

**OMAN WASTEWATER
SERVICES COMPANY S.A.O.C**



**الشركة العمانية
لخدمات الصرف الصحي ش.م.ع.م**

OMAN WASTEWATER SERVICE COMPANY

ELECTRICAL STANDARD SPECIFICATION

SECTION 08

ELECTRIC MOTORS

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1-0 SCOPE

This specification covers the design, manufacture and testing of induction motors to be installed to be installed within Oman Wastewater Services Company projects.

2-0 STANDARDS SPECIFICATIONS

The Motors shall conform in design, materials and performance (except where otherwise specified) with all relevant Statutory Regulations and the latest editions (at time of order) of all relevant British and Harmonized European standards including:

- BS EN 60034 Rotating Electrical Machines
- BS 2048 Dimensions for fractional horse-power motors
- BS EN 60079 Electrical apparatus for Explosive Gas Atmospheres, Electrical installations in Hazardous areas.
- BS EN 60204 Safety of Machinery
- BS EN 60529 Specification for Degrees of Protection Provided By Enclosures.
- BS EN 4999 General Requirements for Rotating Electrical Machines
- BS EN 5000 Rotating Electrical Machines of particular types or for particular applications
- All relevant IEC recommendations relating to electric motors
- National Electrical Manufacturers Association (NEMA)
- Omani Electrical Standards.

3-0 SERVICE AND ENVIRONMENTAL CONDITIONS

The Motor shall, in all respects, be suitable for operation under service conditions stated on Electrical Standard Specification Section-01.

4-0 POWER SUPPLY SYSTEMS

4-1 Motor voltage ratings shall be in accordance with the following:

4.1.1 Rating above 350 kW
6600V, 3 phase, 50Hz

4.1.2 Ratings 0.3 to 350 kW
415V, 3 phase, 50Hz

4.1.3 Ratings below 0.3 kW
240V, 1 phase, 50Hz

4-2 Auxiliary power supplies, for condensation heaters shall be 240V, 1 phase, 50Hz

4-3 Motors shall be capable of providing their continuous rated output for variations in voltage of $\pm 10\%$ and in frequency of $\pm 1\%$

5-0 PERFORMANCE

Unless otherwise stated, motors shall be designed for continuous running duty and maximum continuous rating.

5-1 All motors shall be capable of starting 10 times per hour.

5-2 The Locked rotor current of motors shall not exceed 6 times the full load current.

5-3 Motors shall be designed, unless otherwise specified, for direct-on-line starting and shall be capable of starting and accelerating the driven equipment with

80% of the nominal voltage at the motor terminals. Under these conditions motor temperature limitations should not be exceeded.

- 5-4 The starting torque characteristics at 80% rated voltage shall be adequate for starting the driven load under the most severe conditions, e.g. Pump with open discharge valve.
- 5-5 Motors shall be specifically selected to match the variable speed drive. They shall be adequately rated in accordance with the mechanical equipment manufacturer.
- 5-6 When a motor is to operate in a potentially explosive atmosphere, it shall be classified for the Zone, and be suitably rated for the installation positions Gas Group and Temperature classification of the area. Equipment shall be in accordance with BS EN 60079 and shall be EEx certified by an appropriate certifying authority.
- 5-7 Motors shall have a maximum noise level of 85 dB (A) measured at a distance of 1 meter from motor surface and running at rated load. Where noise level is measured under no load conditions the maximum level shall be reduced to 82 dB

6-0 MOTOR PROTECTION

- 6-1 Two resistance temperature detectors (RTD) per phase shall be installed within the stator windings to monitor winding temperature. The RTD leads shall be brought out to a separate terminal box mounted on the motor enclosure. The detectors shall be provided with temperature indicators, alarms and trips for use with motor control protection.
- 6-2 Thermistors shall be embedded in the stator slots during winding assembly and shall not be fitted to the end winding after manufacture. The thermistor wiring shall be properly terminated in a connection box and clearly labeled.
- 6-3 The temperature of each bearing shall be monitored by means of thermistors.
- 6-4 Motor with differential protection will be specified on the motor data sheets. For this purpose an adequately sized separate terminal box mounted on the opposite side to the main terminal box shall be provided for terminating the neutral end of the winding and to accommodate three current transformers to be supplied by others.

6-5 Submersible pump motors shall be equipped with the following thermal protection and fault monitoring devices:

- At least two thermal switch or sensors embedded in the stator windings coils, set to operate with a tripping temperature of 125⁰C, for motors rated up to 54 Kw, and 140⁰C for motors rated above 54 kW.
- Sensors for detecting moisture ingress into the oil filled chamber between the pump casing and the stator housing.

6-6 Where a sensing relay is required to operate with motor protection, it shall be supplied and delivered as a loose item.

6-7 The motors shall be fitted with anti-condensation heaters of a size to maintain the temperature of the windings 5 °C above ambient. Each heater shall be provided with a switch and automatic control to disconnect it when its motor is in operation

7-0 CONSTRUCTION

7-1 Enclosure

7-1.1 Motors shall be Totally Enclosed Fan Cooled (TEFC) unless otherwise specified.

7-1.2 Totally Enclosed Non-Ventilated (TENV) if used shall have the same rating and accessories as specified for TEFC motors.

7-1.3 Motors for installation in hazardous area shall be specified on the motor data sheet. Motors shall be certified for use in a hazardous area by a recognized testing authority. Copies of certificates shall be supplied by the seller.

7-1.4 The degree of protection for motor enclosures and terminal boxes shall be

- a) IP 55 for outdoor use.
- b) IP 54 for general purpose drives
- c) IP 68 for submersible machines

- 7-1.5 Where motors are to be supplied as an integral part of submersible units they shall be supplied with flexible connections. Each flexible shall have a minimum length of 10 meters. These cables shall comply with any Hazardous Area requirements and the requirements of BS EN 0079.
- 7-1.6 For submersibles fed by an inverter, all flexible cabling shall incorporate earthed, armoured braiding to maintain EMC rating. Both ends of each phase winding shall be brought out as six connections to enable various forms of starting to be utilized. The phase cores of the flexible cables shall be identified as U1, V1, W1 and U2, V2, W2.
- 7-1.7 A motor earth connection shall be brought out with the phase conductors.
- 7-1.8 Where multi-core cables are used, an earth connection shall be included within each cable.
- 7-1.9 Motors for operation on variable frequency drives shall meet current power quality levels. Enclosures shall be equal to those furnished for severe duty.
- 7-1.10 Means of lifting shall be provided for all motors. Motors weighing over 25 Kg shall be fitted with eye bolts, lugs or extension pieces for hoisting. Motors weighing over 200 Kg shall be fitted with jacking bolts or equivalent facilities to lift, position and line up.

7-2 Windings

- 7-2.1 The winding of MV motors shall be star connected. When specified on the motor data sheet, motors with differential protection shall have both ends of each phase winding brought out to separate phase end and neutral en terminal boxes. Low voltage motors three phase windings may be either star or delta connected in accordance with manufacturers' standards.

- 7-2.2 Classification of materials for the insulation of motors windings in relation to thermal stability in service shall conform to IEC 85 or relevant BS.
- 7-2.3 Winding insulation shall be class F with class B (80°C) temperature rise, unless otherwise.
- 7-2.4 Motors shall be designed to prevent deterioration caused by condensation under the specified site conditions.
- 7-2.5 All 6.6 kV motors shall be equipped with anti-condensation heaters (240V). Anti-condensation heaters will be provided on lower voltage motors when specified.
- 7-2.6 A separate terminal box shall be provided for terminating the high voltage motor anti-condensation heater connections. Terminals for the low voltage motor heater connections may be located in the main motor terminal box. In protecting motors against deterioration caused by condensation, the manufacturer shall take in account that motors will be at a standstill for long periods when on standby duty.
- 7-2.7 Motors shall be suitable for switching by all types of switching devices including SF6, vacuum break type of contactors or circuit breakers.
- 7-2.8 Motors for two-speed operation shall be dual wound with two separate sets of windings, each brought to a separate terminal box.

7-3 Terminal Boxes and Terminations

- 7-3.1 Terminal boxes shall be adequately sized for the number and size of cables specified.
- 7-3.2 The terminal chamber shall be designed such that no foreign objects can enter the motor frame from the terminal box.
- 7-3.3 Terminal boxes shall be located on the left hand side of the motor when facing the non-drive end unless stated. (Exception: terminal boxes may be top mounted where this is the manufacturer standard location).

- 7-3.4 Terminal boxes shall be rotatable to permit cable entry 3, 6, 9, 12 o'clock positions. Required position will be stated on the motor data sheet.
- 7-3.5 Cable entries shall have ISO metric or NPT threads, size as stated on the motor data sheet. Entries to be suitable for compression type glands or NPT adaptors provided by others.
- 7-3.6 Terminal boxes for hazardous area motors shall be capable of withstanding the system prospective fault current, as detailed in the data sheet.
- 7-3.7 When a motor is provided with a heater, current transformer or temperature detectors, the connections for each device shall be brought out to a separate terminal box. Each of these terminal boxes shall be provided with an internal earth terminal.

7-4 Rotors and cooling fans

- 7-4.1 External fans shall be constructed of non-corroding material or treated with a corrosion resistant material.
- 7-4.2 The flow of cooling air shall be in the direction of the driven equipment.
- 7-4.3 The direction of rotation of the motor shall be clearly indicated on the drawing and on the motor by raised or embossed markings. If bi-directional fans are used the direction of arrow shall have two points.
- 7-4.4 Shaft ends shall be provided with suitably threads holes to facilitate the assembly or removal of couplings and bearings, etc.

7-5 Earthing

- 7-5.1 The motor terminal box shall be fitted with an internal earthing stud. The stud size shall be M10 except for low voltage motors.
- 7-5.2 The motor frame shall be fitted with M10 earthing stud.
- 7-5.3 Earthing stud shall be located to provide easy access for making a bolted connection.

7-6 Rating plate

7-6.1 Manufacturer's serial number and frame reference of the motor shall be stamped on a non-removable part of the frame. These numbers shall also be shown on the rating plate.

7-6.2 The rating plate or plates shall be made of corrosion resistant metallic material fixed to a non-removable part of the frame, and shall be marked with the appropriate items in accordance with the IEC or equivalent British standard, the values given shall be those actually measured.

In addition to these items, the following information shall be indicated:

- Manufacturer's name,
- Equipment number (as stated on the motor data sheet),
- Rated output in Kw,
- Operating voltage, frequency, and winding connection configuration,
- Full load current,
- Locked rotor current in % of rated current,
- Locked rotor torque in % of rated torque,
- Output shaft speed,
- Allowable running-up time in seconds at 80% nominal terminal voltage,
- Insulation class,
- Relevant standard,
- Suitability for Variable Speed Operation,
- Type of enclosure in accordance with IEC or BS standards,
- Type of explosion protection if applicable,
- Bearing type, size, fit, regreasing period and type of grease,
- Purchase order number and date of order,

7-7 Shop Painting

7-7.1 The colour, finish and corrosion protection shall be suitable for the environmental conditions stated in Section 3.0.

8-0 BEARINGS

- 8.1 The types of bearings and their lubrication, for horizontal machines, shall be of the sleeve or ball type as specified under the respective items of mechanical equipment. Vertical motors shall have thrust bearings designed to carry the maximum axial thrust (up and down) imposed by the driven equipment manufacturer. Weather protection shall be provided for the top bearings.
- 8.2 Motors above 350 kW shall be provided with local bearing temperature indicators.
- 8.3 The supplier shall make provision, in accordance with his standard practice, to prevent damage to bearing by shaft currents.
- 8.4 Where required, large machines shall be provided with insulated bearings to prevent bearing failure due to circulating rotor current.
- 8.5 Full details of all bearings shall be given on the motor identification plate and also in the parts list provided within the Operation Manual.
- 8.6 Sealed-for-life bearings are acceptable on motors rated up to and including 22 kW.
- 8.7 For motors above 22 kW, bearings shall be fitted with lubrication points and grease relief facilities.
- 8.8 Lubrication points shall be located such that there is no danger from moving parts, while the motor is being greased.
- 8.9 If vibration proximity monitoring is required, it will be stated in the motor data sheet.

9-0 INSPECTION AND TESTING

- 8.10 The purchaser reserves the right to inspect motors or motor materials of construction at the manufacturer's works prior to prove compliance with specification.
- 8.11 Tests shall be carried out by the manufacturer at his works in accordance with the relevant standards. Vendor shall submit a list of routine tests that he proposes to carry out on motors.
- 8.12 Test result shall be recorded and certificates issued for each motor.
- 8.13 Individual, load/efficiency curves for each motor rated 22 to 110 Kw inclusive shall be supplied by the manufacturer.
- 8.14 For motors above 110 Kw, Duplicate tests as defined in BS 4999 Part 143 shall be carried out with witnessing.
- 8.15 For motors operated by VSD above 75 Kw, variable speed drives shall be string tested to validate the system performance. This test shall include connection of the inverter to the motor to be installed at site, with a complete system check on the test bed.
- 8.16 Routine test shall be carried out on all motors as follows:
- No load current
 - High voltage on windings and auxiliary.
 - Windings resistance
 - Vibration.
- 8.17 Performance tests and noise test shall be carried out on the first of each type/size of motor.
- Full load heat run and temperature rise
 - Efficiency at 100 %, 75 %, 50 % and 25 % load
 - Power factor at 100%, 75%, 50% and 25% load
 - Noise
 - Momentary overload
- 8.18 Type test certificate shall be provided to cover the following:
- Locked rotor current
 - Locked rotor torque
 - Saturation curves
 - Percent slip

- 8.19 The purchaser shall witness performance and noise tests on all motors. The vendor shall give two weeks notices of test prior to commencement.
- 8.20 The Contractor shall provide calculations to demonstrate motor power rating and bearing life with derating factors taken into account.

10-0 DRAWINGS & DATA

The vendor shall provide drawings and data in accordance with the specification.

Information shall include the following:

- a) Motor locked rotor and full load currents;
- b) Power factors and efficiencies at full load, 75% load and 50% load;
- c) Motor housing material, winding material, ambient temperatures and maximum elevations in which motor is designed to operate continuously, service factor, insulation Class, temperature rise, type of enclosure, voltage, bearing life and dynamic balance;
- d) Nameplate data;
- e) Dimensions, weights and mounting details of motors;
- f) Motor construction details;
- g) Speed torque/current at 100 % volts;
- h) Wiring diagrams, internal and typical external connections.

11-0 DEVIATIONS

Deviations from this specification are only acceptable where the vendor has listed in his quotation the requirements he cannot or does not wish to comply with and the purchaser has accepted, in writing.

In the absence of a list of deviations it will be assumed by the purchaser that the vendor complies fully with this specification

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