

**VOLUME: V-A**

**SECTION-II**

**TECHNICAL SPECIFICATION  
FOR  
A.C. & D.C. MOTORS**

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**TECHNICAL SPECIFICATION  
FOR  
A.C. & D.C. MOTORS**

- 1.00.00      **SCOPE**
- 1.01.00      This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00      Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00      In case of any discrepancy, the driven equipment specification shall govern.
- 2.00.00      **CODES & STANDARDS**
- 2.01.00      All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00      Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:
- i)      IS-325
  - ii)      IS-12615
  - iii)      IEC-60034
- 3.00.00      **SERVICE CONDITIONS**
- 3.01.00      The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.
- 3.02.00      Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00      For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
- 4.00.00      **TYPE AND RATING**
- 4.01.00      **A.C. Motors**
- 4.01.01      Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.
- 4.02.00 **D.C. Motors**
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.
- 4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- Starter panel complete with all accessories shall be included in the scope of supply.
- 5.00.00 **PERFORMANCE**
- 5.01.00 **Running Requirements**
- 5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 **Starting Requirements**
- Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-
- |                     |   |                                             |
|---------------------|---|---------------------------------------------|
| Motors up to 1500kW | - | 600% subject to IS tolerance of plus 20%.   |
| Motors above 1500kW | - | 450% not subject to any positive tolerance. |
- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.
- 5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.
- b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

- 6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**

- 6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.
- 6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.
- 6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

| Voltage Rating of Motor |   | Minimum Ph-Ph & Ph-Earth clearance |
|-------------------------|---|------------------------------------|
| 0.415 kV                | : | 25 mm                              |
| 3.3 kV                  | : | 65 mm                              |
| 11.0 kV                 | : | 140 mm                             |

**Note:** In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

**6.08.00 Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

| Rating |        | Conductor Size |                      |
|--------|--------|----------------|----------------------|
| Above  | Up to  |                |                      |
| -----  | 5.5 kW | :              | 8 SWG GI Wires.      |
| 5.5 kW | 22 kW  | :              | 25mm X 4mm GS Flat.  |
| 23 kW  | 55 kW  | :              | 40mm X 6mm GS Flat.  |
| 56kW   | 174kW  | :              | 50mm X 8mm GS Flat.  |
| 175kW  | ABOVE  | :              | 75mm X 10mm GS Flat. |

6.08.03 The cable terminal box shall have a separate grounding pad.

**6.09.00 Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

| Rating |         | : | Cable Size          |
|--------|---------|---|---------------------|
| Above  | Up to   |   |                     |
| -----  | 5.5 kW  | : | 1R X 3C X 6 Sq.mm   |
| 5.5 kW | 11 kW   | : | 1R X 3C X 10 Sq.mm  |
| 11 kW  | 22 kW   | : | 1R X 3C X 35 Sq.mm  |
| 22 kW  | 37.5 kW | : | 1R X 3C X 70 Sq.mm. |
| 37.5kW | 55 kW   | : | 1R X 3C X 150 Sq.mm |
| 55 kW  | 75 kW   | : | 1R X 3C X 300 Sq.mm |
| 75 kW  | 110kW   | : | 2R X 3C X 150 Sq.mm |
| 110 kW | 175kW   | : | 2R X 3C X 300 Sq.mm |

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

| Rating |       | : | Cable Size |
|--------|-------|---|------------|
| Above  | Up to |   |            |

|         |           |   |                       |
|---------|-----------|---|-----------------------|
| 175 kW  | 1000 kW   | : | 1R X 3C X 240 Sq.mm   |
| 1000 kW | 2000 kW   | : | 2R X 3C X 240 Sq.mm   |
| 2000 kW | 4500 kW   | : | 2R X 3C X 300 Sq.mm   |
| 4501 kW | 10,000 kW | : | 9R X 1C X 1000 Sq.mm. |

**Note:** During detail engineering if higher cable size is required same shall be provided.

**6.10.00 Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

**7.00.00 ACCESSORIES**

**7.01.00 General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

**7.02.00 Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

- i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).
- ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

**7.03.00 Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V and 3300V motor bearing temperature.
  - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.
- 7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

**7.08.00 Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

**7.09.00 Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

**7.10.00 Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

**8.00.00 TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition, any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

| Voltage rating of motor | Impulse Test Voltage |
|-------------------------|----------------------|
| 3.3 kV                  | 18 kV peak           |
| 11 kV                   | 49 kV peak           |

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS: 7816 as routine test
- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.
- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.

- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.
- k. Over speed test as routine test.
- l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

| Specified Design<br>Ambient temperature | Thermometer Method | Resistance Method |
|-----------------------------------------|--------------------|-------------------|
| 50 deg.C                                | 60 deg.C           | 70 deg.C          |
| 45 deg.C                                | 65 deg.C           | 75 deg.C          |
| 40 deg.C                                | 70 deg.C           | 80 deg.C          |

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

**9.00.00 DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

**9.02.00 To be Submitted with the bid**

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write-up on forced lubrication system, if any
- d) Type test report

**9.03.00 To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

**ANNEXURE-A**

**DESIGN DATA**

**1.0 AUXILIARY POWER SUPPLY**

| Supply          | Description                                                                                     | Consumer                                                                                                   |
|-----------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| H.V. Supply     | 11000 V, 3Ø, 3W, 50 Hz,<br>Non-effectively earthed<br><br>Fault level 44 kA symm.<br>for 1 sec. | Motors 1500 kW & above                                                                                     |
| M.V. Supply     | 3300 V, 3Ø, 3W, 50 Hz,<br>Non-effectively earthed<br><br>Fault level 40 kA symm.<br>for 1 sec.  | Motors 175 kW and<br>Up to less than 1500 kW.                                                              |
| L.V. Supply (i) | 415V, 3Ø, 3W, 50 Hz<br>effectively earthed<br><br>Fault level 50 kA symm.<br>for 1 sec.         | Motors above 0.2kW<br>and below 175kW.                                                                     |
| (ii)            | 240V AC/415V AC<br><br>240V, 1Ø, 2W, 50 Hz<br>effectively earthed                               | Motors upto 0.2kW.<br><br>Lighting, Space heat-<br>ing , A.C supply for Contr-<br>ol & protective devices. |
| D.C. Supply     | 220V, 2W, unearthed<br><br>Fault level 25* kA.<br>for 1 sec.                                    | D.C. alarm, control<br>& protective devices                                                                |

\* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

**Note-**

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

**2.0 RANGE OF VARIATION**

A.C. Supply :

|                           |   |                    |
|---------------------------|---|--------------------|
| Voltage                   | : | $\pm 10\%$         |
| Frequency                 | : | +3% to -5%         |
| Combined Volt + frequency | : | 10% (absolute sum) |

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

|         |   |                 |
|---------|---|-----------------|
| Voltage | : | 187 to 242 Volt |
|---------|---|-----------------|