BHARAT HEAVY ELECTRICALS LIMITED

HIGH PRESSURE BOILER PLANT, TIRUCHIRAPALLI-620 014

CONTROLS & INSTRUMENTATION/FB

TECHNICAL SPECIFICATION OF

FLAME PROOF LT AC MOTORS

SPECIFICATION REFERENCE – TCI : 141, Rev. 12

Revision History

Rev. No.	Date	Description	Prepared	Reviewed		Approved
			Engineering	Engineering	Quality	Engineering
01 to 11		Earlier Revisions	-Sd-	-Sd-	-Sd-	-Sd-
12	28-08-18	Energy efficiency, Type test requirements included				

Sl. No.	Description	Requirement
1	Site Conditions :-	
	Altitude above MSL	50 metres
	Ambient temperature	50° C
	Relative Humidity	100 %
	Atmosphere	Tropical, dusty, salty, corrosive and highly polluted
2	Motor type	Squirrel cage type induction motor suitable for direct on line starting through any type of breaker.
3	Applicable Standards	IS-325, IS-1231, IS-6362, IS-2253, IS-5572, IS-12065, IS-12075, IS/IEC-60079, IS-12615, IS/IEC-60529 & IEC-60034. (Latest version of relevant standards shall be referred).
4	Application	Light Fuel Oil (LFO), Heavy Fuel Oil (HFO), Drain Oil & Sump Oil - Pump motor.
5	Type of Enclosure and degree of protection	Totally Enclosed Fan Cooled (TEFC), IP-55 as per IEC- 60529
6	Flame proof enclosures	Flame proof, Ex - 'd' enclosures as per IS 2148/IEC-60079 shall be provided for the following applications, Light Fuel Oil (LFO), Heavy Fuel Oil (HFO), Drain Oil & Sump Oil - Pump motor – Flame proof motor. Area of Classification: Gas Group – II B with temperature class T4, Zone 2 as per IEC 60079.
7	Duty Cycle	Continuous, S1
8	Energy Efficiency Class	IE-2/IE-3 as per IS-12615/IEC 60034-30. Refer project specific transmittal for applicable energy efficiency class.
9	Rated Voltage & Tolerance	415 V, AC, 3 Phase, ± 10 %.
10	Rated Frequency & Tolerance	50 Hz, ± 5 %
11	Combined voltage & frequency tolerance	10 % (absolute sum)

Sl. No.	Description	Requirement
12	General Requirements	a. All motors shall be so designed that maximum inrush currents, locked rotor and pull out torque developed at extreme voltage and frequency variations do not endanger the motor and driven equipment. b. Motor shall be designed to keep torsional and rotational natural frequencies of vibration at least 25 percent above the motor rated speed ranges to avoid resonant vibration over the operating speed range of the motor and driven equipment. c. Maximum continuous rating (MCR) of the motor shall have at least 15 % margin over the maximum load demand of the driven equipment including voltage and frequency variation. (Applicable only if vendor supplies motor along with the driven equipment or load).
13	Torque requirements	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% of motor full load torque. Pull Out torque at rated voltage shall not be less than 205 % of full load torque.
14	Requirements during Starting & Running	• Motor shall start with rated load and accelerate to full speed with 80 % rated voltage at motor terminals • The motor shall be capable of withstanding the stresses imposed if started at 110 % rated voltage. • The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75 % rated voltage at motor terminals. • The motor shall be designed to withstand momentary over-load of 60% of full load torque for 15 seconds without any damage. • The motor shall be designed to withstand 120 % of rated speed for 2 minutes without any mechanical damage.

Sl. No.	Description	Requirement
15	Class of Insulation	Class-F insulation with temperature rise limited to Class-B. Temperature rise of the motor shall be limited to 70° C (by resistance method) over an ambient temperature of 50° C.
16	Stress withstanding capability during Bus Transfer	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.
17	Capacity to restart for rated voltage	a. Two successive starts from cold condition b. Three equally spread starts per hour c. Two hot starts in succession, with motor initially running at normal temperature.
18	Starting Current	The starting current (% of FLC) shall be limited as per the standard IS-12615.
19	Locked Rotor Condition	The ratio of Locked Rotor KVA at rated voltage to rated KW shall not exceed as indicated below (without any further tolerance) For Motor rating from 50 KW ≤ 110KW : 11
20	Locked Rotor with-stand time	For motor with starting time up to 20 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than starting time.
		For motor with starting time more than 20 seconds but not exceeding 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
		For motor with starting time more than 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be 10% more than the starting time
		Vendor to provide Speed switches mounted on the motor shaft in case the above requirement is not met with.

Sl. No.	Description	Requirement
21	Type of balancing of rotor	Dynamic balancing
22	Method of cooling	IC-0411 as per IS-6362
23	Direction of cooling air flow	NDE side to DE Side
24	Winding wire	Enameled Copper Wire, Grade-2, as per IS-13730, Part-3. Windings shall be non-hygroscopic, oil resistant and flame resistant.
25	Treatment on Winding Insulation	Winding Insulation shall be given tropical and fungicidal treatment for operation of motor in hot, humid & tropical climate.
26	Noise level	Noise level shall be limited to 85 dB at 1 metre distance.
27	Vibration level	The peak amplitude of vibration shall be as per IS-12075 (Limits of Severity-Normal grade shall be followed).
28	Shaft extension	Motor shall be provided with key slotted bare shaft extension, with key at the drive end.
29	Terminal box	The flame proof terminal box shall be provided as per IS/IEC-60079. The terminal box shall be capable of being turned through 360° in steps of 180° or 90°. Shall meet IP 55 protection class requirements as per IEC 60034-5. 1 No. Earth terminal shall be provided inside the terminal box. Minimum Distance between centre of the terminal stud & the gland plate and Minimum inter-phase/phase-earth air clearance shall be provided as per IEC standards. Terminal box shall have adequate space to terminate the Power cable applicable to the motor by using suitable lugs. Connection diagram shall be marked inside the terminal box.

Sl. No.	Description	Requirement
30	Cable Entries, Cable Glands & Lugs	Cable entries, Cable glands and Lugs shall be provided suitable for the power cable size as indicated in the annexure (project specific transmittal). Double Compression type, brass with nickel plated flame proof cable glands shall be provided – Quantity to be matched with the number of entries. 3 Nos. of Tinned Copper Lugs shall be provided.
31	Terminals	Separate Terminals for Space heaters and Windings with suitable connecting links shall be supplied.
32	Body Earth	Shall have 2 Nos. of earth points (Threaded hole with suitable GI Bolt) at appropriate location (in motor base frame).
33	Space heater for motors rated 30 KW and above	Separate space heater suitable for 240 V AC, Single Phase supply shall be provided.
34	Lifting device	Eye bolt.
35	Project specific requirements	Vendor to take care of the project specific requirements indicated in the annexure - “Project specific transmittal”.
36	Name Plates	Motor shall have name plate as per relevant IS and in addition, Manufacture’s name, frame size, Energy Efficiency class, Insulation class designation shall also be indicated.
37	Quality assurance, Inspection & Testing	Motors up to 30 KW, Inspection by Vendor meeting IEC standard requirements, as applicable. Routine & type test reports shall be submitted for review and acceptance by BHEL. For Motors >30 KW, Inspection by BHEL/Third party Inspection TPI agency as per BHEL approved VQP/RQP. Routine tests will be witnessed by BHEL/TPI. Type test reports shall be submitted for review and acceptance by BHEL. In case the vendor is not able to submit report of the type test(s) conducted within last 5 years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the vendor shall conduct all such

Sl. No.	Description	Requirement
		tests either in an independent laboratory or at manufacturer's works in presence of Owner's representative under this contract, free of cost to the Owner and submit the reports for approval.
38	Type test reports	Type test reports shall be produced for the following tests as per the requirements spelt in the standards, 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency, power factor and slip. 5. Temperature rise test. 6. Momentary excess torque test. 7. High voltage test. 8. Test for vibration severity of motor. 9. Test for noise levels of motor. 10. Test for degree of protection. 11. Over speed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1 13. Energy Efficiency test.
39	Confirmation and Documents to be submitted by the vendor, during Purchase Enquiry.	a. Vendor to indicate the references of technical specification and project specific annexure and indicate "No Deviation" in the Sub-delivery Enquiry deviation form. Any deviation shall only be indicated in the Sub-delivery Enquiry deviation form. Deviations indicated elsewhere in the offer shall not considered. b. Motor GA drawing indicating foundation, shaft details and terminal box arrangement with complete dimensions.

Sl. No.	Description	Requirement
40	Documents to be submitted by the vendor for approval by BHEL/Customer, after placement of purchase order.	3 Sets of the following :- a. Final technical Data sheet as per the format submitted by BHEL. b. Motor GA drawing indicating foundation, shaft details and terminal box arrangement with complete dimensions. c. Motor Characteristic curves (Torque Vs. Speed, Current Vs. Speed, Speed Vs. time, Current Vs. time, Efficiency and PF Vs. load, Thermal withstand characteristic) d. O & M manuals.
41	Packing	The packing shall be suitable for safe transport, safe delivery at site and shall avoid damages due to environmental conditions during storage at site.
42	Painting	Paint shade shall be as per the purchase enquiry. The finish shall be corrosion resistant, epoxy based paint.

Controls & Instrumentation/Fossil Boilers
Project Specific Transmittal for LT AC motors and DC motors

Transmittal Ref.: TR:LT AC-DC MOTOR:1727

Project Details :

Project/Rating : BHUSAWAL TPP, 1 X 660 MW
Customer Number : 1727

Annexure to the technical specification of LT AC Motor and DC Motor

Energy efficient level: IE3 as per IS 12615 – 2011 (For LT AC Motors).

Table-1, Power cable size for LT AC motors:-

Vendor to provide the cable entry and supply cable-glands, lugs as per the technical specification requirement and suitable for the power cable sizes as indicated below. The cable sizes indicated below are tentative. The actual power cable size based on the run length will be intimated during technical evaluation stage.

Sl. No.	From (KW)	To (KW)	Power Cable size in sq. mm. (#)
1.	0.01	3.7	3C-2.5mm^2(CU)
2.	3.71	9.3	3C-10mm^2(AL)
3.	9.31	22	3C-25mm^2(AL)
4.	22.1	37	3C-50mm^2(AL)
5.	37.1	55	3C-95mm^2(AL)
6.	55.1	75	3C-150mm^2(AL)
7.	75.1	90	3C-240mm^2(AL)
8.	90.1	132	2-3C-240mm^2(AL)

Table-2 (applicable to LT AC, Flame proof Motors only) :-

Sl. No.	Motor rating (KW)	Minimum Distance between centre of motor terminal and the gland plate (mm)
1	Up to 3 KW	As per manufacturers' practice
2	Above 3 KW – Up to 7 KW	85
3	Above 7 KW – Up to 13 KW	115

4	Above 13 KW – Up to 24 KW	167
5	Above 24 KW – Up to 37 KW	196
6	Above 37 KW – Up to 55 KW	249
7	Above 55 KW – Up to 90 KW	277
8	Above 90 KW – Up to 125 KW	331

Table-3 Applicable for LT AC motors :-

Minimum inter-phase and phase-earth air clearance for LT AC motors with lugs installed shall be as follow

Sl. No.	Motor MCR in KW	Clearance (in mm)
1	Up to 110 KW	10
2	Above 110 KW – Up to 150 KW	12.5

Table-4 (Power cable size for DC motors) :-

Vendor to provide the cable entry and supply cable-glands, lugs as per the technical specification requirement and suitable for the power cable sizes as indicated below. The cable sizes indicated below are tentative. The actual power cable size based on the run length will be intimated during technical evaluation stage.

Sl. No.	Full Load current (Amp)	Power Cable, Armoured, Aluminium Conductor
1.	16	2C-50mm^2 (AL)
2.	20	2C-50mm^2 (AL)
3.	25	2C-50mm^2 (AL)
4.	35	2C-95mm^2 (AL)
5.	50	2C-95mm^2 (AL)
6.	63	2R-2C-95mm^2 (AL)
7.	80	2R-2C-95mm^2 (AL)
8.	100	2R-2C-95mm^2 (AL)

1.0 SCOPE

1.1 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.2 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.3 In case of any discrepancy, the driven equipment specification shall govern etc.

2.0 STANDARDS

2.1 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.

2.2 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

(a) IS-325

(b) IS-12615

(c) IEC-34

3.0 SERVICE CONDITIONS

3.1 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash canopy to be provided to all outdoor install motors.

3.2 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.

3.3 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

4.0 TYPE AND RATING

4.1 A.C. MOTORS

4.1.1 Motors shall be general purpose, constant speed, squirrel cage, three phase, induction type.

4.1.2 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.1.3 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.1.4 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.

4.1.5 ~~All LT motors used in this project are proposed to be energy efficient type suitable for EFF1 efficiency rating.~~

4.1.6 The motor name plate rating shall have at least 10% margin over the input power requirement of the ~~HT driven equipment~~ and 15% for LT driven equipments at rated duty point. This clause is applicable, only vendor supplies motor along with load.

4.1.7 Motors located in hazardous area shall be flame proof type.

4.2 D.C. MOTORS

4.2.1 D.C. Motor provided for emergency service shall be shunt/compound wound type.

4.2.2 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

4.2.3 ~~Starter panel complete with all accessories shall be included in the scope of supply.~~

4.3 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.

5.0 PERFORMANCE

5.1 RUNNING REQUIREMENTS

5.1.1 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.1.2 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.1.3 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.1.4 Motor shall not be stalled if the supply voltage drops to 70% of the rated voltage for 2 seconds duration.

5.2 STARTING REQUIREMENTS

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above for HT motors

5.2.1 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage

5.2.2 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall

be 75% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 85% rated voltage at motor terminals.

5.2.3 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

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.

5.2.4 ~~HT pump motors shall be suitable to start with forward rotation~~.

5.2.5 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

5.3 STRESS DURING BUS TRANSFER.

5.3.1 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.

5.3.2 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.

5.4 LOCKED ROTOR WITHSTAND TIME

5.4.1 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.4.2 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.4.3 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity

6.0 SPECIFIC REQUIREMENTS

6.1 ENCLOSURE

6.1.1 All indoor motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified and outdoor motor enclosure shall confirm to degree of IPW-55.Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

6.1.2 For hazardous area approved type of increased safety enclosure shall be furnished.

6.2 COOLING

6.2.1 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.2.2 In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.

6.3 WINDING AND INSULATION

6.3.1 All insulated winding shall be of copper.

6.3.2 All motors shall have class F insulation but limited to class B temperature rise.

6.3.3 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.4 TROPICAL PROTECTION

6.4.1 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.4.2 All fittings and hardwares shall be corrosion resistant.

6.5 BEARINGS

6.5.1 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.5.2 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.5.3 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.5.4 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.5.5 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

6.5.6 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.

6.5.7 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.5.8 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.5.9 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.6 NOISE & VIBRATION

6.6.1 The noise level shall be as per statutory acceptance (IS/IEC).

6.6.2 The peak amplitude of the vibration shall be within IS/IEC specified limits.

6.7 MOTOR TERMINAL BOX

6.7.1 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.7.2 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.

6.7.3 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.7.4 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.7.5 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.7.6 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.7.7 The terminal box shall be capable of withstanding maximum system fault current for duration of 0.25 sec.

6.7.8 For 11kV and 3.3kV 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.

6.7.9 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.7.10 The gland plate for single core cable shall be non-magnetic type.

6.7.11 Due to any reason, if the terminal box is found to be not suitable for the approved cable size for either HT/LT motors, then the bidder shall arrange necessary adopter box to facilitate the termination of cables. The adopter box shall be of the same short circuit rating and specifications as the main terminal box. The adopter box shall be located as near as possible to the main terminal box. The interconnecting cabling between adopter box and main terminal box along with providing suitable cable glands and termination kits as applicable shall also be done by the bidder.

6.8 GROUNDING

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

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

Motor above 90 kW	:	75 x 10 mm GS Flat
Motor above 30 kW up to 90 kW	:	50 x 6 mm GS Flat
Motor above 5 kW up to 30 kW	:	25 x 6 mm GS Flat
Motor up to 5 kW	:	8 SWG GS Wire

6.8.3 The cable terminal box shall have a separate grounding pad

6.9 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.

6.10 CONSTRUCTION

6.10.1 Stator Core

The Stator Core Lamination shall be made of high-grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core.

6.10.2 Rotor

The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage.

7.0 ACCESSORIES

7.1 GENERAL

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

7.2 SPACE HEATER

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

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

7.3 TEMPERATURE DETECTORS

7.3.1 All 11kV and 3.3kV motors shall be provided with twelve (12) nos. Simplex type winding temperature detectors, four (4) nos. per phase.

7.3.2 11kV and 3.3kV motor bearing shall be provided with duplex type temperature detectors.

7.3.3 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.3.4 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 DCS connectivity.

7.3.5 Five numbers of Temperature detectors / thermisters shall be provided for L.T. Motors above 90 kW (3 nos. Winding temperatures & 2 nos. bearing temperatures).

7.4 INDICATOR/SWITCH

7.4.1 Dial type local indicator with alarm contacts shall be provided for the following :

(a) 11kV and 3.3kV motor bearing temperature

(b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor

7.4.2 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.4.3 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.

7.5 CURRENT TRANSFORMER FOR DIFFERENTIAL PROTECTION

7.5.1 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.

7.5.2 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.

7.6 ACCESSORY TERMINAL BOX

7.6.1 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.

7.6.2 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.7 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.

7.8 LIFTING PROVISIONS

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

7.9 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 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade (RAL-7032).

8.0 TESTS

8.1 ROUTINE AND TYPE TEST:

Tests are to be conducted for ~~HT and~~ LT motors 60kW and above in presence of Mahagenco representative and contractor as per IS: 325 and required copies of test certificates are to be furnished for approval and despatch clearance. In addition, following tests shall have to be carried out on the motors in presence of MAHAGENCO representative & contractor on LT & HT motors. For Motors below 60kW type and routine test conducted as per IS325 shall be witnessed by contractor and test certificate shall be submitted for review of Mahagenco & Dispatch clearance

8 . 1 . 1 FOR HT MOTORS:

(a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS 14422,1995 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) Tan delta measurement on coils

(e) Surge withstand test for inter turn insulation.

(f) Test to diagnose rotor bar failure during manufacture.

Tests indicated at (d), (e), (f) shall be carried out during manufacture of the coils and shall be furnished for verification .

8 . 1 . 2 FOR HT & LT MOTORS:

(a) Test for suitability of IP55/ IPW– 55 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.

(b) 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 within last three years.

(c) Test for noise level as routine test.

(d) Test for vibration as routine test.

(e) Overspeed test as type test.

8.2 TEST WITNESS:

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at lest fifteen (15) days advance notice of the date when the tests are to be carried out.

AC & DC MOTOR

DATASHEET – A

SR. NO.	ITEM	UNIT	
1.0	**AUXILIARY POWER SUPPLY**		
1.1	H.T. SUPPLY		
	11kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors rated 1000 kW and above
	Fault level 44 kA symm		
	3.3kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors above 160 kW and below 1000kW
	Fault level 40 kA symm		
1.2	L.T. SUPPLY		
	415V, 3Ø, 3W, 50 Hz effectively earthed		Motors below and including160kW
	Fault level 50 kA symm		
	240V, 1Ø, 2W, 50 Hz effectively earthed		Lighting, space heating, A.C. control & protective devices
1.3	D.C. SUPPLY		
	220V, 2W, unearthed		D.C. alarm, control & protective devices
	Fault level 25* kA.		
	Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation		
2.0	**RANGE OF VARIATION**		

SR. NO.	ITEM	UNIT	
2.1	A.C. SUPPLY:		
	Voltage		± 10%
	Frequency		± 5%
	Combined Voltage & 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		
2.2	D.C. SUPPLY		
	Voltage		~~198 to 240 Volt~~ **-15% to +10%**

TITLE SHEET

SPECIFICATION FOR

Clean-Out Conveyor Drive with Gear reducer

(For Gravimetric/Volumetric Feeder)

Specification No. : GF-187 **Revision No.:05**
PGMA : 65-xxx

05	18-11-2003	Annexure-I LT motor data sheet added	
04	24.01.2002	Sheet 10/10, Pt.2 "After Functional testing" deleted; Cl.3.I added in sheet no.3/10& specification prepared in "word".	-Sd-
03	16.01.2001	Hub & Shear Pin As Spares Added.	-sd-
02	08.07.1997	Sl.No.12 was Gear Reduction Ratio Of the Geared Motor = 5:1 (Total Reduction 1041:1)	-sd-
01	08.07.1997	Point No. 5 & 6 Altered.	-sd-
00	-	First Release	-sd-
Rev. No.	**Date**	**Revision Statement**	**Checked & Approved**

	Name	Signature	Date
Prepared	**S.Manivannan**	**-Sd-**	**25-01-2002**
Checked	**S.Selvaraju**	**-Sd-**	**25-01-2002**
Approved	**S.V.Sivaramulu**	**-Sd-**	**25-01-2002**

Scope of work

This specification covers the requirement for design, supply, manufacture, testing, marking and identification, packing for shipment and delivery of the items listed
Below.

- Clean-out conveyor drive AC geared motor with gear box.
- One torque hub
- Two shear pins

The extent of supply stated here in is not necessarily exhaustive and shall not relieve the vendor form his responsibility to provide goods and services necessary to satisfy the performance criteria and guarantees specified.

Application : **U**sed for running 36" & 24" gravimetric feeder clean-out conveyor at constant speed.

Duty Class : Continuous and intermittent.
(Minimum 50 Starts Per Day)

Consisting Of :

1.0 Clean-out conveyor
Ac geared motor : Please refer sheet no. 05/12 & 06/12 of this specification.

2.0 Gear box……: Please refer sheet no. 07/12, 08/12 & 09/12 of this specification for over all dimensions.

2.1 Gear box reduction ratio : 1041:1 (Please refer table in sheet no. 07/12)

2.2 Gear arrangement : Helical and worm gear arrangement.
Approx. centre distance of worm gearing is 3.5 inches.

2.3 Output shaft and mating flange dimensions are strictly to be maintained as per the sketch shown on this specification so as to match with the mating components which are getting manufactured at BHEL- Trichy.

2.4 Please refer section-VV shown no. 09/12 of this specification. The shear pin should fail if the torque exceeds the value provided in the table corresponding to the size of feeder. The failure of shear pin should simultaneously actuate the micro switch which is to be used in customer annunciator circuit. The arrangement shown is suggestive only. The supplier shall suitably design the arrangement.

2.5 Dimensions with Asterisk (*) marks should be strictly maintained. Other dimensions may be altered to suit the gearbox design but got approved by B.H.E.L, prior to proceeding with manufacture.

2.6 Only glass type oil level indicator must be provided. Dipstick type of arrangement is not acceptable.

3.0 Along with the offer, the supplier shall submit the following documents for evaluation in triplicate.

A. Dimensional general arrangement drawing showing AC geared motor and gear box with bill of materials.

B. Cross sectional drawings of AC geared motor and gearbox showing all the internals and spare parts with overall dimensions and with bill of materials.

C. A life guarantee certificate for 40,000 hours for gears and shaft.

D. A list of bearings used in the total system. The list shall indicate the make, size and type (whether sealed or non-sealed) of bearing.

E. A list showing all the oil seals, o-rings and circlips used in the total system. The list shall indicate the description, quantity ,make, size, type, etc.

F. 3 Years O & M spare parts list along with pricing required for the total system. The list shall indicate the description, quantity, part no. & Ref. Drawings of the components.

G. Quality assurance plan shall be submitted by the supplier for raw material; in process & final Assy. QP shall be submitted for AC geared motor and gear box individually.

H. The documents as mentioned in sheet No. 05/12 & 06/12 of this specification for AC geared motor.

I. Calculation for shear key diameter with sketch; Material of construction with relevant Indian standard & clause no.

4.0 <u>The successful bidder shall submit the following documents in triplicate.</u>

A. Dimensional general arrangement drawing and cross sectional drawing as called for in 3A &, 3B submitted by the bidder shall be modified in line with BHEL's comments and got approved before going for production.

B. Quality assurance plan as called for in 3.G submitted by the bidder shall be modified in line with BHEL's comments for raw materials, in process and final Assy. Modified QP shall be for AC geared motor and gear box individually and got approved by BHEL.

C. Test certificate for no load and full load for each Assy. (The motor should be designed for 50 starts per day.)

5.0. Catalogues, preservation (storage) procedure and O&M manuals for AC geared motor and gearbox shall form part of the supply. Number of copies required will be specified in the purchase order. The catalogues and manuals shall be printed (Black & White) and supplied in bound volumes. Three copies shall be sent to BHEL for advance information and one copy must accompany along with each shipment. Balance copies shall be sent thro' regular despatch.

6.0 Other Information's Required :-

A. Weight of AC geared motor.

B. Weight of gearbox.

C. Lubrication details.

D. Painting details.

E. Coupling details in between AC geared motor & gearbox.

F. Recommended storage and preservation procedure prior to Assy, after Assy. but prior to regular running.

7.0 <u>Packing: -</u>

The total drive assembly should be properly covered with thick tear-proof polythene sheets and despatched in suitable moisture-proof and tamper-proof wooden cratings.

Clean-Out Conveyor Drive (AC Geared Motor)

1.	Application	: To drive the clean-out conveyor chain.
2.	Motor rating	: 0.25 KW
3.	Power supply for the drive	: 415 V ± 10%, 50 HZ ± 5%, 3ø
4.	Ambient temperature	: 50° C
5.	Duty cycle	: Continuous & intermittent (minimum 50 starts per day)
6.	Speed of drive at full load	: 950 RPM
7.	Method of starting	: DOL
8.	Mounting & position	: Horizontal flange mounting.
9.	Type of enclosure	: TENV
10.	Degree of protection	: IP 55
11.	Class of insulation	: B or F
12.	Total gear reduction Ratio	: 1041 ± 5 : 1
13.	Temperature rise over 50°c Ambient	: Shall be limited to that of class 'B' by resistance method.

General

1. Geared motor will be assembled to a gear box assy. for a total reduction ratio as per table shown in sheet no. 07/12

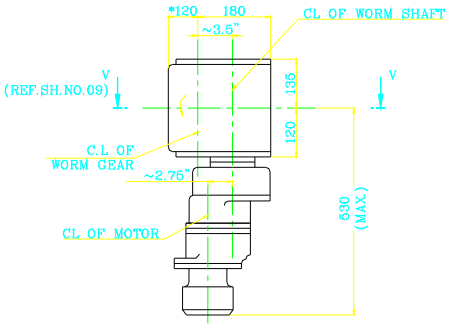
2. Motors to be supplied wit lifting eye bolts.

3. Motor supplier shall fully comply with the enclosed Lt motor specification in addition to the above points.

Documents required from vendor along with offer :-

1. Certified dimension drawing.

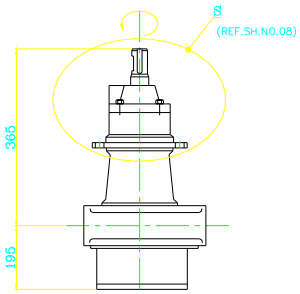
2. Certified connection diagram.

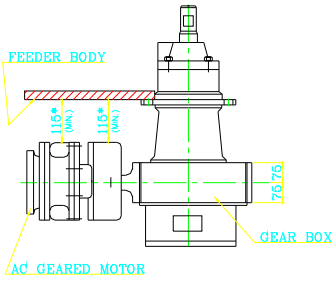


NOTE: –

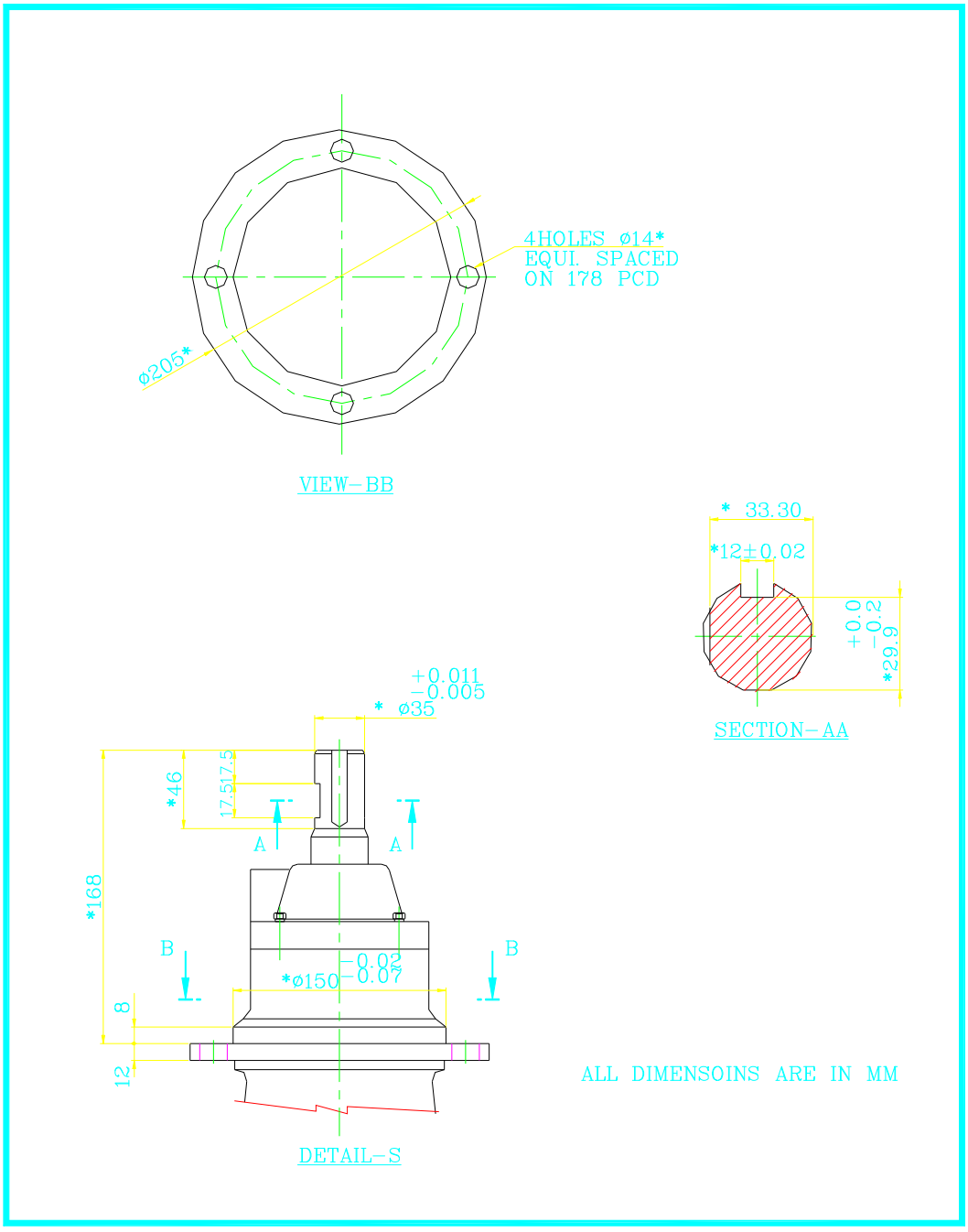
1. AC GEARED MOTOR & GEAR BOX FLANGE MATING DIMENSIONS TO BE SUITABLY DECIDED BY THE SUPPLIER.
2. TERMINAL BOX GLAND OPENING SHALL HAVE 1/2" NPT(F) THREAD PROVISION.
3. CONDUIT CONNECTOR 1/2" NPT(M) X 1/2" CONDUIT ENTRY TO BE PROVIDED WITH LOCKNUT.

01	1041:1	
SERIAL NO.	TOTAL REDUCTION RATIO	REMARKS

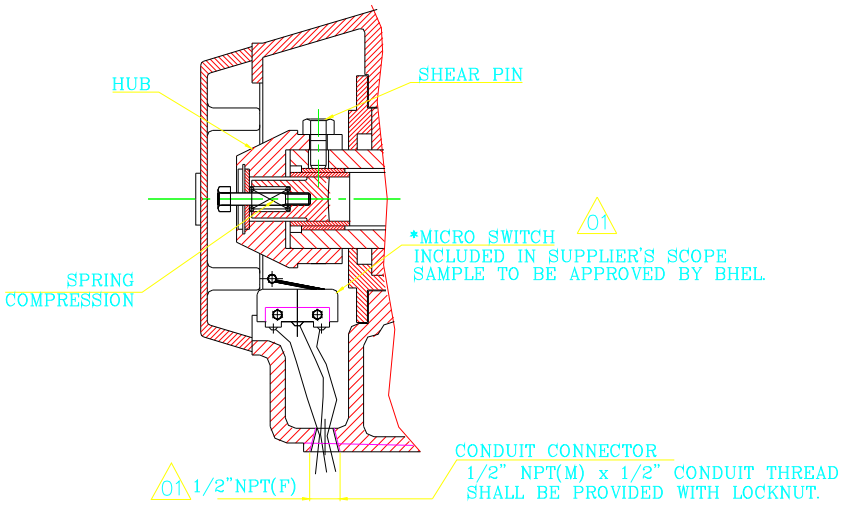




ALL DIMENSIONS ARE IN MM


4HOLES ø14*
EQUI. SPACED
ON 178 PCD
ø205*
VIEW–BB
* 33.30
*12±0.02
+0.0
–0.2
*29.9
SECTION–AA
+0.011
–0.005
* ø35
*46
17.5
17.5
A
A
*168
B
B
–0.02
–0.07
*ø150
8
12
DETAIL–S
ALL DIMENSOINS ARE IN MM

THE SHEAR PIN & MICRO-SWITCH ARRANGEMENT SHOWN IS SUGGESTIVE ONLY.
SHEAR PIN SHOULD SHEAR OFF IF THE TORQUE EXCEEDS THE VALUE PROVIDED
IN THE TABLE CORRESPONDING TO THE SIZE OF FEEDER.



SECTION-VV
(PARTIAL)

*NOTE :-
CONTACT RATING OF SHEAR PIN MICRO-SWITCH :- 5A AT 240V AC OR 0.5A AT 220V DC.

01	36"/24"Feeder	50 Kgm
Style No.	Feeder Size	Torque Rate

ALL DIMENSIONS ARE IN MM

Annexure to purchase Specn. GF-187 (C.O.Conveyor Drive with Reducer)

1. All Gears, pinion, shafts are to be subjected to ultrasonic testing and MPI after machining.

2. Backlash of gear wheels and pinions and teeth contact before functional testing (No loading run test) shall be checked.

3. Materials used shall be of tested Quality and shall be co-related with TCs for mechanical and chemical properties.

4. Gear boxes shall be run tested till the bearing temperature are stabilised and for a minimum of 4 hours and checks for smooth running, temperature rise, noise level etc. shall be carried out.

5. Motors shall be routine and type tested as per IS-325.
   Degree of protection test for enclosure:
   Type test certificate will be furnished for first numeral.
   If type test certificate is not available for second numeral,
   Test for second numeral will be repeated for motors.
   Test on motors are to be carried out based on data sheet approved by BHEL.

6. Quality plans shall be mutually discussed and finalised with BHEL.

Annexure-I

LT motor data sheet

Supplier to fill up & submit along with the offer for evaluation

Sl.No.	Characteristics	Vendor's Confirmation
01	Application	
02	Manufacturer	
03	Type & Frame size and Degree of protection	
04	Rated out put in KW & speed	
05	Rated Voltage, Frequency & Phase	
06	Full load current	
07	Full Laod efficiency and power factor	
08	Duty cycle	
09	Rated torque	
10	Starting current	
11	Starting torque in %age of full load torque	
12	Pull up torque in %age of full load torque	
13	Pull out torque in %age of full load torque	
14	No load starting time	
15	Locked rotor withstand time at rated voltage	a)Hot
		b)Cold
16	Locked rotor withstand time at minimum starting voltage	a)Hot
		b)Cold
17	Locked rotor withstand time at 110% of rated voltage	a)Hot
		b)Cold
18	Starting time at minimum starting voltage with mechanism coupled	
19	Starting time at rated voltage with mechanism coupled	
20	Minimum permissible starting time	
21	Stator thermal time constant	

Sl.No.	Characteristics	Vendor's Confirmation
22	Stator winding connection	
23	Class of insulation & temperature rise	
24	Type & number of terminals brought out	
25	Resistance per phase	
26	Quantity & Power consumption of space heater	
27	Direction of rotation	
28	Bearing make and type	Drive End: Non Drive end:
29	Lubricant quantity, Grade & Recommended interval of Lubrication	
30	Type of mounting & shaft orientation	
31.0	Terminal box	
31.1	Location & angle of rotation	
31.2	Gland size for stator winding	
31.3	Gland size for space heater	
31.4	Cable Entry	
32	GD^2 of motor (in Kg-M^2)	
33	Total weight of motor (in kg)	
34	Anticipated bearing life	
35	Method of connection to driven equipment	
36	Limiting rotor temperature for determining safe stall time	

Vendor's Signature with office seal

BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPPALLI-620 014

Fuel Systems/PE (FB)

Rev. No.	Rev. Date	Description	Chd. & Appd.
06	26/08/2016	Updated for indicating reference to annexure-1 for project specific Energy Efficiency Class requirements	Arul Prabhu.R
05	31/12/2014	Updated for standard IS-12615/ IEC 60034-30,motor efficiency & Vibration clauses, location of earthing points, TTR requirements	Arul Prabhu.R
04	02/04/2011	In page No.04/15 Cl.No.5.4.0 Reduction ratio 80:1(Style-04) added.	J.V.V.A.K
03	05/10/2010	In page No.04/15 Cl.No.5.4.0 Reduction ratio 100:1 added.	J.V.V.A.K
02	24/08/2007	In page No.04/15 Cl.No.5.4.0 Reduction ratio 203:1 added	S.Selva
01	23/10/2006	In page 15/15, note 1 altered.	J.V.V.A.K.

	Name	Signature			Date
Prepared	JVVA / DVK / DMB				
Checked	JVVA / DVK / DMB				
Approved	SDB / KAK				

CONTENTS:

1.0 SCOPE OF WORK

1.1 This specification covers the requirements for the design, supply, manufacture, testing, marking and identification, packing for shipment and delivery of the items listed below.

- Feeder main drive AC motor with tacho generators.
- Gear box

1.2. The extent of supply stated herein is not necessarily exhaustive and shall not relieve the vendor from his responsibility to provide goods and services necessary to satisfy the performance criteria and guarantees specified.

2.0 APPLICATION

2.1 Feeder main drive AC motor and gear box used for driving the conveyor belt (loaded with coal) of 36" Gravimetric feeders at varied speeds.

3.0 AC INDUCTION MOTOR – (Suitable for variable frequency control application)

3.1	Motor rating	: 7.5 KW
3.2	Applicable standard	: IS-12615/ IEC 60034-30 (All routine & type test as per relevant standards shall be performed)
3.3	Type of mounting	: Vertical flange mounting
3.4	Type of motor	: Squirrel cage induction motor – Inverter duty
3.5	Enclosure protection	: IP-55
3.6	Power supply	: Refer to Annexure-A
3.7	Speed range required	: 0-1400 RPM corresponding to demand signal of 4-20 mA.
3.8	Allowable variation in speed	: ± 5 RPM
3.9	Duty cycle	: Continuous (S1)
3.10	Type of enclosure	: Totally enclosed fan cooled
3.11	Method of starting	: Direct on line
3.12	Class of insulation	: Class-F, Temperature rise limited to Class-B
3.13	Full load torque	: 3.8 Kg-m (minimum)

3.14 Starting torque : 200% full load torque (minimum)

3.15 Efficiency Clause : Motor shall be Energy Efficient motors, For applicable Efficiency class refer Anneuxure-1 for project specific requirements.

3.16 Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14.

3.17 Motor body shall have two earthing points on opposite sides.

3.18 Motor winding shall be VPI (vacuum pressure impregnation) treated.

3.19 Motors shall be suitable for variable frequency control and shall match with the drive in respect of over voltage / spikes generated by the controller.

3.20 The windings shall be VPI treated and two coat enamelled. These motors shall be sized to operate satisfactorily under lowest speed conditions.

4.0 TACHOGENERATOR:

4.1 Two numbers of Tacho generator shall be in-built at the drive end of AC motor to give redundant isolated output as given below :
4.2 Output into 10K Ohm load : 45 V AC ± 5% at 1000 RPM
4.3 Number of poles : 24
4.4 Output waveform : Sinusoidal

5.0 GEAR REDUCER:

5.1.0 Type : Large speed reduction, flange mounted compact gear reducer with one or two stages of spur or helical gears and last stage of worm gear reduction. The approximate centre distance of worm gearing is 184 mm (7 1/4").

5.2.0 Duty class : Continuous

5.3.0 Direction of rotation : Should be able to rotate in both directions

5.4.0 Reduction ratio :
5.4.1 Style 01 : 128:1
5.4.2 Style 02 : 203:1
5.4.3 Style 03 : 100:1
5.4.4 Style 04 : 80:1

5.5.0 Arrangement & Dims: Refer Sketch nos. 1, 2, 3 & 4.

5.6.0 Function : The gear reducer is used to drive the conveyor belt of gravimetric feeders.

Since gravimetric feeder is a variable slow speed equipment, VFD motor will be connected to the input side of gear reducer and the output shaft of the gear reducer will be coupled to the drive pulley of the feeder conveyor belt. The gravimetric feeder is a constant torque equipment.

.TECHNICAL REQUIREMENTS:

5.7.1 Output shaft and mating flange dimensions are strictly to be maintained as shown in the sketches 1, 2, 3 & 4 (page 11, 12, 13 & 14 of this specn.).

5.7.2 Dimensions with asterisk marks (*) should be strictly maintained. Other dimensions may be altered to suit the gear box design with the approval of BHEL.

5.7.3 In addition to dipstick arrangement, glass type oil level indicator must also be provided.

5.7.4 All gears, pinion, shafts are to be subjected to ultrasonic testing and MPI after machining.

5.7.5 Backlash of gear wheels and pinion and teeth contact before functional testing (no load run test) shall be checked.

5.7.6 Materials used shall be of tested quality and shall be correlated with test certificates for the mechanical and chemical properties.

5.7.7 Gear box shall be run tested till the bearing temperatures are stabilised and for a minimum of 4 hours and checks for smooth running, temperature rise, noise level etc. shall be carried out.

6.0 TESTING:

6.1.0 The total drive assembly with gear box should be trial run for minimum 8 hours continuously and observed for its smooth, noiseless and vibration-free running.

6.2.0 Test certificate for no load test for each assembly shall be furnished

6.3.0 Applicable QP for feeder drive Assy. QA:CI:STD:QP:21 (Latest revision)

7.0 DOCUMENTS:

7.1.0 The following documents shall be submitted in triplicate along with the offer.

7.1.1 Compliance for each clause of this specification & applicable Quality Plan.

7.1.2 Compliance for flange dimensions in the enclosed Sketch no.-05.

7.1.3 Catalogues for the offered drives.

7.1.4 Dimensional general arrangement drawing with bill of materials and total weight.

7.1.5 Exploded view of the gear box showing all the internals and spare parts with overall dimensions and bill of materials. The bill of materials shall also contain details of bought-out items like bearings, oil seals, circlips etc.

7.1.6 A list of spare parts for 3 years operation with details for ordering like part number, quantity and price.

7.2.0 The following documents shall be submitted in triplicate by the Successful Bidder, within 15 days from PO, for BHEL's review / approval.

7.2.1 Motor data sheet and characteristic curves in Annexure - A .

7.2.2 Tachogenerator data sheet and characteristic curves in Annexure - C.

7.2.3 Dimensional drawing for motor & Tachogenerator.

7.2.4 Type test certificate for applicable motor frame size. Type test certificates not earlier than 5 years from date of enquiry.

7.2.5 Dimensional general arrangement of total assembly drawing and cross sectional drawing with detailed bill of material as called for in clauses 7.1.4 and 7.1.5 and submitted by the bidder shall be modified inline with BHEL's comments and BHEL's approval shall be obtained before manufacture.

7.2.6 Twenty numbers of Operation and maintenance manuals covering all aspects of storage, preservation, installation, operation and maintenance shall form part of the supply.

8.0 OTHER INFORMATION REQUIRED:

8.1.0 Weight of motor.

8.2.0 Weight of gear box.

8.3.0 Lubrication details.

8.4.0 Painting details.

8.5.0 Mounting arrangement of tachogenerator on the output shaft of AC motor.

8.6.0 Recommended storage and preservation procedure prior to assembly and after assembly but prior to regular running.

9.0 PACKING:

The total drive assembly should be packed in such a way that it should not get damaged during transport. The total assembly should be properly covered with thick tear-proof polythene sheet and despatched in suitable moisture-proof and tamper proof wooden crates.

10.0 DATA SHEETS

PURCHASE ORDER No. & DATE :

10.1 ANNEXURE - A

10.1.0 Technical Data Sheet for AC motor suitable for VFD application

10.1.1 Application : Gravimetric Feeder main drive motor

10.1.2 Manufacturer :

10.1.3 Type, Frame size, Duty cycle :

10.1.4 Type of mounting : Vertical Flange Mounting

10.1.5 Degree of protection and method of cooling : IP-55 TEFC

10.1.6 Rated output in KW and speed in RPM :

10.1.7 Ambient Temperature : 50°C

10.1.8 Rated Voltage & Frequency : 415V, 3 Phase, 50HZ

10.1.9 Allowed variation in
Voltage : ± 10%
Frequency & : ± 5%
Combined variation : 10% Absolute sum

10.1.10 Full load current :

10.1.11 Rated torque :

10.1.12 Starting torque in % of FLT (FLT - Full Load Torque) :

10.1.13 Pull-up torque in % of FLT :

10.1.14 Pull-out torque in % of FLT :

10.1.15 No Load starting time :

10.1.16 Minimum permissible starting voltage : 80% of Rated Voltage

PURCHASE ORDER No. & DATE :

10.1.17 Power Factor at rated frequency & voltage
- a) 100% Load :
- b) 75% Load :
- c) 50% Load :
- d) No Load :

10.1.18 Efficiency at rated voltage & frequency
- a) 100% Load :
- b) 75% Load :
- c) 50% Load :
- d) No Load :

10.1.19 Starting current at
- 100% Rated voltage :
- 80% Rated voltage :

10.1.20 Starting time	80% Voltage	100% Voltage
a) with driven eqpt.coupled :		
b) without driven eqpt. :		

10.1.21 Safe stall time in seconds	Hot condition	Cold condition
a) at 80% rated voltage :		
b) at 100% rated voltage :		
c) at 110% rated voltage :		

10.1.22 Limiting rotor temperature : to determine safe stall time

10.1.23 Stator winding resistance : per phase

10.1.24 Moment of Inertia :

10.1.25 Method of starting :

10.1.26 Thermal time constant :

10.1.27 Number of starts/hour
- Equally spread :
- Successive hot :
- Successive cold :

10.1.28 Permissible running time at :

full load at 75% R.V

10.1.29 Permissible vibration limits :

10.1.30 Class of insulation :

10.1.31 Material and treatment of insulation :

10.1.32 Temperature rise by resistance method :

10.1.33 Stator winding connection :

10.1.34 No.of terminals brought out :

10.1.35 Terminal box location and angle of rotation :

10.1.36 Fault withstanding capability:

10.1.37 Bearings	Drive end	Non-drive end
a) Type of bearing :		
b) Manufacturer :		
c) Model number :		
d) Life in hours :		
e) Recommended lubricant :		

10.1.38 Method of coupling with driven equipment :

10.1.39 Weight of motor :

10.1.40 Documents enclosed (After P.O)

a) Speed - Torque curve at 110%, 100%, 90% & 80% Rated Voltage
b) Starting time Vs Speed curve
c) Current Vs Time curve
d) Speed Vs Current curve
e) Thermal withstand curve for hot and cold condition
f) Efficiency, power factor Vs Load curve
g) Dimensional drawing and terminal wiring drawing.

Signature of Vendor Representative

PURCHASE ORDER No. & DATE :

10.2 ANNEXURE - B

9.3.0 Technical Data Sheet for Tachogenerators

9.3.1 Make & type of Tachogenerator :

9.3.2 Model number :

9.3.3 Class of insulation :

9.3.4 Output voltage with variation in output voltage :

9.3.5 Output voltage waveform :

9.3.6 Frequency of output voltage :

9.3.7 Max. load resistance at output :

9.3.8 Stator resistance :

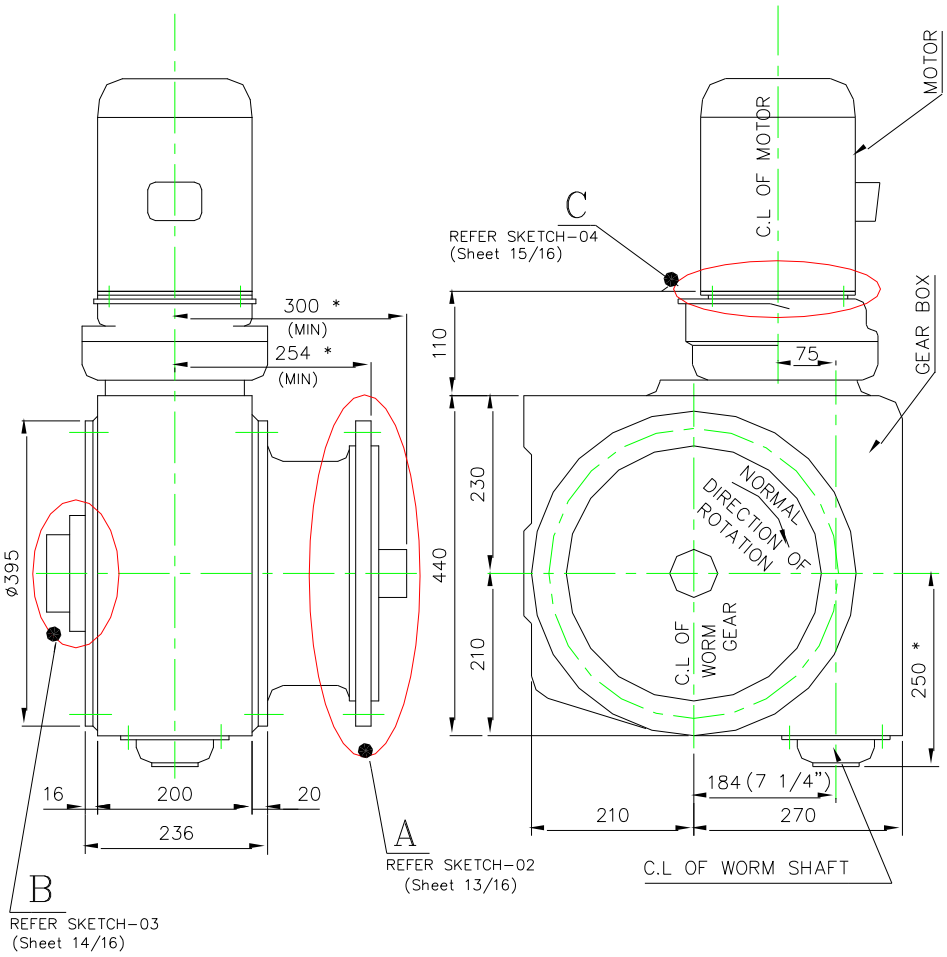
9.3.9 Linearity :

9.3.10 Documents (After P.O)

a) Dimensional drawing for the tachogenerator
b) Output voltage & frequency Vs Speed.

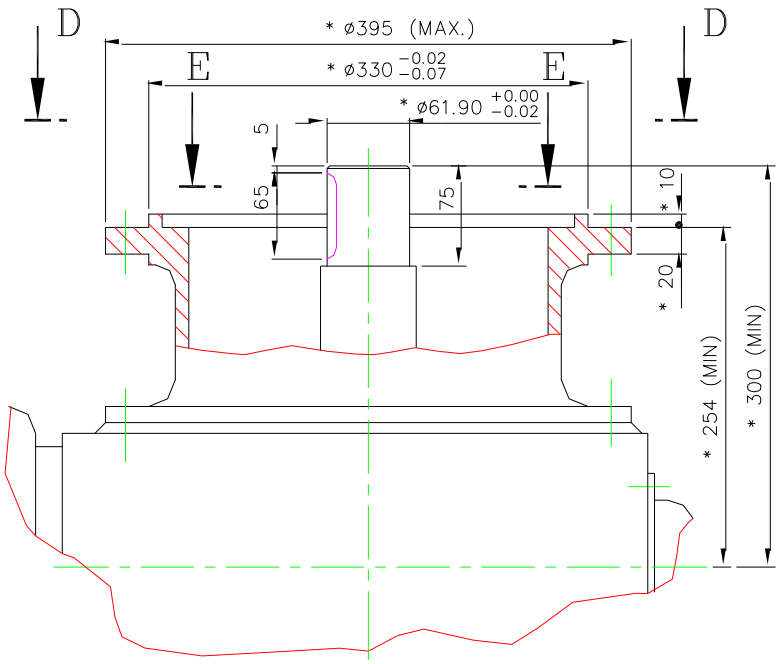
Signature of Vendor Representative with seal

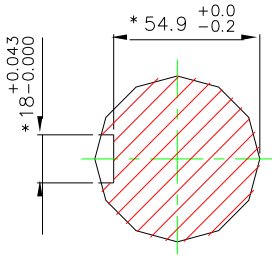
SKETCH NO: – 01



ALL DIMENSIONS ARE IN MM

SKETCH NO: – 02

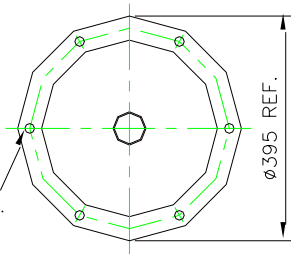




SECTION – EE

DETAIL – A

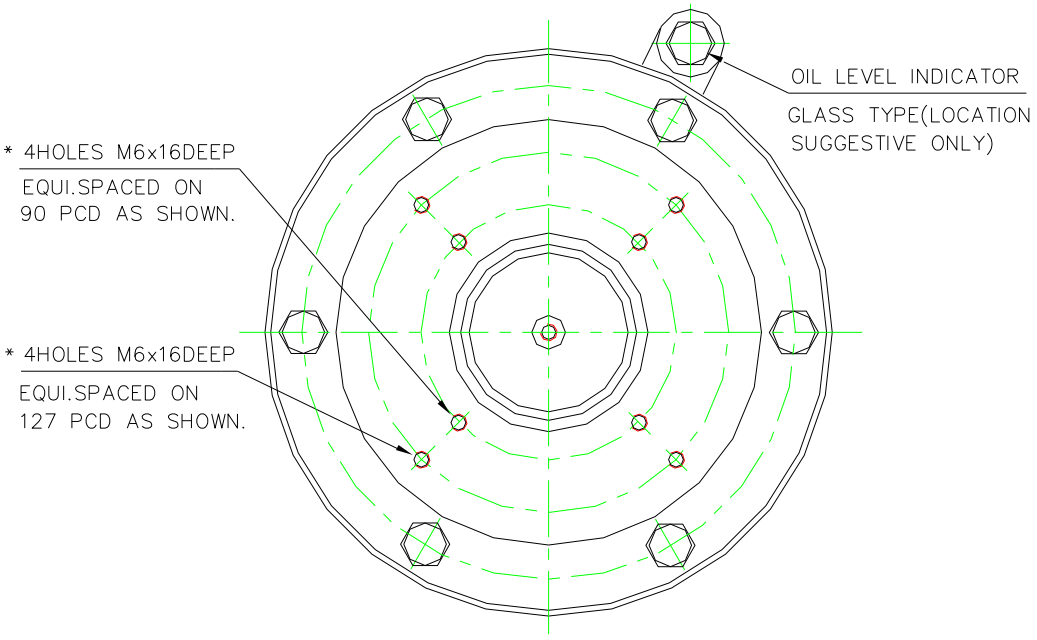
* 6HOLES ø18 ON 362 PCD EQUI SPACED AS SHOWN.

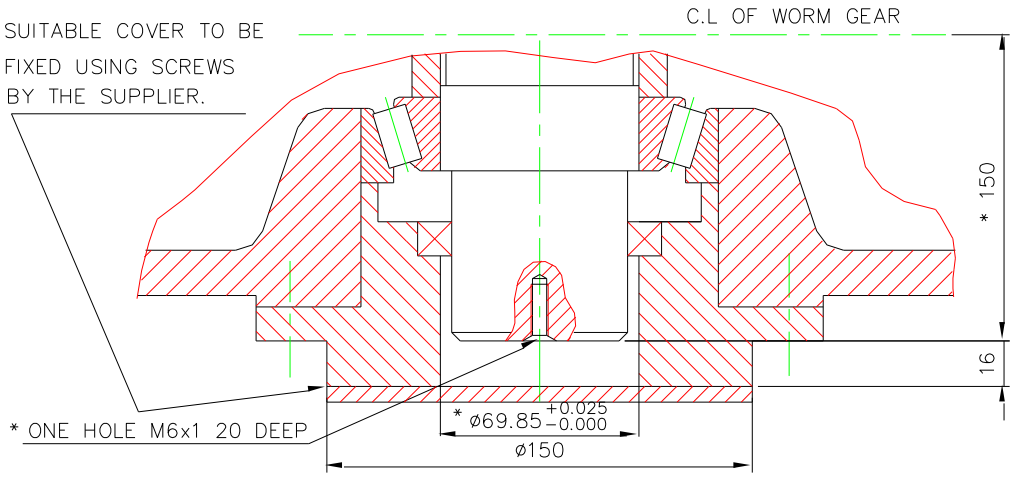


VIEW – DD

ALL DIMENSIONS ARE IN MM

SKETCH NO.–03



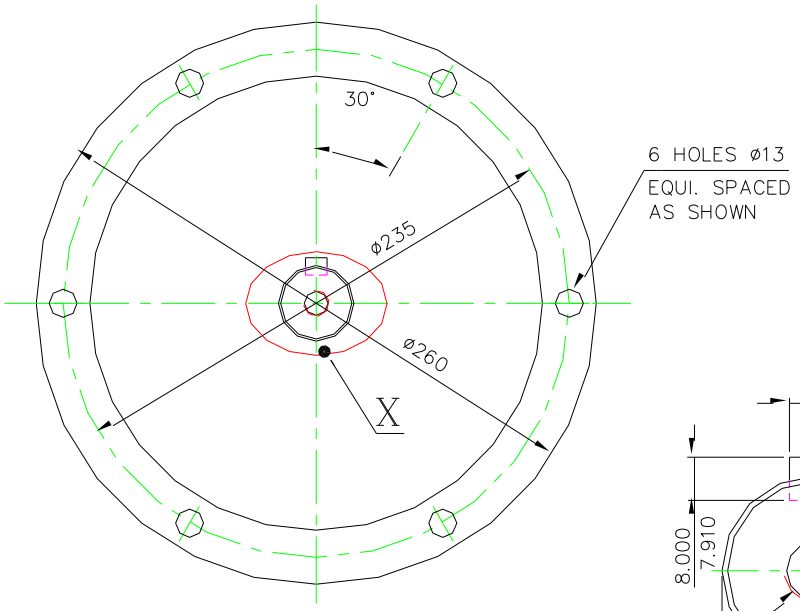


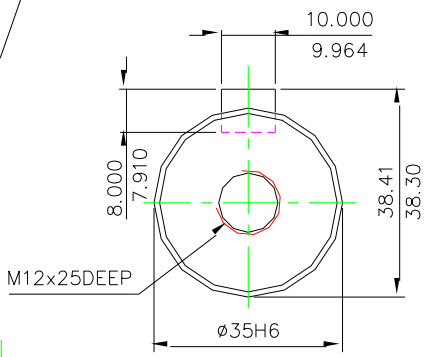
DETAIL–B

ALL DIMENSIONS ARE IN MM

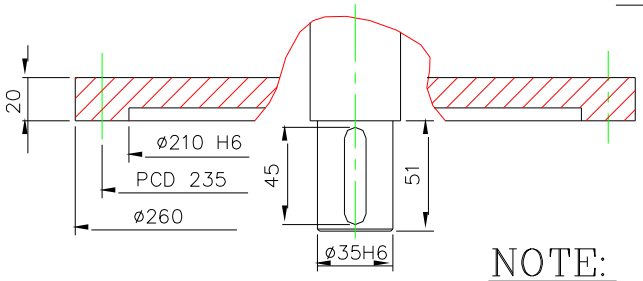
SKETCH NO.–04

MATING FLANGE AND SHAFT DETAIL (GEAR BOX INPUT SIDE)





DETAIL–X

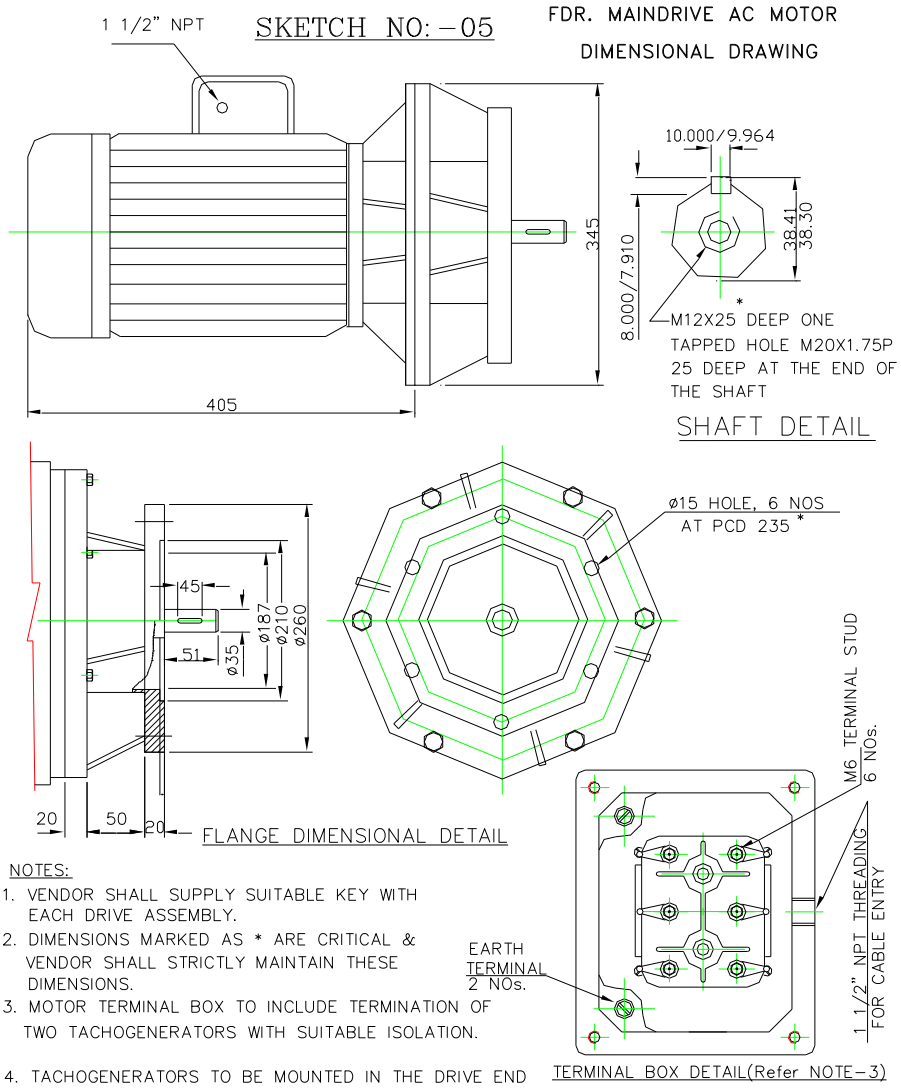


DETAIL–C

NOTE:

THE DIMENSIONS OF THE INPUT SIDE FLANGE AND PINION OF THE GEAR BOX SHALL MATCH WITH THE MATING DIMENSIONS OF VFD MOTOR AS SHOWN ABOVE.

ALL DIMENSIONS ARE IN MM



NOTES:

1. VENDOR SHALL SUPPLY SUITABLE KEY WITH EACH DRIVE ASSEMBLY.
2. DIMENSIONS MARKED AS * ARE CRITICAL & VENDOR SHALL STRICTLY MAINTAIN THESE DIMENSIONS.
3. MOTOR TERMINAL BOX TO INCLUDE TERMINATION OF TWO TACHOGENERATORS WITH SUITABLE ISOLATION.
4. TACHOGENERATORS TO BE MOUNTED IN THE DRIVE END

ALL DIMENSIONS ARE IN MM

BHARAT HEAVY ELECTRICALS LIMITED / TIRUCHIRAPPALLI
CONTROLS AND INSTRUMENTATION/QA/FB

STANDARD QUALITY PLAN
FOR
FEEDER DRIVE ASSEMBLY AND

CLEANOUT CONVEYOR ASSEMBLY

REV	DATE	PREPARED	REVIEWED	APPROVED	REVISION HISTORY
00	----	--- Sd ---	--- Sd ---	--- Sd ---	Initial release
01	----	--- Sd ---	--- Sd ---	--- Sd ---	Standards include
02	----	--- Sd ---	--- Sd ---	--- Sd ---	General Included
03	01.06.96	--- Sd ---	--- Sd ---	--- Sd ---	CHP included
04	16.06.97	--- Sd ---	--- Sd ---	--- Sd ---	Formet Revised
05	21.03.02	--- Sd ---	--- Sd ---	--- Sd ---	Department name changed, CTQ requirements added & General revision.
06	08.01.04	RM.VAIRAVAN	N.SRIDHAR	S.SOMASUNDARAM	Revised to include the comments /Feedback of internal discussion.

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF.DOC. & ACCEPTANCE STANDARD	FORMAT OF RECORD	AGENCY	REMARKS
A.	**FINISHED PRODUCT INSPECTION**							
1.	Motor	Routine & type test as per IS 325	ELEC	100%	PO, Specification & IS 325	T.C.	MQCD	
2.	Clutch * routine test	a) Verification for provision of accessories like louver wire mesh , lifting eye bolt, PVC sheathed flex, conduit connector, etc.	VISU	- do -	Specification PO & Data Sheet	- do -	- do -	
	⇒	b) High Voltage test	ELEC	- do -	1.5 KV for 1 sec. No failure.	- do -	- do -	
	⇒	c) Insulation resistance measurement	ELEC		Specification , & Data Sheet Minimum, 50 mega ohm with 500V megger			
		d) Measurement of coil resistance	ELEC	- do -	+/- 5% of rated value.	- do -	- do -	
		e) No load test	ELEC	- do -	- do -	- do -	- do -	
3.	Tacho generator Routine test	a) Number of tacho generator	VISU	- do -	Specification & data sheet	- do -	- do -	

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF.DOC. & ACCEPTANCE STANDARD	FORMAT OF RECORD	AGENCY	REMARKS
		b) Verification for number of poles.	VISU	100%	Specification & data sheet	T.C.	MQCD	
		c) Measurement of stator winding / coil resistance	ELEC.	- do -	- do -	- do -	- do -	
		d) Dimensional verification	MEAS	- do -	- do -	- do -	- do -	
		e) High Voltage test	ELEC.	- do -	1KV DC for 1sec. No Failure	- do -	- do -	
		f) Measurement of insulation resistance.	ELEC.	- do -	- do -	- do -	- do -	
	⇒	g) Speed Vs output voltage chart & output waveform (Performance test)	ELEC.	- do -	wave shall be sinusoidal linearity within +/- 1%	- do -	- do -	
4.	Motor-clutch tacho assembly testing * 1) Routine tests	a) Verification of name plate rating for motor clutch & tacho Generator.	VISU.	- do -	Specification & Data sheet	- do -	- do -	**C H P**
		b) Verification for provision of accessories like louver, wire mesh, lifting eyebolt etc.	VISU.	- do -	- do -	- do -	- do -	**C H P**

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF.DOC. & ACCEPTANCE STANDARD	FORMAT OF RECORD	AGENCY	REMARKS
	⇒	c) Dimensional check for fixing hole dimensions & for output shaft diameter	MEAS.	100%	Specification & Data sheet	T.C.	MQCD	**C H P**
		d) Verification for wiring & provision of conduits with connectors for external connection.	VISU.	- do -	- do -	- do -	- do -	**C H P**
	⇒	e) Functional Check : Measurement of input voltage, current, power, output torque, rpm, efficiency, P.F at no load, 25%, 50%, 75%, 100% load and at 150% load	ELEC.	- do -	- do -	- do -	- do -	**C H P**
		f) Locked rotor test	ELEC	- do -	- do -	- do -	- do -	**C H P**
		g) Measurement of starting torque and current.	ELEC	- do -	- do -	- do -	- do -	**C H P**
	2. Type Tests	a) Temperature rise by resistance method at full load & at minimum speed.	ELEC.	One of design	- do -	- do -	MQCD/ LAB	**CHP** – Verification of TC

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF.DOC. & ACCEPTANCE STANDARD	FORMAT OF RECORD	AGENCY	REMARKS
	⇒	b) Enclosure protection test	ENVI	One of design	Specification & Data sheet	T.C.	MQCD	
5.	Motor-clutch - Tacho gear box testing * Routine test	a) Functional check	VISU & ELEC	100 %	P.O Specification & Data sheet	- do -	- do -	**C H P**
		b) Verification of documents for all CTQ characters	ELEC	100 %	- do -	- do -	- do -	**C H P**
		c) All tests detailed under Sl.no: A. 04.1	ELEC	- do -	- do -	- do -	- do -	**C H P**

B. NOTES :

1. ELEC : ELECTRICAL; ENVI : ENVIRONMENTAL;
   VISU : VISUAL; MEAS : MEASUREMENT;
   TC : TEST CERTIFICATE; PO : PURCHASE ORDER;
   MQCD : MANUFACTURER'S QUALITY CONTROL DEPARTMENT;
   ⇒ : CRITICAL TO QUALITY POINTS;
   Lab : Govt. Approved / NABL Accredited.
   CHP : CUSTOMER HOLD POINT - INSPECTION BY BHEL.

2. All testing facilities shall be arranged by the vendor at their works. tests for which facilities are not available & those tests marked as test lab in agency column above are to be carried out at recognized national test houses like ETDC / CIL / NPL / ERTL / NABL accredited laboratories etc at vendor's cost.

3. Through log books/any other documents available at the vendor's works, it shall be possible to correlate the finished product with raw material & in process stage check / inspection carried out.

4. All measuring & testing instruments shall be periodically calibrated from recognized test houses & certificates made available during inspection for verification.

5. Test certificates for routine & type tests are to be furnished by the vendor. Type test certificate shall not be earlier than 5 years from the date of Purchase enquiry.

6. Vendor to give tentative inspection program in advance & confirm exact date two weeks in advance for arranging BHEL's inspection.

7. Packing shall be as per the ' PACKING PROCEDURE ' indicated in the Specification. Any loose supply items for the purpose of ' Safe transit ' shall be clearly indicated in the packing slip.

8. Item marked * are applicable only for feeder drive assembly and not for clean out conveyer.

C. REFERENCE STANDARDS (For The Indicated Standards Refer The Latest Version)

IS 325 : Specification for 3 phase induction motor