel impeller lockscrew. The impeller shall be fixed at location with no expected or required adjustment.

2.04 Replaceable suction wear ring shall be press fit into the suction cover and heat-shrunk onto the Impeller. The double wear ring system shall be of the peripheral design requiring no axial adjustment. The wear rings shall be constructed of AISI 420 Stainless Steel, Heat Treated to 350-500 BHN, with a minimum of 50BHN difference to prevent galling. Wear rings that require an external axial adjustment are not acceptable.

2.05 A dished style backplate with deflector vanes constructed of ASTM A48 Class 30 Grey iron shall be provided, including a single mechanical seal, Tungsten Carbide vs Silicon Carbide. The design shall allow for continuous operation without the need for external flush water or venting. Double seals or cartridge seals with a water flush are not acceptable. Seal shall be Cycloseal, as manufactured by Cornell Pump Co.. A standard hardened stainless steel shaft sleeve design shall be provided with an o-ring seal. The shaft sleeve will be Heat Treated 420 stainless steel. The sleeve will extend beyond the gland or box assembly.

The seal shall have a 316 stainless steel rotating spring. The faces will be tungsten on Silicon carbide and Viton "0" ring. Seal shall be John Crane.

2.06 The end suction centrifugal pump shall be pedestal frame style with ASTM A48 Class 30 fine grain Grey Iron bearing frame. The bearing frame shall be equipped with antifriction style bearings. The bearings shall be either ball or roller style properly sized to accommodate all thrusts, both mechanical and hydraulic imposed upon them. The frame shall be designed for captured bearing positioning and shall not require any field axial adjustment. The bearings shall have a minimum calculated L10 bearing life rating of 20,000 hours at the stated design condition. A complete bearing life, and shaft stress loading calculation, shall be provided by the pump manufacturer to illustrate compliance with this requirement. Bearing lubrication shall be grease with proper provisions to facilitate easy lubrication in the field. Pumps that are close-coupled or rely on the motor bearings to handle the hydraulic loading will not be acceptable.

The frame shall be fitted with appropriate lip seals running on a polished surface of the shaft to prevent water infiltration when the pump is submerged and not running. An expeller shall be fitted to the shaft at each end of the frame to create a reduced pressure at the lip seal when the pump is operating submerged. The

bearing frame shall be suitable for temporary submergence at 30 feet for a maximum 2-week period.

2.07 The pump shaft shall be of high strength carbon steel equal to MOD SAE1144 "Stress-Proof Steel". The pump shaft shall be accurately machined and polished and of sufficient size to transmit the maximum horsepower to be encountered when the pump is operating with a maximum diameter impeller and at the maximum rated motor operating speed.

The Shaft shall be protected by a renewable shaft sleeve, which extends through then stuffing box and under the mechanical seal. The sleeve shall be grooved on the inside for an o-ring to prevent leakage along the shaft and shall be positively locked to prevent rotation. The sleeve O.D. shall be a minimum of 0.375 inches wider than the shaft.

2.08 The shaft shall be protected by a renewable shaft sleeve, which extends through the stuffing box and under the gland. The sleeve shall be grooved on the inside for an o-ring to prevent leakage along the shaft and shall be positively locked to prevent rotation. The sleeve O.D. shall be a minimum of 0.375 inches over the shaft diameter and constructed of 420 Stainless Steel, Heat Treated to 400-500 BHN. The shaft sleeve shall be positively secured to the shaft by a key to prevent slip between the sleeve and the shaft.

2.09 The base elbow shall be of Cast Iron, heavy-section construction with a bolted and contoured clean out port. The base shall be of sufficient strength to support the entire weight of assembled pump and of sufficient height so that no part of the elbow will touch the floor. The flanges shall be 125# ANSI standard. Suction size shall be ___ inches, discharge size shall be ___ inches.

2.10 The motor shall be a vertical mount "P" base, solid shaft type. It shall be Immersible TEBC, suitable for use with a VFD with a 1.15 SF on sine wave –1.0 SF on VFD operation. It shall be ____ hp at _____ rpm (nominal), and non-overloading, exclusive of the service factor at any point on the pump head capacity curve. Motor supply power is ____ volt, __ hertz, __ phase.

Refer to section 3.0, 4.0, 5.0 and 6.0 for motor details.

2.11 Each pump shall be fully tested on water before shipment. Tests shall consist of laboratory testing at shutoff and five points over the operating range of the pump. One of the points will be the specified primary design point. Certified test data will include head, capacity, motor output HP, RPM, pump efficiency and be charted and graphed. All tests will be under the direction of a registered engineer and be conducted in accordance with the applicable Hydraulic Institute Standards and Procedures according to Level "B" and be submitted as requested.

Each pump shall be vibration tested when operating at prime design point before shipment. Test shall be conducted as directed by the Hydraulic Institute Standards and under the direction of a registered Engineer. Test data will be certified and submitted as requested.

Each pump shall be hydrostatically tested for casing integrity at 1.25 times the shut-off pressure of actual trim at operating speed before shipment. Tests shall be conducted as directed by a registered Engineer and data certified and submitted as requested.

Each pump shall be tested for its NPSHR, when operating and in conjunction with the H/Q performance test before shipment. The test shall include three (3) points on the test performance curve using water at ambient temperature. Tests shall be conducted and submitted as requested.

2.12 The complete pumping unit rotating element including pump, motor, and all other elements (as may be specified) in the power train (or powered via the power train) shall be designed and manufactured to limit torsional stresses.

2.13 Prior to shop coating, all surfaces of the pumps, motors, and accessories shall be thoroughly clean, dry, and free from all mill-scale, rust, grease, dirt, paint and other foreign matter.

All ferrous surfaces prepared in according to SSPC-SP6 or SSPCt-SP8 respectively.

All gears, bearing surfaces and other surfaces obviously not to be painted shall be given a heavy coat of grease or other suitable rust resistant coating, unless otherwise specified herein. This coating shall be maintained, as required, to prevent corrosion during periods of storage and installation.

Each pump shall be shop coated with Intertol Rust-inhibitive No. 621 as manufactured by Koppers Company Inc. or with Chem-Prime No. 77 as manufactured by Tnemec or equal.

CORNELL IMMERSIBLE MOTOR SPECIFICATION

This specification details the electrical and mechanical requirements for totally enclosed blower cooled immersible squirrel cage induction motors.

3.0 GENERAL

3.1 All motors defined under this specification shall conform to the latest applicable requirements of NEMA, ANSI,
IEEE, and NEC.

3.2 Motors are to be designed for continuous duty for three phase, 50 or 60 Hz and shall be suitable for inverterduty
operation under variable torque load conditions.

3.3 Ratings to be based on a 40°C ambient, 1000 meters (3300 ft) or lower operation with a maximum winding
temperature rise of 80°C (Class B) by resistance at 1.0 service factor.

3.4 Motors to be furnished with Class F insulation. All motors covered under this specification shall be capable of operating at 1.15 service factor on sine wave power and 1.0 service factor on VFD operation. They shall be
selected for operation within their full load rating without applying the service factor.

3.5 Motors shall be of Premium Efficiency design.

3.6 Motors shall be equipped with space heaters appropriate for the frame size.

3.7 Motors shall be equipped with thermal protection by normally closed thermostats connected in series.

3.8 25 feet of power cable shall be provided as standard.

4.0 BEARINGS AND LUBRICATION

4.1 Bearings shall be either single or double shielded or of open construction, deep groove Conrad type, and have a Class 3 internal fit conforming to AFBMA std 20.

4.2 Bearing temperature rise shall not exceed 50°C for 1800 RPM and slower motors.

4.3 Bearing AFBMA identification shall be on the motor nameplate.

4.4 Motor lubrication system is to be re-greasable.

4.5 Motor to be greased by manufacturer with a premium moisture resistant polyurea thickened grease containing rust inhibitors and suitable for operation over temperatures from -25°C to 120°C.

5.0 ENCLOSURE

5.1 Motor enclosure, including frame, end brackets, fan shroud and conduit box shall be fabricated steel or cast iron type ASTM A48 class 25 or better.

5.2 Motor leads will be potted into the motor frame to prevent any moisture leakage into the motor frame. 25 feet of power cable shall be provided as standard and the power leads shall enter into either the conduit box or directly into the motor casing through either a sealable water tight gland or a potted hub that will be bolted and sealed to the conduit box while still allowing the power cable to be removable.

5.3 Cable entry system shall be designed to prevent moisture leakage up to 30 feet submergence for a period of 2 weeks.

5.4 Motor shall be blower cooled such that when the motor is submerged, the blower shall disable without overloading the main motor. The blower motor shall be connected to an independent control circuit per NEMA standards. The blower fan shall be corrosion resistant, non-sparking bi-directional. The main motor shaft will not protrude through the opposite drive end bracket and there will be no running fit to allow entrance of water into the motor. Once the motor is submerged, the blower motor must be replaced or properly serviced following a return to an unflooded state.

5.5 Motor rotor construction shall be of cast aluminum or fabricated copper and its alloys. Rotors shall be dynamically balanced to ISO G 0.4. Balance weights if required shall be secured to the rotor balance sprues or bar rotor endplates. Machine screws and nuts are prohibited.

5.6 The motor shall be designed to prevent infiltration of water along the shaft by utilizing an appropriate immersible seal arrangement running on a polished surface of the shaft. The immersible seal arrangement shall be capable of withstanding submergence of 30 feet for a period of 2 weeks.

5.7 All mounting hardware shall be hex head, high strength, SAE Grade 5, and plated for protection. Screwdriver slot fasteners are prohibited on all frames.

5.8 Corrosion resistant stainless steel nameplate shall be affixed to the motor frame with stainless steel or brass drive pins. Nameplate information shall include all required NEMA data and AFBMA numbers.

5.9 All mating fits shall have rabbet joints with O-rings to ensure a watertight design.

5.10 All motor parts, including frame, bracket, fan cover and terminal box are to receive a minimum of two coats severe duty, high grade epoxy paint. All motor parts shall be primed with an epoxy primer. These parts include the stator/frame assembly, rotor assembly, end brackets, fan cover, conduit box, and conduit box cover.

6.0 ELECTRICAL

6.1 All motors shall successfully operate under power supply variations per NEMA MG1-1993-14.30.

6.2 All motors shall be designed with torque starting requirements in accordance with NEMA-MG1-1998 20.10.1 unless high torque starting is required, then it shall be in accordance with 20.10.2.

6.3 Motors shall have random wound copper windings.

6.4 Motor insulation shall be class F minimum on all motors.

6.5 Motor leads shall be non-wicking type, Class F temperature rating or better and permanently numbered for identification.

6.6 Each completed and assembled motor shall receive a routine factory test per NEMA standards.