ENGINEERING DEPARTMENT

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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

REV.	DATE	ALTERATION	PREPARED	CHECKED	APPROVED
09					
08					
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06					
05					
04					
03	11.08.15	Generally revised	B.Sumith	B.Sumith	R.Prabha
02	07.11.13	Generally revised	B.Sumith	B.Sumith	R.Prabha
01	15.07.03	Generally revised	E.Loganathan	R.Prabha	GR.Srinivasan
00	03.06.02	Fresh issue	-Sd- E.Loganathan	-Sd- R.Prabha	-Sd- GR.Srinivasan

1.0 SCOPE

1.1 This standards specifies the requirement of HT & LT MOTORS for use in Utility/Captive Power Plants.

1.2 Wherever the specification requires information to be furnished by the tenderer / supplier, the same shall be furnished in the offer.

2.0 CODES & STANDARDS

2.1	Three phase induction motors	: IS :325
2.2	Single phase AC motors	: IS : 996
2.3	Crane duty motors	: IS : 3177
2.4	DC motors/generators	: IS : 4722
2.5	Energy Efficient Motors	: IS : 12615, IEC:60034-30 03

Motors conforming to equivalent international standards shall also be considered, provided the same ensures equal or better features compared to the standards listed above.

3.0 TYPE

AC Motors : Squirrel cage induction motor suitable for direct on line (DOL) starting.
Continuous duty LT motors upto 160 kW output rating (at 50 deg.C ambient temperature) shall be energy efficient motors, High Efficiency (IE2) as per IEC: 60034-30 03
: Crane duty motors shall be slip ring type induction motor

DC Motors : Shunt wound

4.0 TEMPERATURE RISE

4.1 Air cooled motors : 70 Deg.C by resistance method, over an ambient of 50 Deg.C (unless specified otherwise in Project Synopsis) for both class B & F Insulation.

4.2	Water cooled motors with maximum 38 Deg.C	: 77 Deg.C by resistance method for both cooling water temperature of class B & F insulation.
5.0	**RATING** 02	: Continuously rated (S1) unless specified otherwise. Crane duty motors – S4, 40% Cyclic duration factor.
5.1	Margin	: Maximum continuous rating (MCR) shall have atleast ten percent (10%) margin over maximum load demand including voltage and frequency variation. MCR shall correspond to the above Temperature rise, and supply variations given in Annexure – A
6.0	**SUPPLY CONDITIONS**	: Details given in Annexure – A. Motors shall be capable of withstanding the thermal, mechanical and electrical stresses when starting at extreme supply voltage and frequency limits.
6.1	Supply change over conditions	: Motor shall be designed to withstand the Voltage and torque stresses corresponding to 150% of the rated voltage, during change over of buses.
7.0	**TORQUE REQUIREMENTS**	: Motors for reciprocating compressors shall be designed to withstand the pulsating torque of the driven equipments.
7.1	Accelerating torque at minimum permissible voltage	: Ten (10) percent in excess of the driven equipment torque requirement at any speed.
7.2	Pull out torque at rated voltage	: 205 percent of full load torque. For crane duty minimum 275 percent of full load torque.

8.0 NUMBER OF STARTS : Two starts in succession under the specified conditions of load, torque and inertia with motor initially at it's normal running temperature.

9.0 STARTING CURRENT

The ratio of locked rotor KVA at rated voltage to rated KW (MCR corresponding to the specified temperature rise) shall not exceed the following. No further tolerance to be considered.

Sl.No.	MCR	Starting KVA/Rated KW
(a)	Up to 110 KW	6.0
(b)	Above 110 KW	5.5

Starting current of DC motors shall be limited to 200% of the rated current with starting resistors.

10.0 LOCKED ROTOR WITHSTAND TIME / STARTING TIME

Starting time at minimum starting Voltage	Up to 20 seconds	More than 20 seconds but less than 45 seconds	More than 45 seconds
Locked rotor with stand time at highest permissible voltage	2.5 seconds more than the starting time	5 seconds more than the starting time	Ten (10) percent more than the starting time.

Note: Where above requirements are not met, speed switches shall be mounted on motor shaft, with prior consent of purchaser.

11 CONTROL

11.1 H T Motors : Any type of circuit breaker including vacuum.

11.2 L T Motors : Up to 160 KW contactor controlled. Greater than 160 KW circuit breaker controlled.

12 ENCLOSURE AND METHOD OF COOLING

Enclosure TEFC Method of Cooling-ICO141	Enclosure CACA Method of Cooling-ICO151	Enclosure CACA Method of Cooling-ICO161	Enclosure CACW Method of Cooling-ICW 37A 81	Enclosure SPDP Method of Cooling-ICO1
LT Motors HT Motors	HT Motors	HT Motors	This option is acceptable for HT Motors rated above 3000 kw	This option is acceptable for circulating water and cooling tower motors located indoors

TEFC - Totally enclosed fan cooled
CACA - Closed air circuit air cooled
CACW - Closed air circuit water cooled
SPDP - Screen protected drip proof

13 ENCLOSURE DEGREE OF PROTECTION
: IP 55 for Outdoors.
: IP 54 for Indoors.
: IP 23 for SPDP Motors.
: Flame proof as per relevant IS & NEC for hazardous areas.

14 VIBRATION AT BEARINGS 02 : Within limits specified in IS : 12705 / BS : 4999 rt –142. Motors shall be designed to withstand the Vibration produced by the driven equipment.

15 NOISE LEVEL : Within limits specified in IS : 12065

16 CONSTRUCTIONAL FEATURES

16.1	Component interchangeability	: To be ensured for motors of identical rating & design
16.2	Drain holes	: To be provided for totally enclosed motors.
16.3	Cooling Fans	
	(a) Type	: Shaft driven
	(b) Direction of rotation	: Preferably in either direction. Particularly where identical motors are used for opposite direction of rotation.
16.4	Lifting Lug/eye bolts	: To be provided.
16.5	Rotors	: To be dynamically balanced. Combined critical speed with driven equipment shall be away from the running speed by at least 20%.
16.6	Brush	: Electrographic or metal graphite type. Brushes should run for three months with out the need for replacement.
16.7	Commutator	: Industrial Type
16.8	Space heater	: Rated for 240 V AC, to be provided for motors rated above 30 KW

17.0 WINDING AND INSULATION

17.1	(a)	Insulation for LT & DC Motors	: Class B or better 02
	(b)	Insulation for HT motors	: Non hygroscopic, preferably epoxy impregnated type. Class – F.
	(c)	Stress control & anti-corona protection	: To be provided for HT Motors.
	(d)	Slot packing for HT Motors	: To be impregnated with a conducting material.
	(e)	Over hang winding support	: Properly braced and blocked.

	(f)	Cage winding	: Joints to be braced or welded. Thermal capacity should take care of starting duty specified.

17.2 Winding Temperature detector for HT Motors

	(a)	Type	: Platinum resistance temperature detectors. resistance at Zero Degree C shall be 100 ohms. Simplex or duplex type.
	(b)	Numbers	: Six - Evenly distributed around the stator.
	(c)	Insulation class of Temp	: Same as stator winding insulation class. Detectors Protective covering to be provided on leads external to slot.

17.3 All HT motors : To be suitable for VFD operation.

18 BEARINGS

18.1 Type : Roller or other type to suit application. For vertical motors, thrust bearings may be kings bury tilting Pad type.

18.2 Lubrication : Self lubricated/Sump oil lubricated/forced oil lubricated.

18.3 Forced oil lubrication oil pumps : Two (2) numbers, each rated for100% requirement. In case of failure of the forced lubricated system, ring oil system shall provide sufficient lubrication for coasting down of motor along with driven equipments.

18.4 Jacking oil pump : If provided , shall preferably meet jacking oil requirement of motor and driven equipment.

18.5 Bearing sump accessories : Drain plug, Filling hole and oil level indicator.

18.6	Lubricating oil temperature	: 71 Degree C at bearing outlet.
18.7	Instrumentation (for HT motors)	: Dial type thermometer with adjustable alarm Contact & Resistance Temperature Detectors. (RTD) for each bearing.
	RTD type	: Duplex, Three wire. Hundred ohms at zero deg.C.
18.8	Prevention of Shaft Current	: For motors above 1000 KW
	(a) Bearing insulation	: For pedestal mounted bearing, both bearings to be insulated. Earth bonding link at drive end bearing.
	(b) other measures	: Water /oil pipe connections etc. to be insulated as necessary. : Insulation to be meggered at 500 volts.
19.0	**HEAT EXCHANGERS**	: To be provided with 15% excess tubes.
19.1	Air to air heat exchangers 02	: For motors rated above 1000 KW, dial type thermo meter with adjustable alarm contacts shall be provided to measure primary air inlet and outlet temperature.
19.2	Air to water heat exchanger	: Cooler tubes of stainless steel 304 or 70/30 brass. : Flow switch to be provided. : Water leakage detector to be provided. : Pipe flange connections, drain cock, air release plug etc. shall be external to motor.
19.3	Hydraulic Pressure withstand	: 1.5 times the maximum working pressure or 3.5 bar (g) whichever is higher.
20.0	**TERMINAL BOX**	
20.1	General	: Separate terminal box for power and instrumentation.

(a) Details of owner's Cables : Copper/Aluminium conductors. Exact details to be intimated to successful Bidder.

(b) Glands : Single compression nickeled chrome finish brass.

(c) Lugs : Tinned copper lugs. For motors rated higher than 160 KW lugs shall conform to DIN 46329

20.2 For HT motors : Phase separated type, capable of being turned through 180 degree. OR provided with Elastimold-type termination kits.

(a) Distance between gland Plate and terminal : Not less than 500 mm

(b) Accessories if Elastimold : Complete accessories along with heat Offered shrinkable trifurcating sleeves for 3 core cable. Where two cables per phase is envisaged, six sets of apparatus bushing and elbow connectors are to be provided.

: Metal enclosure with open bottom.

20.3 (A) For LT motors : Terminal box capable of being turned through 180 degree.

Distance between gland plate & Terminals : As follows

Motor MCR in KW	Cable Size	Minimum distance between center of stud and gland plate in MM
1	2	3
Up to 3 KW PVC insulated	3Cx2.5 Sq.mm (Cu)	As per manufacture's practice.

Above 3 KW – up to 7 KW	3Cx6 Sq.mm (Al) PVC insulated	85	
Above 7 KW – up to 13 KW	3Cx16 Sq.mm (Al) PVC insulated	115	
Above 24 KW – up to 37 KW	3Cx70 Sq.mm (Al) PVC insulated	196	
Above 37 KW – up to 55 KW	3Cx120 Sq.mm (Al) PVC insulated	249	
Above 55 KW – up to 90 KW	3Cx150 Sq.mm (Al) XLPE insulated	277	
Above 90 KW – up to 110 KW	3Cx240 Sq.mm (Al) XLPE insulated	331	02
Above 110 KW – up to 200 KW	3-1/2Cx300 Sq.mm (Al) XLPE insulated	203	02

(B) For HT Motors : At the time of PO

21.0 NEUTRAL CURRENT TRANSFORMERS (CTs) 02 : Neutral CTs of PS class shall be provided on each phase, for motors rated 2000 kW and above. These shall be star connected.

21.1 Star formation : In separate terminal box. Terminals to be brought out through bushings.

21.2 Location of CTs : In above terminal box.

21.3 CT type : Epoxy cast resin class PS. Parameters to be given to successful Bidder.

22.0 EARTHING TERMINALS : Two numbers, on opposite side suitable for bolted connection.

23.0 RATING PLATE : To be provided indicating KW rating at specified cooling medium with corresponding temperature rise.
: Bearing identification number.

: For ball/roller bearing, recommended lubricant.

24.0 PAINT & FINISH

: Minimum one coat of primer and two coats of finished enamel paint. Paint shade – 692 for indoors. 631 for outdoors.
* Details will be confirmed to successful bidder

02

25.0 FASTENERS

: Corrosion resistant material or cadmium plated.
: Current carrying fasteners shall be of stainless steel/high tensile brass/copper.

26.0 QUALITY ASSURANCE

26.1 All materials, components and equipments covered under this specification shall be procured. manufactured, erected, commissioned and tested as per a comprehensive quality assurance program to be approved by the owner. A complete quality plan shall be furnished for the motor rated above 50 KW. All welding and brazing operation shall be carried out as per approved welding and brazing procedure and by qualified welder/brazers.

26.2 The bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/ test and inspection procedure etc. for Owner's review/approval. In these approved quality plans, Owner shall identify customer hold points(CHP), which shall be carried out in the presence of the Owner's representative and beyond which work shall not proceed with out the consent of Owner's representative in writing.

26.3 Owner reserves the right to witness any of the tests and verify the documents of the contractor and his sub contractor. No materials/equipments shall be dispatched from the manufacturer's works before the same is duly cleared for dispatch by the Owner.

26.4 All the sub vendors proposed by the Contractor for procurement of major bought out items including raw materials, semi- finished components shall be subject to Owner's approval.

26.5 The Contractor shall carry out an inspection and testing program during manufacture in his works, and that of his sub- contractor's to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials,parts and equipments. He shall carry out all tests/ inspection required to

establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification , in addition to carry out tests as per the approved Quality plan.

26.6 Quality audit/ surveillance/ approval of the results of the test and inspection will not, however, exclude the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities, and responsibilities of the contractor in ensuring complete conformance of the materials / equipments supplied to relevant specification, standard, data sheets, drawing etc.

26.7 Indicating tests/checks to be carried out for the motors rated above 50 KW during manufacturing are to be listed by manufacturer.

27.0 TESTS

(a) All motors shall be subjected to routine tests. All LT motors shall be of type tested quality. For each type and rating of HT motor, type tests, shall be carried out.

(b) The tests shall be carried out as per applicable standards including all special tests. The list of routine tests and type tests are given below:

27.1 Induction motors

27.2 Routine Test

For all the motors:

(a) Visual check

(i) Marking on rating plates.
(ii) Appearance and painting
(iii) Location and details of terminal boxes and accessories
(iv) Check for phase sequence and terminal markings.

(b) Dimensional check

(c) Insulation resistance test for winding, space heater and RTD

(d) Measurement of resistance of windings, space heater and RTD

(e) High voltage test on windings, space heater and RTD followed by insulation resistance test.

(f) No load test.

(g) Locked rotor test (For all the ratings of motors as per IS 4029)

(h) Reduced voltage running test at no load.

(i) Over speed test.

(j) Vibration measurement at rated speed and rated voltage.

(k) Degree of protection test for IP 54 & IP 55 enclosure (It shall not be possible to insert a feeler gauge of 0.1 mm thick in the enclosure or flange faces)

Additional routine tests for HT motors only

(l) Shaft voltage measurement.

(m) Tan delta tests on windings and also on individual phases. 02

(n) Polarization index measurement (The PI value with 2.5 KV shall be not less than 2.0)

(o) Measurement of bearing temperature during steady state conditions.

(p) Functional check on auxiliaries.

27.3 Type Tests

For all the motors.

(a) All the tests as listed under routine tests.

(b) Measurement of noise at no load.

(c) Momentary overload test.

(d) Full load test to determine efficiency, power factor and slip. 02

(e) Pull out torque measurement.

(f) Temperature rise test During test winding temperature, bearing temperature, core temperature, coolant flow and its temperature shall be recorded at various intervals In case the test is carried out at other than rated load specific approval for the test method and procedure shall be obtained. Wherever ETD's are provided the temperature shall be measured by ETD also.

(g) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(h) Fault level withstand test for terminal box. (For breaker controlled motors only).

(i) Measurement of no load starting time & starting current.

Additional type tests for HT motors only.

(j) No load saturation and loss curves (up to approximately 115% of rated voltage)

(k) Surge withstand test for main insulation on a sample coil after placing it in stator
Core with at least five impulses on 1.2/50 micro sec. Wave at test voltages indicated in Annexure – A

(l) Surge withstand test for inter turn insulation on each type of motor coil with at least five impulses of 0.3/3 micro sec. At test voltages indicated in Annexure–A This test shall be followed by one minute power frequency high voltage test on turn to turn insulation after cutting the coil and bringing out turns suitably. The test voltage shall be mutually agreed upon.

(m) Determination of magnetic center (for pedestal mounted bearing motors only.)

27.4 When tests to determine the break away starting current of cage induction motors are taken at reduced voltage, due allowance shall be made for the effect of saturation and the estimated value of break away starting current at rated voltage shall be given on all test certificates.

27.5 DC motors shall be subjected to all routine and type tests as per IS :4722. In addition following tests shall be carried out.

(a) Noise level measurement as type test.

(b) Vibration measurement as routine test.

(c) Degree of protection test as per IS:4691 as type test.

28.0 COMMISSIONING CHECKS (If called for)

Commissioning checks should be carried out as per IS: 900 and other relevant standards.

29.0 DOCUMENTS REQUIRED

29.1 With bid (3 sets)

(a) Filled in motor data sheet
(b) Catalogue
(c) Q.P
(d) Compliance / Deviation list

29.2 With supplies (15 Sets)

(a) Filled in motor data sheet
(b) Catalogue
(c) Q.P
(d) Test report.

ANNEXURE - A

TECHNICAL PARAMETERS FOR MOTORS

	11KV SYSTEM	**3.3/6.6 KV SYSTEM**	**415/380 V SYSTEM**	**220 V DC**
1.0 Supply system a) Nominal system volt b) Voltage variation c) Frequency d) Frequency variation e) Combined voltage and frequency variation	11KV +/- 6% 50 Hz + 5 to –5% 10%	3.3/6.6 KV +/-10% 50 Hz + 5 to –5% 10%	415/380/240 V +/-10% 50 Hz +5 to –5% 10%	220 V 190 to 240V
2.0 Permissible rating in each voltage level.	> 1500 KW	> 160 KW (for coal handling & ash conveyor > 200 KW and up to 1500 KW (for other motors.)	< 0.2 KW (for 240 V) > 0.2 & up to 200 KW (for 415/380 V)	
3.0 Fault Level	40 kA rms for 1 sec	40 kA rms for 1 sec	45 kA rms for 1 sec	-
4.0 Minimum starting voltage available	75% (for more than 4000 KW) 80% (> 1500 KW & up to 4000 KW)	85% (for up to 1000 KW) 80% (> 1000 KW & up to 1500 KW 90% (for coal mill motor of < 1000 KW)	80% (for more than 110 KW) 85% (for up to 110 KW)	190 V
5.0 Class of insulation	Class F with B limits.	Class F with B limits.	Class B	Class B
6.0 1.2/50 micro sec impulse withstand level for main insulation	49 KV	19/36 KV	-	

02

7.0 0.3/3 micro sec surge withstand level for interturn insulation	32.0 KV	12.0/24.0 KV	-	
8.0 High frequency over voltage test value	27 KV	8/16 KV		
9.0 Terminal box				
a) Fault withstand level for 0.12 sec.	750 MVA	150/250 MVA	31 MVA (for > 125 KW)	
b) Clearance between bare live parts.	130 mm	70/110 mm*	12.5 mm 02	10mm
c) Clearance between bare live parts & earth	120 mm	60/100 mm*	12.5 mm 02	10 mm

ANNEXURE – B

PROFORMA OF MOTOR INFORMATION

Bidder's name :

1 GENERAL

(i) Manufacturer

(ii) Equipment driven by motor

(iii) Motor type

2 DESIGN AND PERFORMANCE DATA

(i) Frame size

(ii) Type of duty

(iii) Type of enclosure and method of cooling

(iv) Applicable standard to which motor generally conforms

(v) Type of mounting

(vi) Direction of rotation as viewed from non-driving end

(vii) Standard continuous rating at 40deg.C ambient temperature as per Indian standard (KW)

(viii) Derated rating for specified normal condition ie. 50deg.C ambient temperature (KW)

(ix) Rated voltage (Volts)

(x) Rated speed at rated voltage and frequency (r.p.m)

(xi) Full load current at rated voltage and frequency (Amp)

(xii) Power factor at rated load

(xiii) Efficiency of motor at rated voltage and frequency (without any tolerance) at

a) Design duty point (%)

b) 100% of full load (%)

(xiv) Starting current (amps) at

a) 100% voltage

b) 85% voltage

c) 80% voltage (for boiler feed-pump only)

(xv) Torques at

a) Starting (Kg-metre)

b) Pull up (Kg-metre)

c) Pull out (Kg-metre)

(xvi) Stator winding insulation

a) Class & type

b) Tropicalised (Yes / No)

c) Temperature rise over specified ambient of 50deg.C (deg)

(xvii) Stator winding connection

(xviii) Number of stator terminals brought out

(xix) Type of terminal box for

a) Stator leads

b) Space heater

c) Temperature detector

(xx) Space heaters

a) Number

b) Location

c) Power requirement (KW)

(xxi) Bearing type

a) Driving end

b) Non driving end

(xxii) Type of construction of rotor

(xxiii) Weight of

a) Motor stator (Kg)

b) Motor rotor (Kg)

c) Total weight (Kg)

(xxiv) Motor starting time (sec)

(xxv) Motor rated torque (Kg-met)

(xxvi) Motor accelerating torque (Kg-met)

NOTE: INDICATE TOLERANCE VALUES AGAINST EACH DATA

ANNEXURE – C

PROFORMA OF DC MOTOR INFORMATION

Bidder's name :

1 GENERAL

(i) Manufacturer

(ii) Equipment driven by motor

(iii) Motor type

(iv) Country of origin

2 DESIGN AND PERFORMANCE DATA

(i) Frame size

(ii) Type of duty

(iii) Type of enclosure and method of cooling

(iv) Applicable standard to which motor generally conforms

(v) Type of mounting

(vi) Standard continuous rating at 40deg.C ambient temperature as per Indian standard (KW)

(vii) Derated rating for specified normal condition ie. 50deg.C ambient temperature (KW)

(viii) Rated voltage (Volts)

(ix) Range of voltage between which from Volts to Volts the motor can develop rated torque

x) Minimum permissible voltage at which motor can develop the required starting torque

(xi) Current at

a) Starting at minimum permissible voltage

b) Rated load

(xii) Armature winding

a) Class & type of insulation

b) Tropicalised (Yes / No)

c) Commutator material

(xiii) Shunt winding

a) Class & type of insulation

b) Tropicalisted (Yes / No)

(xiv) Feature incorporated to ensure satisfactory communication during operation

(xv) Type of terminal box

(xvi) Motor starter (for motor 10 KW above)

a) Type

b) Make

(xvii) Space heater (if provided)

a) Number

b) Location

c) Power requirement (KW)

(xviii) Weight of motor (Kg)

NOTE: INDICATE TOLERANCE VALUES AGAINST EACH DATA