

WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION E-51-06

MOTORS BELOW 40 kW FOR SUBMERSIBLE PUMP

1 GENERAL

This standard specification is for submersible motors of rating below 40 kW.

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 (P)	Minimum Motor Efficiency
5kW – 7.5kW	75%
7.6kW – 15kW	77%
15.1kW – 37kW	81%
37.1kW – 40kW	83%

- (b) Standards : IEC 60034 except where modified herein.
- (c) Degree of protection : IP 68 to IEC 60034-5 for continuous submersion in water.
- (d) Duty rating : Maximum continuous rating (MCR), S1 duty to IEC 60034-1.
- (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.
- (f) Ambient temperature : 40°C maximum continuous for 4 hours.
35°C average over any 24 hours.
5°C minimum.
- (g) Humidity : Up to 98% relative humidity.
- (h) Water temperature : 5°C - 40°C
- (i) Electricity supply : 380V 3 phase, 50 hertz, 4 wire system with solidly earthed neutral.
- (j) Voltage variations : $\pm 6\%$
- (k) Frequency variations : $\pm 2\%$

2 STARTING PERFORMANCE AND RATING

Motor above 3 kW shall be suitable for both direct-on-line and soft/auto-transformer

starting. The direct-on-line 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 running conditions.

When used in conjunction with a variable speed drive (VSD) or inverter supply, the motor shall be designed with reference to IEC TS60034-17 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 Ventilation and Cooling

Motors filled with oil for cooling shall not be used.

Water-filled type motor shall have self-circulation cooling to IEC 60034-6, characteristic code IC 4W1W0 (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 IC 4A1W0 (viz. machine cooled by air in an internal closed circuit and immersed in water externally).

3.2 Bearings

Metric size rolling bearings shall be supplied, viz. imperial size bearings shall not be acceptable.

Vertical shafts shall have approved thrust and guide bearings.

3.3 Cabling and Termination

Power supply cables and control cables (where applicable) shall be supplied integral with the motor. The length of the power supply and control cables shall be 50 metres unless otherwise specified. The voltage drop on cable at full load shall not be greater than 2.5%.

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 be synthetic rubber insulated and sheathed, 450/750V grade to BS 6007 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 moisture. Unless otherwise specified, the size of power supply cable shall be selected according to the motor rated full load current (FLC) from the following Table 1.

Table 1 - Power Supply Cable Schedule (50 metres)

Stranded Copper Size (mm ²)	Permissible Motor Rated Full Load Current for 1 cable (A)
2.5	14
4	22
6	31
10	43
16	58
25	76
35	94

For portable submersible dewatering pumps, the power supply cable shall be terminated to an IP44 industrial type weatherproof electric plug to IEC 60309.

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

3.5 Enclosure Construction

Motors shall have cast iron casings and be provided with lifting lugs for easy handling during erection and maintenance.

4 PROTECTIVE EQUIPMENT

A winding embedded thermostat switch shall be provided for pump motor above 3 kW.

For use with 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.

- End of this Specification -