

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION E-51-06
MOTORS BELOW 40 kW FOR SUBMERSIBLE PUMP

1 TECHNICAL REQUIREMENTS

1.1 General

This standard specification is for submersible motors of rating below 40 kW and used in clear water applications unless otherwise specified.

The motor shall comply with the following requirements:

- (a) Type : Energy efficient squirrel-cage type induction motor with the following minimum full load efficiency:

Rated Output Power	Minimum Motor Efficiency
5 – 7.5 kW	75%
7.6 – 15 kW	77%
15.1 – 37 kW	81%
37.1 – 40 kW	83%

- (b) Standards : IEC 60034 except where modified herein.
- (c) Degree of protection : IP68 to IEC 60034-5 for continuous submersion in water.
- (d) Duty rating : Maximum continuous rating (MCR), S1 duty to IEC 60034-1, unless otherwise specified.
- (e) Insulation : Dry-type Motors - Class F design with temperature rise not exceeding the limits applicable to Class B in IEC 60034-1.
Water-filled Motors - Class B design with temperature not exceeding the limit specified in IEC 60034-1.

1.2 Operating Conditions

- (a) Ambient air temperature : 40°C maximum continuous for 4 hours.
35°C average over 24 hours.
5°C minimum.
- (b) Humidity : Up to 98% relative humidity.
- (c) Water temperature range : 5°C - 40°C

1.3 Electrical Conditions

- (a) Electricity supply : 380V three-phase, 50 Hz, four-wire system with solidly earthed neutral.
- (b) Voltage variations : -10% to +6%
- (c) Frequency variations : $\pm 2\%$

2 STARTING PERFORMANCE AND RATING

Motors shall be suitable for both direct-on-line (DOL) and soft/auto-transformer starting. The DOL starting current at rated voltage shall not exceed 7.5 times the full load current.

The starting time (time taken to attain 90% of the rated speed) under the most arduous conditions shall be as follows:

85% rated voltage at motor terminals - not more than 4 seconds
49% rated voltage at motor terminals - not more than 10 seconds

The motor shall be suitable for two starts in succession followed by a cooling period of 10 minutes before attempting another starting sequence. The motor shall also be capable of at least twelve starts per hour, equally spaced, during normal operating conditions.

When used in conjunction with a variable speed drive (VSD) or inverter supply, the motor shall be designed with reference to IEC TS 60034-17 or other equivalent standards to withstand over-voltage, higher rate of rise of voltage, over-heating due to harmonics, flow of bearing current and other stressing effects arising from the pulse width modulated (PWM) waveform of the supply voltage.

3 DESIGN AND CONSTRUCTION

3.1 Enclosure and Cooling

Motors filled with oil for cooling shall not be used.

The motor shall have a cast iron casing unless otherwise specified. It shall have lifting lugs for easy handling during erection or maintenance.

Water-filled type motor shall have self-circulation cooling to IEC 60034-6, characteristic code IC4W1W0 (viz. machine cooled by water in an internal closed circuit and immersed in water externally). Dry-type motor shall have self-circulation cooling to IEC 60034-6, characteristic code IC4A1W0 (viz. machine cooled by air in an internal closed circuit and immersed in water externally).

3.2 Bearings

Motor bearings shall be of rolling type and metric sizes. Water-lubricated bearings

shall be used and approved type thrust and guide bearings shall be provided for vertical-shaft motors.

3.3 Cabling and Termination

Power supply cables and control cables (where applicable) shall be supplied integral with the motor. For fixed submersible pumps, the length of the power supply and control cables shall be the duty pump head plus 10 metres unless otherwise specified. For portable submersible pumps, the length of the power supply and control cables shall be 50 metres unless otherwise specified.

The power supply cable shall be waterproof, flexible, resistant to abrasion and impact, of adequate current rating and complete with an integral earth continuity conductor. The earth continuity conductor shall have the same current carrying capacity as the line conductors and terminate at an earthing terminal inside the casing. Cable cores shall be identified by colour codes or lettering. The cable shall have insulation and an oversheath of synthetic rubber. The cable shall be of 450/750V grade to BS EN 50525 or other equivalent international standard with a maximum conductor temperature of 85°C.

The cable and termination at the motor end shall be suitable for continuous operation under water and shall have the same degree of protection as for the motor. The other end of the cable shall be suitably sealed to keep out of moisture.

Unless otherwise specified, the minimum size of the power supply cable shall be selected from Table 1 below. In addition, the voltage drop on the cable at full load shall not be greater than 2.5%.

Table 1 - Power Supply Cable Schedule

Stranded Copper Size (mm ²)	Permissible Motor Rated Full Load Current for one cable (A)
2.5	14
4	22
6	31
10	43
16	58
25	76
35	94

For portable submersible pumps, the power supply cable shall be terminated to an industrial type weatherproof electric plug to IEC 60309 with a degree of protection IP44 to IEC 60529.

3.4 Markings and Data Plates

An instruction plate and a data plate of stainless steel shall be provided. The instruction plate shall give the connections and the phase sequence for the required

direction of rotation while the data plate shall be stamped with the information specified in IEC 60034-1.

4 PROTECTIVE EQUIPMENT

A winding embedded thermostat switch shall be provided for motors of rating more than 3 kW.

For portable submersible dewatering pumps, the motors shall be equipped with in-line self-resetting temperature switches and float switches for over-current protection and for auto start/stop controls respectively.

5 INFORMATION FOR ASSESSMENT

Descriptive literature relevant to the motor and auxiliary equipment, in particular the dimensions of the motor shall be submitted for assessment.

The following torque-speed characteristics shall also be included in the submission:

- (a) Torque characteristic at rated voltage.
- (b) Torque characteristic at the lowest specified voltage across the motor terminals.

The Y-axis shall be torque in N-m while the X-axis shall be the motor speed in rpm. Characteristic curves plotted on per-unit values are not acceptable.

- End of this Specification -