MUNICIPAL, INDUSTRIAL & IRRIGATION BID SPECIFICATIONS

SUBMERSIBLE PERMANENT MAGNET MOTORS (6-INCH)

1.0 GENERAL

1.1 Manufacturer Requirements

1.1.1 Manufacturer shall have been in active production of Submersible Motors used on vertical submersible multi-staged turbine or centrifugal pumps.

1.1.2 Each motor shall have its factory performance and submergence specifications verified by wet testing. The results of these tests shall be recorded by the motor's unique serial number. Copies of these test results shall be available to the Engineer upon request.

1.1.3 Manufacturer shall be a recognized member of water systems industry associations such as Hydraulics Institute, National Groundwater Association (NGWA) and Water Systems Council (WSC), as well as actively contributing to both human and financial resources that further continuous improvement of water industry standards.

1.1.4 Pump, motor, and start/control electronics and equipment shall be specified, assembled, or recommended by the same manufacturer to ensure the best optimization of components relative to performance and service life.

1.1.5 Pump and motor shall be manufactured by Franklin Electric or have obtained an "Approved Equal" status from the Specifying Engineer.

1.2 Quality Requirements

1.2.1 Motors shall be produced in an ISO certified facility in North America or Europe.

1.2.2 Every factory assembled motor shall have an energized wet test to verify it meets manufacturing performance and submergence specifications prior to being boxed.

1.3 Permanently Affixed Nameplate Minimum Data

1.3.1 Original Manufacturer's Name (OEM)
1.3.2 Country of Assembly
1.3.3 Model Number
1.3.4 Serial Number (a unique manufacturing number for this motor)
1.3.5 Nominal Rated Voltage(s)
1.3.6 HP and kW Full Load (FL) Output Ratings
1.3.7 Maximum rpm at Nameplate Service Factor Load HP and kW
1.3.8 Axial thrust load bearing rating
1.3.9 NEMA Service Factor Maximum Amps (SFA)
1.3.10 NEMA Operating Duty Rating
1.3.11 UL Thermal Insulation Class Rating
1.3.12 Maximum Operating Ambient Temperature
1.3.13 Minimum Cooling Flow Requirement Past the Motor

1.4 After the Sale In-Field Minimum Requirements

1.4.1 The motor manufacturer shall directly employ a North American based, full-time, Field Service Group that is regionally disbursed.
- 1.4.1.1 They shall provide at-the-well site assistance.
- 1.4.1.2 They shall provide support by telephone and internet.
- 1.4.1.3 They shall conduct application and installation group training regularly in the field.

1.4.2 Their group shall maintain factory or Headquarter based training facilities in North America and schedule periodic training classes.

1.4.3 Factory laboratories shall furnish no-charge written performance and teardown reports to the Field Service Group and customer to assist them in resolving field issues.

1.4.4 The motor system shall be sold through a business to business, professional contractor oriented, wholesale network partner with direct contact to the manufacturer.
- 1.4.2.1 Wholesale partner must be capable of providing sales support through maintaining continuity of the supply chain.
- 1.4.2.2 Wholesale partner must be capable of providing application advise during installation and operation of the product.

1.5 Application and Installation Documentation Minimum Requirements

1.5.1 The motor manufacturer shall create and provide an Application and Installation Manual, Product Installation Manual, and Quick Installation Setup documentation for the submersible motor and PM capable Variable Frequency Drive (VFD) control panel, that clearly presents data required proper installation of the system components.

1.5.2 These manual documents shall be regularly reviewed and updated by the motor manufacturer to ensure the manual remains both correct and current.

1.5.3 These manual documents shall be available in a published copy for field use and on the manufacturer's internet site.

2.0 MOTOR SPECIFICATIONS

2.1 Motor Basic Construction

2.1.1 Motors shall be Squirrel Cage Permanent Magnet Rotor.
2.1.2 Motors shall thermal insulation Class F rating or higher.
2.1.3 Motors shall be suitable for use with a Variable Frequency Drive.
2.1.4 The motor with its lead connected shall be qualified for 1200 feet of submergence by factory wet testing at a minimum of 500 psi.
2.1.5 Motor voltage tolerance shall be a minimum of ± 10% from the nameplate rating(s).
2.1.6 Motor shall be capable of achieving true synchronous speed of 3600 rpm
2.1.7 Motor electrical design to utilize 4-pole construction

2.1.8 **CRITICAL** - Motor nameplate hp and rotational speeds shall meet the pump required hp and meet the below industry accepted hp design criteria.
- 2.1.8.1 7.5 HP; 3450 rpm at 115 Hz 10.1 amps; 3600 rpm at 120 Hz 12.0 max amps
- 2.1.8.2 10 HP; 3450 rpm at 115 Hz 12.2 amps; 3600 rpm at 120 Hz 15.2 max amps
- 2.1.8.3 15 HP; 3450 rpm at 115 Hz 17.2 amps; 3600 rpm at 120 Hz 22.5 max amps
- 2.1.8.4 20 HP; 3450 rpm at 115 Hz 26.0 amps; 3600 rpm at 120 Hz 31.4 max amps
- 2.1.8.5 25 HP; 3450 rpm at 115 Hz 30.4 amps; 3600 rpm at 120 Hz 38.2 max amps
- 2.1.8.6 30 HP; 3450 rpm at 115 Hz 35.3 amps; 3600 rpm at 120 Hz 46.0 max amps
- 2.1.8.7 40 HP; 3450 rpm at 115 Hz 51.7 amps; 3600 rpm at 120 Hz 63.0 max amps
- 2.1.8.7 50 HP; 3450 rpm at 115 Hz 61.2 amps; 3600 rpm at 120 Hz 78.5 max amps
- 2.1.8.8 60 HP; 3450 rpm at 115 Hz 74.0 amps; 3600 rpm at 120 Hz 80.0 max amps
- 2.1.8.9 Minimum Operating Efficiencies
  - 2.1.8.9.1 6-inch three-phase - minimum efficiency at 3600 rpm and 120 Hz is 91%

2.1.9 Rotation: The industry standard rotation is counter-clockwise (CCW) viewing the top end of the shaft.
2.1.9.1 Three-phase motors shall be electrically reversible.
2.1.9.2 Three-phase motor mechanical systems shall be suitable for either CCW or CW rotation.
2.1.10 The top endbell shall be double flange for ease of handling and safety.
2.1.11 The bearing systems shall be designed to be lubricated by a FDA approved non-toxic, water based and water soluble fill solution.
2.1.12 The radial bearings shall be sleeve type consisting of stainless steel shaft journals and carbon-graphite sleeves. The carbon-graphite sleeves shall be grooved to provide a path for water circulation through the bearing.
2.1.13 The thrust bearing shall be a Kingsbury-type consisting of a rotating carbon-graphite disc and stainless steel segments that pivot independently. The independent pivoting of the segments allows the bearing to equally distribute the load.
2.1.14 The up-thrust system shall be designed to handle the intermittent upthrust created when a pump starts.
2.1.15 The leads shall be able to be field replaceable without special tools.
2.1.16 The motor pump mounting face shall meet the NEMA specification for submersible motors.
2.1.17 The shaft extension shall be splined to meet the NEMA specification for submersible motors.
2.1.18 The motor with lead attached shall ship from the factory as a complete pre-filled and fully wet tested unit that is ready for installation.

2.2 Motor Detailed Construction

2.2.1 Diaphragm: The diaphragm system shall be of a positive pressure spring loaded design. It will both equalize the pressure between the interior and exterior of the motor and supply a slight internal pressure.
2.2.2 Encapsulated Stator Requirements
- 2.2.2.1 The stator core and winding area must be hermetically sealed.
- 2.2.2.2 The windings shall be wound with Class H (356 °F/180 °C) high temperature electrical winding wire.
- 2.2.2.3 The complete interior of the sealed winding area that is not occupied by the core and winding shall be filled with a special thermo-setting resin that cures to a solid mass.
- 2.2.2.4 All internal stator winding shall be made using copper wire

2.2.3 Encapsulating Resin Requirements
- 2.2.3.1 The resin shall be a thermo-setting resin capable of a Class F or higher UL temperature rating.
- 2.2.3.2 The resin shall be in direct contact with the electrical windings and secure them in place. This process must ensure that neither the windings end turn bundle nor the individual wires can wear against each other.
- 2.2.3.3 The resin shall have a superior heat conduction factor.
- 2.2.3.4 The resin shall have a high electrical resistance.
- 2.2.3.5 The resin shall have an electrical arc, anti-carbon tracking quality.

2.3 Industry Standard Requirements

Motors shall meet the accepted water systems industry third party standards. Compliance to the third party standards or directives shall be confirmed by obtaining the appropriate Recognition, Listing or Approval rating from the third party organization. As a minimum the following third party organization standards shall be met.

2.3.1 NEMA MG1 Motors & Generators for Physical Dimensions
2.3.2 ANSI/NFPA 70 USA National Electrical Code
2.3.3 ANSI/UL 778 Motor Operated Water Pumps
2.3.4 CE, CSA and/or cUL markings (if applicable)
2.3.5 Agency abbreviations expanded
- NEMA: National Electrical Manufacturers Association
- ANSI: American National Standards Institute
- NFPA: National Fire Protection Association
- UL: Underwriters Laboratories
- AISI: American Iron and Steel Institute
- MG: Motors and Generators
- NSF: National Sanitation Foundation
- CSA: Canadian Standard Association
- cUL: Underwriters Laboratories of Canada
- CE: European Conformity

SUBMERSIBLE PERMANENT MAGNET MOTORS (6-INCH)

2.4 Motor Mechanical Options (Select Only One in Each Three Digit Section)

2.4.1 Frame Size: Motors shall meet NEMA frame size nomenclature that rates the motor frame size equal to the inside diameter of the smallest well casing in which it should be installed.
- 6-inch motor frame (fits 6-inch ID well casing) - maximum motor diameter 5.44 inches
- 8-inch motor frame (fits 8-inch ID well casing) - maximum motor diameter 7.70 inches

2.4.2 Shell Material and Endbells
- 300 Series Stainless AISI shell material with epoxy-coated cast iron endbells. This is suitable for most water wells.
- 300 Series Stainless Steel AISI shell material with 300 Stainless Steel AISI endbells. This construction supplies superior corrosion-resistance for aggressive water applications.

2.4.3 Shaft Seal: Must Be Mechanical Type Face Seal

2.4.3.1 Sand Fighter™ mechanical seal with both seal faces made of silicon-carbide. This seal is suitable for higher abrasive water wells.

2.4.4 Motor Ambient Temperature Rating

2.4.4.1 Standard Motor Temperature Rating. This rating is suitable for most water wells.
- 6-inch 86 °F/30 °C Ambient Standard

2.5 Motor Electrical Options

2.5.1 Motor Frequency: 120 Hz & 1.15 sf

2.5.2 Motor Phase: Three-phase

2.5.3 Motor Full Load Output – hp or kW
- 7.5 hp/5.5 kW
- 10 hp/7.5 kW
- 15 hp/11 kW
- 20 hp/15 kW
- 25 hp/18.5 kW
- 30 hp/22 kW
- 40 hp/30 kW
- 50 hp/37 kW
- 60 hp/22 kW

2.5.4 Motor Voltage
- 460 V
- Uind = 380 V

2.5.5 Number of Power Leads Exiting 3-Phase Motors: Three Power Leads Exiting Motor sized for connection to a PM Control Capable Variable Frequency Drives (VFD)

2.6 Motor Protection Control

Controls shall be provided with the motor as a single order item package to ensure proper specification and settings of the control system. They shall meet and be installed by all applicable Country, State, Local and Regional codes and the requirements of the manufacturer's Application (AIM) Manual. A submersible motor requires a minimum of five (5) areas of power protection. All five (5) are required and serve a different purpose. They are usually located in the motor control panel or motor control center if it is close to the well head.

2.6.1 Branch Circuit Protection

2.6.2 Motor Surge Protection: This protection should be as close to the well head as possible and must be positively grounded to the water strata even at its lowest level.

2.6.3 Motor Overload Protection

2.6.3.1 Franklin Electric SubMonitor

2.6.4 Input power line protection

2.6.5 Output power line protection through either DV/DT or Sinewave topology

2.6.3.2 Motor overload protection shall be supplied per the requirements of the manufacturer's Application (AIM) Manual, but it is not required to be a Franklin Electric SubMonitor.

2.7 Motor Variable Frequency Drive (VFD) Panel

Beyond motor electrical protections the motor must be started and operated using a variable frequency drive panel. The VFD panel shall include a VFD capable of permanent magnet (PM) motor operation as a part of the native control software. The VFD shall utilize scalar volts/hertz output to maintain appropriate operational speeds of the PM motor based on the application control PID or other site specific on/off control schemes.

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