SPECIFICATION FOR SEAL GAS BOOSTER FOR CENTRIFUGAL COMPRESSOR

Rev. No.	Revisions	Prepared	Approved	Date
02	EQC requirements updated	RAM	PSVS	06.11.2014
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1.0 **SCOPE**

This specification defines the scope of supply for a seal gas booster (s) that shall be used to ensure seal gas flow to centrifugal compressor dry seals during compressor start-up or when compressor is in pressurized shutdown.

The seal gas booster (s) is realized as an electric motor or pneumatic driven, reciprocating (single or double acting) / centrifugal compressor. The booster (s) shall be suitable for horizontal or vertical mounting.

Only one single inlet and single outlet for process gas will be acceptable, If Multiple boosters are offered to meet the parameters specified, vendor to integrate the multiple boosters in to single unit with necessary piping, NRV etc. and supply the complete integrated system as a single unit.

2.0 **TECHNICAL DATA**

2.1 **Utility**: Instrument Air (for pneumatic drive, as applicable)

SL NO	PARAMETER	MIN	NOR	MAX	MECH. DESIGN
a	Pressure (kg/cm^{2}g)	4.0	5.0	6.0	10.0
b	Temperature (°C)	40	40	40	65

2.2 **Utility**: Electrical (for electric motor drive, as applicable)

SL NO	PARAMETER	VALUE
a	Supply Voltage	415 V ± 10%
b	Frequency	50 Hz ± 3%
c	Fault level (415 V)	50kA (1 sec.)
d	System earthing (415 V)	Solidly earthed
e	Motors upto 160 KW	415 V, AC, 3 Phase

2.3 **Utility**: Electrical (for pneumatic drive-solenoid valve, as applicable)

SL NO	PARAMETER	VALUE
a	Supply Voltage	24 VDC

2.4 **Design conditions:**

SL NO	PARAMETER	VALUE
a	Design Pressure-booster	25.5 kg/cm2g
b	Design Temperature-booster	170 °C
c	Gas leak test Pressure-booster	28.05 kg/cm2g
d	Hydro test Pressure-booster	38.25 kg/cm2g
e	Design Pressure-instrument air line-applicable for pneumatic drive	10 kg/cm2g
f	Design Temperature-instrument air line-applicable for pneumatic drive	65 °C
g	Gas leak test Pressure-instrument air line-applicable for pneumatic drive	11.0 kg/cm2g
h	Hydro test Pressure-instrument air line-applicable for pneumatic drive	15.0 kg/cm2g

2.5 **Operating conditions:**

SL NO	PARAMETER	VALUE
a	Gas for booster	Nitrogen
b	Inlet pressure	4.0 kg/cm^{2}g
c	Inlet Temperature	40 °C
d	Outlet pressure (required)	5.5 kg/cm^{2}g
e	Flow (required)	29 kg/hr

2.6 **Hazardous area classification:**

SL NO	PARAMETER	VALUE
a	Instrumentation	IEC Zone-I, Gas group IIA/IIB, temp class T3 as minimum.
b	Electrical	IEC Zone 2, Gas Group: IIA/IIB, Temp. Class T3 as minimum.
c	Enclosure protection: MV Motor	Ex-d or Ex-n (without pre start ventilation) as per IEC-60079
d	Cable plugs (SS304)	Ex-d as per IEC-60079.

3.0 TECHNICAL REQUIREMENTS

3.1 The booster shall be suitable for operation of minimum 2000 hrs without any maintenance required.

3.2 The seal gas booster(s) shall be suitable for instant start-up without any lead time. The booster may be electric or pneumatic air driven. Vendor to also advise whether the seal gas booster(s) shall be run off-line (with running frequency) to enable proper working of seal gas booster under all circumstances and thereby increasing its reliability.

3.3 The booster material shall be SS316 / SS316L as a minimum.

3.4 The booster shall be supplied in completely assembled condition. BHEL shall connect the gas inlet & outlet lines, instrument connection / electrical power connection.

3.5 LV motors shall conform to Specification 44NC-4600: ESS 01A and motor data sheet no. A133-086-16-50-DS-5015 Rev 0.

3.6 In case of electrical drive, the vendor shall submit the power consumption.

3.7 In case of pneumatic drive, the vendor shall submit the instrument air consumption.

3.8 Electrical motor drivers as per (IEC / IS) shall be rated for continuous duty (duty type SI) whereas motor as per American standards shall be designed to operate at a service factor of 1.0.

3.9 Exact cable sizes of power and control cables shall be finalized during detailed engineering. Provisions, as required in Vendor's equipment for termination of the same, shall be made accordingly without any cost & time implications to Owner.

3.10 The electrical motor shall be supplied with all cable entries plugged. Cable gland shall be supplied loose with the package.

3.11 All electrical & instrument items shall be CCOE / PESO certified for the area classification as per clause 2.6. Without which the offer is technically not suitable.

3.12 All the sizing, material selection, deisgn etc. shall be in line with ASME standard.

4.0 **SPARES REQUIREMENT**

4.1 Commissioning spares required for commissioning the offered equipment as per vendor recommendation for all electrical / pneumatic equipment shall be included in Vendor's scope of supply along with the main equipment. Vendor to submit a list of such spares required along with the offer.

4.2 Mandatory spares shall be as follows to be included in vendor's scope of supply: The word "TYPE" means the make, model no, range, size/length, rating, material as applicable.

4.2.1 If Pneumatic actuated booster is offered:

- Pneumatic circuit spares (as applicable): all wear & tear parts and seals including:
- Pneumatic cylinder-01 no
- Air filter reducer-01 no
- Snubber-01 no
- Pneumatic distributor-01 no

4.2.2 If Electric actuated booster is offered:

- Electrical drive spares (as applicable): 01 no each "TYPE" as applicable
- set of bearings (DE+NDE)
- set of cooling fans
- inner & outer grease cups
- terminal board
- Fan cover
- DE & NDE shields

4.2.3 Process side Booster spares: 01 set of all wear & tear parts and seals including:

- -gaskets
- -seals
- -o-rings
- -check valve

4.2.4 Special tools kits & tackles: as per vendor recommendation.

5.0 **NACE COMPLIANCE**

The wetted parts of booster shall be compliant to NACE MR-0103/ MR-0175 latest edition.

6.0 **DESIGN STANDARDS (AS APPLICABLE)**

6.1 European directive no 94/9/EC (ATEX)
6.2 European directive no 97/23/EC (PED)
6.3 ASME VIII Div. 1
6.4 ANSI B16.34
6.5 NACE MR-0103/ MR-0175
6.6 CCOE / PESO

7.0 **PIPING REQUIREMENTS**

7.1 **CONNECTIONS**

Description	Type
Process gas inlet	Vendor to inform
Process gas outlet	Vendor to inform
Vent / drain	Vendor to inform
Instrument air inlet	Vendor to inform

7.2 All the materials in contact with gas inlet / outlet and vent shall be of SS 316 / 316L or equivalent forging /casting materials.
7.3 All the materials in instrument air line shall be SS316 piping / tubing.
7.4 All Butt-welded joints shall be TIG welded and the welds shall be 100% radio graphed.
7.5 All the vent/ drain holes, if any shall be plugged with threaded plugs/caps.

8.0 DOCUMENTATION REQUIREMENTS

8.1 Along with technical offer, arranged in this sequence only:
- 8.1.1 Booster technical details.
- 8.1.2 Booster Performance / operation graphs / curves.
- 8.1.3 Booster Data sheets.
- 8.1.4 Instrument air /electrical power consumption.
- 8.1.5 Recommended spares list along with special tools (if any).
- 8.1.6 Signed & stamped copy of this specification.
- 8.1.7 Filled in Check List (Table-1).
- 8.1.8 Filled in PTR (Table-2).
- 8.1.9 Filled in Deviation Format (Table-3).
- 8.1.10 Filled in Price Schedule (Table-4) marked 'QUOTED' for each item.
- 8.1.11 Filled in Logistic Certificate (Attachment-1).

8.2 Within 2 weeks of Placement of Order / LOI: Vendor shall submit following for approval for the documents as mentioned below within 2 weeks of Placement of PO /LOI:
- 8.2.1 General Arrangement drawing of seal gas booster giving overall dimensions. It shall show location / disposition of various equipment / Instruments on the booster and location of customer termination connection.
- 8.2.2 Bill of Material of all the equipment, instruments, components etc. The Bill of Material should clearly show the make and model of each component, which are subjected to BHEL / CUSTOMER approval.
- 8.2.3 Booster Data sheets.
- 8.2.4 Instrument datasheets.
- 8.2.5 Booster Performance / operation graphs / curves.
- 8.2.6 Quality assurance plan.
- 8.2.7 Recommended Spares list.

8.3 **Final Documentation:** Vendor shall furnish the following:
- 8.3.1 Documents mentioned 8.2.1 above.
- 8.3.2 Instruction, Service and Maintenance manual
- 8.3.3 Test and Inspection reports : 3 copies.
- 8.3.4 Guarantee Certificates : 3 copies.
- 8.3.5 Photographs for all views : 2 sets (In DVD, the digital photos shall be provided).

9.0 EQUIPMENT QUALIFICATION CRITERIA (EQC)

Seal Gas Booster shall be identical in frame size and identical or validly similar in terms of **application (seal gas supply to compressor seals),** Type of drive, inlet and discharge pressures, inlet temperatures, flow, number and materials etc. as compared to **at least two units designed, manufactured, tested and supplied from the proposed manufacturing plant in last fifteen years at least one of these units shall have been operating satisfactorily in the field for at least 8000 hours without any major problems as on the date of issue of enquiry**.

Vendor shall furnish complete reference list / details (Proven track record as per Table-2) along with the offer. These details shall include Plant name, year of commissioning,

number of operating hours completed and name of contact person(s) etc. for the seal gas booster similar to one being offered.

10.0 **PROVEN TRACK RECORD**

Vendor shall submit filled in PTR (Table-2) as per EQC listed in above clause.

11.0 **CERTIFICATE FOR LOGISTICS SUPPORT**

Vendor shall submit duly filled in certificate for logistics support (Attachment-1).

12.0 **INSPECTION AND TESTING REQUIREMENTS**

All the equipment shall be subject to inspection and witness tests by Lloyd's. The schedule of quality checks shall be furnished by the vendor in the quality plan which is subject to the approval of BHEL. The minimum shall be as indicated in below table.

Quality Plan

Sl. No.	Description	Type of check Quantum of check 100%	Ref. Documents	Type of Inspection	Agency
1	Assembly of Booster	- Location of equipment - Correctness of flow Schematics - Overall dimensions	- Approved GA drg. of Booster	Physical check	Lloyd's
2	Welding (if applicable)	Type	Manufacturing drawings.	-Review of Radiograph certificate -Welding efficiency of 1	Lloyd's
3	Booster	- Material Certification - Hydrostatic test	-BHEL/ CUSTOMER Specification - Approved drgs/docs.	Verification of test report certificate	Lloyd's
4	Gas leak test	- Leakage	--Do--	Witness	Lloyd's
5	Hydro test	- Leakage	--Do--	Witness	Lloyd's
6	Name Plates	- Correctness	--Do--	Physical check	Lloyd's
7	Performance test	-performance	Booster shall be tested to verify pressure & flow parameters	Witness	Lloyd's

13.0 **MARKING AND SHIPPING**

13.1 Name plates: The Individual components shall be provided with Nameplates giving important details like make, model etc. Each component shall be provided with stainless steel Tag plates duly punching Tag Nos. as applicable on it.

13.2 Preparation for Shipment

13.2.1 Equipment shall be suitably prepared for shipment. The preparation shall make the equipment suitable for 6 months of outdoor storage from the date of shipment.

13.2.2 Seal gas booster assembly shall be marked with details like, drawing no, job number, PO No. etc. at a convenient location.

13.2.3 Lifting Points and lifting lugs shall be clearly identified.

13.2.4 All Loose supplied items like flanges, nut-bolt, gaskets etc. if any, shall be listed out separately in the packing list.

13.2.5 Adequate amount of silica gel or equivalent shall be provided in the box before dispatch for the removal of moisture till installation.

13.2.6 All safety instructions for storage and handling shall be indicated on external surface of the box.

14.0 **DEVIATIONS**

Bidder shall submit duly filled deviation format (Table-5) along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be considered for rejection. If, there are no deviations, bidder shall submit signed copy of deviation format, mentioning "No Deviations".

15.0 **GUARANTEE**

The Seal Gas Booster and each component of the unit shall be guaranteed for 18 months of trouble free performance from the date of shipment or 12 months from the date of commissioning whichever is earlier.

16.0 **TENDER EVALUATION CRITERIA**

16.1 The total price for the complete package i.e. Main System, Mandatory spares, Supervision of erection & commissioning charges shall be considered for L1 evaluation.

16.2 Duly signed & stamped un-priced price schedule and unit prices shall be submitted along with technical offer by bidder as a token of concurrence that all items are quoted without which the offer will not be evaluated. For unpriced bid bidder to fill 'Quoted' for each item and submit (refer Table-5 for PRICE SCHEDULE format).

17.0 **TENDER REJECTION**

Non-compliance to inclusion of any the following documents with technical offer shall lead to rejection of the bids.

17.1 Filled in Check List (Table-1) not included.

17.2 Filled in PTR (Table-2) not included.

17.3 Filled in Dev Format (Table-3) not included.

17.4 Filled in Price Schedule (Table-4) marked 'QUOTED' for each item not included.

17.5 Filled in Logistic Certificate (Attachment-1) not included.

18.0 **SPECIAL NOTES**

18.1 Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the seal gas booster shall be supplied by vendor without any price/delivery implications

18.2 Vendor should bring out in his offer clause wise deviations if any, with respect to proposed supply along with price adder for withdrawing the deviation to comply with specification. Failure to highlight the same will be construed as acceptance on the part of the vendor to meet the requirement of this specification totally.

18.3 Vendor shall provide the relevant technical information and supporting documents whenever asked for by the customer/ consultant.

18.4 Vendor to clearly bring out any additional requirements which are essential for proper functioning of the Seal Gas Booster. This shall be included in the offer.

19.0 **Table-1**: Check List

(To be filled by the vendor and submitted along with the offer without which offer will not be considered)

Sl. No	Description	Vendor Confirmation (Yes/No)
1	Booster technical details, catalog included.	
2	Booster Performance / operation graphs / curves included.	
3	Booster Data sheets included.	
4	Instrument air /electrical power consumption included.	
5	Commissioning spares list included. (As per vendor re	
6	Mandatory spares list included.	
7	Special tools (if any) included.	
8	Signed & stamped copy of this specification included.	
9	Filled in Check List (Table-1) included.	
10	Filled in PTR (Table-2) included.	
11	Filled in Deviation Format (Table-3) included.	
12	Filled in Price Schedule (Table-4) marked ‘QUOTED’ for each item included.	
13	Filled in Logistic Certificate (Attachment-1) included.	

VENDOR SIGNATURE WITH SEAL

20.0 **Table-2: PTR Format**

20.1 Name of the Bidder
20.2 Whether manufacturer & supplier:
20.3 Whether System Integrator & Supplier:
20.4 Name of Packager:

Sl.No	PTR Requirement	Ref-1	Ref-2	Ref-3	Ref-4
1	Description of item as manufactured & Supplied/ engineered (identify bidder's scope of work)				
2	Plant / Purchaser's name, address, Tel no, Fax no, email and contact person				
3	Application (seal gas supply to compressor seals)				
4	Type of drive,				
5	Inlet and discharge pressures, flow				
6	Material				
7	Make & model no of the booster supplied.				
8	Date of order placed				
9	Contractual completion date				
10	Actual completion date/ month & year of commissioning				
11	Number of operating hours completed				
12	Reasons of delay if any				
13	Approved value of order				
14	Details of major break down till date.				

VENDOR SIGNATURE WITH SEAL

Vendor to furnish the complete exhaustive reference list separately for our review.

21.0 **Table-3:Devaition Format**

Sl.No	Clause No. of Specification	Deviation	Reason for deviation	Deviation category	
				Product/design limitation	Optimization

VENDOR SIGNATURE WITH SEAL

22.0 **Table-4: PRICE SCHEDULE**

22.1 Offer ref no.:
22.2 Offer date:
22.3 Enquiry ref. no:
22.4 Enquiry date:

Sl. No.	DESCRIPTION	Qty	PRICE
1	Seal Gas booster (TC9765207034) along with commissioning spares (as per vendor recommendation)	1 set	
2	Mandatory Seal Gas booster spares (TC9765207042) as listed in clause 4.2	1 set	
3	Commissioning Supervision services		
3a	Commissioning Assistance for seal gas booster for 5 days at site / BHEL works and two visit inclusive of Travel, boarding, lodging, and local conveyance.	Lump sum	
3b	Per diem for Commissioning Assistance for seal gas booster at inclusive of Travel, boarding, lodging, and local conveyance if required in addition to 3a above.	Per diem	
4	Additional price to withdraw the deviations if any taken by vendor for respective clause of BHEL specification.	Clause wise	
	Total Price for Evaluation • 1+2+3a+4		

Notes:

i. The price for the spares against sl no 02 above is valid for one year.
ii. Any additional requirements which are essential for proper functioning of the seal gas booster but not indicated in specification are included in the offer.

VENDOR SIGNATURE WITH SEAL

CERTIFICATE FOR LOGISTIC SUPPORT

(TO BE SIGNED BY **VENDOR'S PRINCIPAL** (Original equipment manufacturer)
CORPORATE LEVEL SIGNATORY ON COMPANY LETTERHEAD)

I, ON BEHALF OF M/s, ---------- CONFIRM THAT THE SEAL GAS BOOSTER QUOTED BY M/s ---------- FOR RESID UPGRADATION PROJECT-COKER BLOCK PROJECT OF CPCL, MANALI (INDIA) SHALL CONTINUED TO BE SUPPORTED BY US AND QUOTED SYSTEM SHALL NOT BE WITHDRAWN FROM "INDIAN" MARKET AS A MATTER OF CORPORATE POLICY.

I, FURTHER CONFIRM THAT IN CASE OF PLACEMENT OF ORDER ON US, M/S CPCL SHALL BE SUPPORTED IN PROVIDING BACK-UP ENGINEERING, MAINTENANCE SUPPORT AND SPARE PART SUPPORT FOR A PERIOD OF NOT LESS THAN TEN (10) YEARS FROM THE DATE OF PLACEMENT OF ORDER.

(SIGNATURE WITH SEAL)

CERTIFICATE FOR LOGISTIC SUPPORT

(TO BE SIGNED BY **VENDOR'S CORPORATE** (Bidder for the enquiry) LEVEL SIGNATORY ON COMPANY LETTERHEAD)

I, ON BEHALF OF M/s ----------CONFIRM THAT THE SEAL GAS BOOSTER QUOTED BY US FOR RESID UPGRADATION PROJECT - COKER BLOCK PROJECT OF CPCL, MANALI (INDIA), SHALL CONTINUE TO BE SUPPORTED BY US AND OUR PRINCIPAL M/S ----------

I, FURTHER CONFIRM THAT IN CASE OF PLACEMENT OF ORDER ON US WE SHALL CONTINUE TO SUPPORT M/S CPCL IN PROVIDING BACK-UP ENGINEERING, MAINTENANCE SUPPORT AND SPARE PART SUPPORT TO CPCL FOR A PERIOD OF NOT LESS THAN TEN (10) YEARS FROM THE DATE OF PLACEMENT OF ORDER.

(SIGNATURE WITH SEAL)

CERTIFICATE FOR LOGISTIC SUPPORT

(TO BE SIGNED BY "Bidders **VENDOR" CORPORATE** LEVEL SIGNATORY ON COMPANY LETTERHEAD)

Applicable for all major sub-systems bought-out by the bidder

I, ON BEHALF OF M/s, ---------- CONFIRM THAT THE ---------- QUOTED BY THROUGH M/S---------- ---------- FOR RESID UPGRADATION PROJECT - COKER BLOCK PROJECT OF CPCL, MANALI (INDIA), SHALLCONTINUE TO BE SUPPORTED BY US AND OUR PRINCIPAL M/S ---------- --------

I, FURTHER CONFIRM THAT IN CASE OF PLACEMENT OF ORDER ON US, WE SHALL CONTINUE TO SUPPORT M/S CPCL IN PROVIDING BACK-UP ENGINEERING, MAINTENANCE SUPPORT AND SPARE PART SUPPORT FOR A PERIOD OF NOT LESS THAN TEN (10) YEARS FROM THE DATE OF PLACEMENT OF ORDER.

(SIGNATURE WITH SEAL)

JACOBS™

STANDARD SPECIFICATION FOR

L. V. INDUCTION MOTORS

DOCUMENT NO: 44NC-4600 : ESS 01A

PREVIOUS DOC. NO.: BSS - 05 - 101/2

Rev No.	Issue Date	Pages	Rev Description	Prepared By	Checked By	Approved By
0	03 May 2010	15	Issued for Engineering	VSL	PPP	RBD

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1.0 SCOPE

1.1 This specification covers the Design, Manufacture, Testing and Supply of three phase induction motors of the squirrel cage type.

1.2 This specification shall accompany Data Sheets, technical specification which will stipulate specific requirements of motors. In case of any contradiction between various referred standards/specifications/data sheets and statutory regulations, the following order of precedence shall govern:

- Statutory regulations
- Data sheets
- Technical Specifications
- This Specification
- Codes & Standards

2.0 STANDARDS

2.1 Motors shall be manufactured in accordance with the latest Indian Standard Specification current at the time of order, including amendments, and in particular following :

1	IS: 5	Colors for ready mixed paints & enamels
2	IS: 325	Three Phase Induction motors
3	IS: 1076 (Part 1, 2 & 3)	Preferred numbers
4	IS: 1231	Dimensions of three phase foot mounted induction motors
5	IS: 1271	Thermal evaluation & classification of electrical insulation
6	IS: 2071 Part (1, 2 & 3)	Methods of high voltage testing
7	IS: 2148	Electrical apparatus for explosive gas atmospheres – flameproof enclosures “d”
8	IS: 2223	Dimensions of Flange mounted A..C. induction motors
9	IS: 2253	Designation for types of Construction and Mounting Arrangements of Rotating Electrical Machines.
10	IS: 2254	Dimensions of vertical shaft motors for pumps
11	IS: 2968	Dimensions of Slide Rails for Electrical Motors.
12	IS: 4029	Guide for testing Three Phase induction Motors.
13	IS: 4691	Degree of Protection provided by enclosures for rotating Electrical Machinery
14	IS: 4722	Specification for rotating electrical machines
15	IS: 4728	Terminal Marking and direction of rotation for Rotating Electrical Machinery.
16	IS: 4889	Method of determination of efficiency of rotating Electrical Machines.

17	IS: 5571	Guide for selection of electrical equipment for hazardous areas
18	IS: 5572	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation
19	IS: 6362	Designation of Methods of Cooling for Rotating Electrical Machines.
20	IS: 6381	Electrical apparatus for explosive gas atmospheres – increased safety “e”
21	IS: 7389	Electrical apparatus for explosive gas atmospheres – pressurized enclosures “p”
22	IS: 7816	Guide for testing of insulation resistance of rotating machines.
23	IS: 8223	Dimensions and output series for electrical machines
24	IS: 8289	Specification for electrical equipment with type of protection ‘n’.
25	IS: 8789	Values of performance characteristics for 3-phase induction motor.
26	IS: 9628	Three phase induction motor with type of protection ’n’
27	IS: 12065	Permissible limits of noise level for rotating electrical machines
28	IS: 12075	Mechanical vibration of rotating electrical machines with shaft heights 56 mm & higher – measurement, evaluation & limits of vibration severity
29	IS: 12615	Energy efficient induction motors – three phase squirrel cage
30	IS:12802	Temp. rise measurement of rotating electrical machines
31	IS:12824	Type of duty class & rating assigned to rotating electrical machines
32	IS:13408	Code of practice for selection, installation & maintenance of the apparatus for use in potentially explosive atmospheres
33	IS:13529	Guide on effects of unbalanced voltages on the performance of three phase induction motors.
34	IS:13555	Guide for selection & application of three phase A. C. induction motors for different types of driven equipments
35	IS:14222	Impulse voltage withstand levels for rotating electrical machines with form-wound stator coils
36	IS:14568	Dimensions & output series for rotating electrical machines, frame numbers 355 to 1000 and flange numbers 1180 to 2360

2.2 In case of motors manufactured in accordance with other standards manufacturer or vendor shall state the reference number and title of the standards adopted. Generally equivalent standards by IEC/ BS/ VDE/ IEEE/ NEMA or equivalent standards shall be acceptable.

2.3 In case of imported motors, standards of the country of the origin shall be followed if these are equivalent / stringent than the applicable Indian Standards.

3.0 CLIMATIC CONDITIONS

3.1 Climatic conditions and other environmental conditions will be as specified in the Data Sheets.

It should be however noted in general that the motors shall be suitable for use in tropical climate with high humidity, heavy rainfall, and conducive to fungus growth and corrosion.

4.0 ELECTRICAL SUPPLY SYSTEM

4.1 Characteristics of electric supply system will be specified in Data Sheets.

4.2 Variations in electric supply, under which motor shall be operated continuously without any adverse effects will be as follows, unless specified otherwise in the Data Sheets:

Voltage variation	:	+ / - 10 %
Frequency Variation	:	+ / - 5 %
Combined Voltage & Frequency Variation	:	+ / - 10 %

Motors shall be designed to continue running through the following specific conditions against their specified loads and to recover to normal conditions when the voltage is restored to normal. This is applicable to HV motors only.

Induction motors: at zero voltage for 0.5 seconds, recovering instantaneously to at least 85% normal volts.

5.0 DESIGN FEATURES

5.1 GENERAL

5.1.1 The offered equipment shall be brand new with state of the art technology and proven field track record. No prototype equipment shall be offered.

5.1.2 Availability of spare parts and maintenance support services for the offered equipment shall be ensured for at least for 15 years from the date of supply.

5.1.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out of product/ spares to enable the end user for the placement of order for spares & services

5.1.4 All motors shall be continuous maximum rated unless otherwise specified in Data Sheet. Intermittent rated motors shall conform to duty cycle specified in Data Sheet.

Unless otherwise specified, three phase squirrel cage induction motors of 2,4,6 & 8 poles for all frame size up to 315L shall be energy efficient (eff1/ eff2 as specified in data sheet) having output ratings as specified in IS 1231 for continuous duty (S1) operation at rated voltage and frequency.

5.1.5 Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously with the variation in supply conditions as indicated in the data sheet.

5.1.6 Motor body or frame shall be of close grained cast iron or of welded steel construction in case of large motors. The design of the body shall ensure ruggedness and damping of vibration. The rotor alongwith the fan and half coupling or other drive device (if fitted) shall be statically and dynamically balanced.

5.1.7 All parts of identical motors, such as rotors, bearings and end shields, etc. shall be fully interchangeable with specific reference to rotor.

5.1.8 Design and construction of the motors shall be such as to facilitate inspection, cleaning, maintenance and repairs.

5.1.9 Fans provided for fan-cooled motors shall preferably be of the non-directional type, with protection against accidental contact. In case they are uni-directional, direction of rotation shall be clearly indicated on the non-driving end of the motor.

5.1.10 All motors shall have single bare shaft extension with key way and key, except where noted otherwise.

5.1.11 Fans for motors used in hazardous areas (Zone1 and 2) shall be manufactured from non-sparking material and if non-metallic shall be painted with an electrically conducting paint, to prevent accumulation of static charge.

5.1.12 Direction of airflow, in case of slip ring motors, shall be such that airflow will carry the carbon dust away from the winding.

5.1.13 Air to water heat exchanger shall have double tube plates; spray baffles and drip trays with siphon drains to prevent water reaching the windings.

5.1.14 Type of mounting required shall be as specified in Data Sheets.

5.1.15 All L. V. motors shall be Bi-directional. For 2 pole motors of frame size 280 and above the direction of rotation may be unidirectional.

5.1.16 Normally, clockwise rotation is desired, when viewed from the driving (coupling) end. This is applicable, when the terminals marked as per IS: 4728 are connected to the supply giving terminal phase sequence corresponding to the alphabetical sequence of the terminal letters.

5.1.17 Counter-clockwise rotation of the motor shall be obtained by connecting the supply to terminals so that the phase sequence corresponds to the reversed alphabetical sequence of the terminal letters. Ample space shall be provided at the terminal box for interchanging any two external leads for obtaining the reverse phase sequence.

5.2 ENCLOSURE

5.2.1 Enclosures for motors shall be as specified in Data Sheets. Degree of protection in accordance with IS-4691 shall also be as per Data Sheet.
Motors for outdoor installation shall be of weatherproof construction (IPW 55) such that no additional protection is required to be provided by the Purchaser. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors.

5.2.2 Construction of enclosures for flameproof (Exd) motor and the terminal box shall conform to IS 2148 and shall be suitable for the group of gasses specified in Data Sheet.

5.2.3 Construction of enclosures for increased safety (Exe) motors shall conform to the latest Indian Standard Specification 6381 and shall be suitable for temperature class specified in Data Sheet.

5.2.4 Vertical motors with downward shaft shall be provided with fully covering rain canopies. Vertical motors with upward shaft e.g. on fin-fan coolers, shall be adequately protected, (such

as cowls/canopies) against ingress of water into the enclosure or the bearing housing even when standing still for long periods of time

5.2.5 All internal and external metallic parts which may come into contact with cooling air shall be of corrosion resistant material or appropriately treated to resist the corrosive agents which may be present in the atmosphere. Screws, nuts & bolts shall be hot dip galvanized or zinc passivated to protect against corrosion.

5.2.6 Type of motors that require variable speed drive system shall be suitable for variable speed range with temperature rise within limit and also shall be suitable for area classification.

5.2.7 Flameproof Ex(d) motors operating on variable speed drive system shall have CMRI or equivalent authority certifying the suitability of drive motor with VSDs.

5.2.8 Increased safety Ex(e) motor operating on variable speed drive system shall be type tested as a unit in line with latest requirement of IEC (31J/47/FDIS).

5.3 BEARING & LUBRICATIONS

5.3.1 All motors shall have grease-lubricated ball and/or roller bearings or bearings of the sleeve type. Vertical motors shall have special thrust bearings suitable for the load imposed by the driven equipment.

5.3.2 All bearings shall be of reputed manufacture and of a type interchangeable with other makes and types. Ball and roller bearings shall have an L10 life of 40, 000 hours at rated operating conditions. (The L-10 rating life is the number of hours at constant speed that 90% of a group of identical bearings will complete or exceed before the first evidence of failure). Unless otherwise specified, the bearing shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion.

5.3.3 All bearings shall be provided with seals to prevent the ingress of dust, moisture and all other harmful substances.

5.3.4 For large capacity motors, the bearing shall be of the pedestal oil ring lubricated, sleeve type, fitted with liberally sized oil reservoir and level indicator. Sleeve bearings shall be designed with low bearing pressures and provided with drain plug. A thermometer with alarm and trip contacts shall also be provided.

5.3.5 Grease lubricated bearings shall be packed with suitable grease before the motors are dispatched. These shall be provided with nipples, and relief valves or plugs, suitable for on-line greasing. Bearing shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust or moisture. Where grease nipples are provided these shall be associated, where necessary, with appropriately located relief devices, which ensure passage of grease through the bearing. Pre-lubricated sealed bearings may be considered provided a full guarantee is given for 4 to 5 years of trouble-free service without the necessary of re-lubrication.

5.3.6 In cases such as pumps for hot liquids where the driven machine operates at high temperatures, bearings shall be cooled by a shaft mounted fan. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven object by conduction or convection. For motors operating in hazardous areas, fans shall be of an anti-static non-sparking material.

5.3.7 Wherever necessary, insulating pads between the bearing pedestals and bed plate shall be provided to eliminate shaft circulating currents. An earth terminal shall be provided on the drive and bearing pedestal.

5.3.8 For unlocked shafts, the end clearance on the motor shall exceed the coupling end float. Permissible limits of rotor movement shall be marked on the shaft.

5.3.9 The as built motor data sheets which shall be submitted by the supplier shall contain bearing number for easy reference.

5.4 PHASE CONNECTION

5.4.1 The windings shall be connected in delta. However, for motors rated 2.2KW and below, star connection may be accepted.

5.4.2 If star-delta starting is required, this will be specified in the data sheet and the motor windings shall be fully insulated for delta connection.

5.5 TERMINAL BOX

5.5.1 The terminal box shall be robust construction and large enough to facilitate easy connection of the cables. The terminal box shall be with necessary clearances, creepage distances between live parts and between live parts to earth considering air insulation and without any compound filling. Terminal box cover shall be provided with handles to facilitate easy removal.

5.5.2 Terminal boxes shall be cast iron or of welded steel construction with screwed conduit entries. The size of the terminal boxes, conduit entries and terminals shall be suitable for termination and connection of specified type and size of cables. Adequate space shall be provided for termination of aluminium conductor cables. The terminals shall be complete with two flat washers, one lockwasher and nut to make them secure and vibration-proof.

5.5.3 Numbers of terminals shall be as given below :

SCR Motors upto & including 7.5 KW	-	3 Nos.
SCR Motors above 7.5 KW	-	6 nos.
Slip ring motors	-	6 nos.

5.5.4 Terminal boxes for power cables shall be located on right hand side when viewed from the driving end or on top. The terminal boxes shall be rotatable in steps of 90° without disturbing the motor winding connections to the terminal block.

Caution nameplates on flameproof or increased safety motor terminal boxes shall be as per IS 2148 or IS 6381 respectively.

5.5.5 The terminal box shall be capable of withstanding internal short circuit condition without danger to the personnel or plant from the emission of hot gases or flames due to excessive distortion or damage to the terminal enclosure.

5.5.6 An adequately sized earth terminal shall be provided in the motor terminal box for termination of the fourth core of specified cables.

5.5.7 Identification of Terminals
Motor terminals as well as anti-condensation heater and temperature detector terminals shall be clearly identified as per IS 4728. A motor connection diagram shall also be affixed inside the terminal box on the cover.

5.5.8 Separate auxiliary terminal boxes shall be provided for anti-condensation heaters and temperature detectors. Caution nameplates with inscription "Caution-Live Heater / Detector Terminals" shall be provided on auxiliary terminal boxes for heater and detector terminal boxes.

5.6 STARTING CHARACTERISTICS

5.6.1 Unless otherwise specified, motors shall be designed for direct-on-line starting. Motors shall be designed for re-acceleration under full load after a momentary loss of voltage with the residual voltage being 100% out of phase.

5.6.2 All motors shall be suitable for starting under specified load conditions with 85% of the rated voltage at the terminals.

5.6.3 Minimum locked rotor thermal withstand time at rated voltage shall be 10 seconds under cold condition and 8 seconds under hot condition. The hot thermal withstand time at 100% voltage shall be atleast 5 seconds more than the starting time at 80% voltage.

5.6.4 Unless otherwise agreed, the starting time of the motor shall be less than the hot thermal withstand time of the motor (time t_E in case of increased safety motors) to facilitate application of conventional bimetal relays or thermal release against locked rotor and overload conditions.

5.6.5 All motors shall be capable of atleast two starts in quick succession after the motor windings have attained their maximum permissible temperature. If a more onerous duty is required, the same shall be indicated in the Data Sheet.

5.6.6 Motors shall be designed to allow the minimum number of consecutive starts indicated below:

Condition	Min. no. of consecutive starts
No. of hourly starts uniformly distributed, starting from final steady working temp.	4
With initial temp. of the motor as ambient temp. (cold)	3
With initial temp. of the motor as full load operating temp. (hot)	2

5.6.7 Starting current of squirrel cage motor with full voltage starting shall normally not exceed 600% of the full load current with tolerance specified in IS 325.

5.6.8 Starting torque of Squirrel cage induction motors started on full voltage shall generally not be less than 200% of the full load torque. Cases, where higher starting torque is required, will be indicated in Data Sheets. Pull out torque (breakdown) of motors shall not be less than 200% of the full load torque. In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors) the minimum value of pull out torque at 75% of the rated voltage shall be more than the peak value the pulsating torque. Unless otherwise agreed, the pull out torque shall not exceed 300% of the rated load torque.

5.6.9 Starting torque and minimum torque of the motor shall be compatible with the speed torque curve of the driven equipment under specified operating condition. For heavy-duty drives such as blowers, fans, etc. high starting torque (min.150%) motors shall be provided.

5.6.10 In case of L.V. Motors driving high inertia equipment, the manufacturer shall provide calculations for acceleration time, torque speed curves for motor and current time curves. Necessary Data for the driven equipment such as torque-speed curves, moment of inertia etc., shall be furnished by others for this purpose.

In case of reciprocating compressor or similar equipment, the stator current pulsations shall be given by the manufacturer. In all cases, manufacturer shall ensure that the starting current withstand time of the motors shall be higher than the calculated starting time.

5.6.11 The manufacturer shall also furnish time t_E for Exe and Ex n motors.

5.7 INSULATION AND WINDINGS

5.7.1 L.V. motors shall have class 'B' insulation unless Data Sheet specify another class of insulation.

5.7.2 The windings shall be tropicalized. Winding of motors shall be treated or impregnated with suitable varnishes to render them non-hygroscopic and resistant to dirt and oil. Windings shall also be treated to make them resistant to acidic / alkaline vapours when the atmosphere is specified as corrosive.

5.7.3 In case of SPDP motors, used for outdoor installation, or in case of vertical hollow shaft pump motors, end turns of windings shall be treated with epoxy based varnishes for weather resistance. Suitable baffle shall be provided to avoid direct splashing of water on the windings.

5.7.4 All insulating materials used in the construction of motors shall be non-hygroscopic. Coils shall be made of copper.

5.7.5 Windings shall be adequately braced to prevent any relative movement during operating and in this respect, particular care shall be taken for the stator windings of direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases, which lie together. Core laminations must be capable of withstanding burnout for rewind at 400^0C without damage or loosening.

5.7.6 In case of motors driving equipment with pulsating loads, special attention shall be paid to the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.

5.7.7 Insulation and impregnation of windings shall be carried out in a manner which will facilitate easy removal and replacement of coils. All coils shall be adequately supported to prevent movement under shock or short circuit stresses, or shocks due to electro-dynamic braking with phase reversal.

5.7.8 Joints shall be kept to a minimum, where joints are made, conductors shall be tinned to prevent oxidation, rivetted and soldered or brazed.

5.7.9 All joints shall be supported adequately to relieve them from mechanical strain. Insulation level of the joints shall not be less than for the motor windings.

5.7.10 Leads from motor windings to the terminal box shall be adequately supported throughout and shall be kept away from sharp edges to prevent abrasion. Openings in the motor frame through which the leads are brought out shall be sealed to isolate the terminal box from the motor.

5.8 TEMPERATURE RISE

5.8.1 The temperature rise of motors for all types of enclosures when tested in accordance with IS 325 shall not exceed the limits specified therein, corresponding to the class of insulation used and on the basis of normal conditions of service stipulated in Data Sheets.

5.8.2 Motor shall be suitable for continuous running, without exceeding temperature limits when the motor terminal voltage drops to 85% of the motor rated voltage, for 5 minutes, commencing from hot condition.

5.9 COOLING SYSTEM

All motors shall be self-ventilated, fan cooled. Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motor rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the motor.

5.10 ROTORS

5.10.1 All rotors shall be free from excessive inherent axial thrust. End play of rotor shall be kept to a minimum, unless Data Sheets specify the end-float required.

5.10.2 The rotor shall be dynamically balanced to provide a low vibration level and long service life for the bearings. The accepted values of peak to peak vibration amplitudes for a motor at rated voltage and speed on a machined surface bedplate with the motor leveled and with a half-key or coupling fitted shall not exceed those given in IS: 12075. Die cast aluminum rotors for motors in hazardous areas may be accepted provided the same are type tested and approved by competent authorities.

5.11 EMBEDDED TEMPERATURE DETECTORS

5.11.1 Embedded temperature detecting sensors may be provided when specifically asked for.

5.11.2 Adequate precaution shall be taken to ensure that detector leads shall not be charged accidentally to motor potential. Film type arrestors will be fitted at detector terminals in terminal boxes to prevent danger to detecting equipment and personnel.

5.11.3 All motors operating on VSDs shall have embedded temperature detectors / thermistors for winding with thermistor relay which will trip the motor in case the temperature of winding exceeds the permissible limits. For temperature detectors / thermistors 2/3 logic shall be provided for tripping.

5.12 ANTI-CONDENSATION

5.12.1 Anti-condensation heaters shall be provided when specifically asked for. Heaters shall normally be suitable for 250 volts, Single Phase, A.C. supply, designed for continuous operation unless otherwise specified in Data Sheet. Heaters shall be metal encased with a low surface temperature. In addition, a removable, threaded, plug shall be provided to remove condensed moisture.

5.12.2 Motors meant for humid location such as cooling tower fans, sump pump motors etc. shall be provided with space heaters irrespective of the motor rating in motor data sheet. The heaters shall be permanently ‘ON’ when the motor is not in service.

5.12.3 For motors to be installed in a hazardous atmosphere (Zone-1 or zone-2) such heaters shall be confirm to the provisions of applicable IS and temperature classifications defined in the data sheet.

5.12.4 The heater leads shall be brought out to a separate terminal box of the same specification and grade of protection as the main power terminal box.

5.12.5 A warning label with indelible red inscription shall be provided on the motor to indicate that the power line and the heater supply shall be isolated before carrying out any work on the motor.

5.13 LIFTING HOOK

All motors shall be provided with lifting hooks or eye bolts.

5.14 EARTHING TERMINALS

5.14.1 Two earthing terminals comprising terminal studs, two plain washers, one spring washer shall be provided preferably on diagonally opposite sides of the frame.

5.14.2 All accessories used shall be hot dip galvanised.

5.15 PAINTING

5.15.1 Before despatch from the motor manufacturer's works, all motors shall have all bright parts coated with anti-rusting compound.

5.15.2 All motors shall be painted in an approve manner using two priming coats, one undercoat and one finish coat to the Purchaser's Painting Specification, and shall have all surface throughly cleaned and degreased prior to painting.

5.15.3 The Purchaser's Painting Specification will be issued to the Vendor when orders are placed. The final colour shall be to the Purchaser's requirements.

5.16 RATING PLATES, LABELS & MARKING

5.16.1 Rating plates shall be provided on all motors. These rating plates together with any labels giving necessary instructions, shall be of a design so that corrosion will not cause obliteration.

5.16.2 The Purchaser's Motor reference and bearing numbers and other details shall be marked on an auxiliary stainless steel nameplate if called for in Data Sheets. Rating plates/name plates shall be fixed to an easily visible, non-removable part of the frame. Rating plates shall give the necessary information as specified in the applicable standards. Additional nameplate shall be provided to indicate the service and tag no. of each motor.

5.16.3 For motors to be used in explosive gas atmospheres, indication plate shall have information such as, the type of construction and the explosion grade and ignition temperature class of gas.

5.16.4 Motor terminals shall be clearly and permanently marked with reference letters in accordance with the applicable Indian Standards/IEC.

5.16.5 A non-corrosive connection diagram plate shall be fixed to the motors having special windings or tappings, such as multi-speed motors.

5.16.6 Uni-directional motors shall have their direction of rotation clearly marked by means of an arrow.

5.17 VIBRATIONS

Limits of viberations shall be in accordance with IS-12075. The velocity of motor vibration shall not exceed the value specified in the IS-12075 when measured on the bearing housings of motors in the horizontal, vertical & axial directions operated with no-load at rated voltage and rated frequency.

5.18 NOISE LEVEL

The mean sound pressure level of motors shall not exceed 85 dBA at 1 meter, measured in accordance with IS-12065 or relevant IEC standard.

5.19 CRITICAL SPEEDS

The first actual critical speed of stiff rotors shall not be lower than 125% of the synchronous speed. For flexible rotors this shall be between 60% and 80% of the synchronous speed; the second actual critical speed shall be above 125% of the synchronous speed.

5.20 BEDPLATES & SOLEPLATES

When slide rails, bedplates or soleplates are supplied alongwith motor, the holding down bolts for the motor shall also be supplied. All embedded parts shall be supplied and shims of SS 304 shall be used.

6.0 SPECIAL TOOLS

A set of any special tools necessary for maintaining the whole of the requirement supplied shall be provided.

7.0 INSPECTION AND TESTING

7.1 Test Certificates shall be furnished for all motors indicated in the Data Sheets.

7.2 Routine tests as per IS 4722 shall be carried out on all motors. Type tests shall be carried out on L.V. Motors, when specifically called for. In case of identical motors, type tests may be carried out on the first of each rating and speed.

7.3 The manufacturer shall periodically carry out the following type tests as per applicable Indian Standards for all the frame sizes & ratings of the motors:

a) Full load test and measurement of voltage, current, power & slip
b) Measurement of starting torque, starting current, full load torque & pull out torque
c) Measurement of efficiency & pf at 100%, 75% & 50% load
d) Temperature rise test
e) Momentary overload test
f) Measurement of noise level test
g) Measurement of vibration
h) Over speed test

The above tests shall be witnessed and approved by reputed inspection agencies. The manufacturer shall maintain the test records and submit to the Owner's inspector at the time of final inspection & testing. In no case the test records shall be more than 5 years old.
In special cases where the type tests are asked to be carried out, these shall be witnessed by the Owner's inspector.

The manufacturer shall carry out routine tests as per applicable Indian Standards. Routine tests not limited to the following shall form part of the acceptance testing:

a) General visual checks, name plate details, mounting, terminal box location and cable gland sizes
b) Measurement of shaft height dimensions
c) Measurement of clearances in the terminal boxes
d) Verification of type of terminals (For Ex-e & Ex-n motors)

e) Verification of direction of rotation
f) Measurement of winding resistance
g) Insulation resistance test (before & after high voltage test)
h) High voltage test
i) No load test & measurement of voltage, speed, current & power inputs
j) Locked rotor test at reduced voltage & measurement of voltage, current & power input
k) Reduced voltage staring & running
l) Tests on Ex-d enclosures as per IS

7.4 The Purchaser reserves the right to witness all tests and the Purchaser shall be given ten working days notice of all tests being carried out.

7.5 All apparatus, instruments etc. required for tests shall be provided by the manufacture and shall have been checked and tested for accuracy during the twelve months prior to the test. Calibration certificates for all indicating meters and instruments used for testing shall be furnished at the time of inspection.

7.6 A certificate issued by the relevant authorities shall be provided for each Ex-d or Ex-e certified motor.
The manufacturer shall submit the following certificates for verification to the Owner's Inspector:
(a) Test certificate for the degree of protection of enclosure
(b) Test certificates issued by the recognized independent test house for hazardous area motors
(c) Approval certificates issued by Statutory Authorities for Ex-d motors
BIS license & marking requirement as required by Statutory Authorities for Ex-d motors

7.7 Thought the motors shall be accepted on the basis of the satisfactory result of the testing at shop, it shall not absolve the Vendor from liability regarding the proper functioning of the motors coupled to the driven equipment at site.

8.0 PACKING AND DISPATCH

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/ rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/ cases to prevent the damage to finish. Crates/ cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up'. 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO no' etc shall be clearly marked on the package together with other details as per purchase order.
The equipment may be stored in outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/ high ambient temperature, unless otherwise agreed.

9.0 INFORMATION, DRAWINGS, LITERATURES

9.1 Vendor to furnish these as per Vendor Document Requirements attached with the specification. The drawings shall generally include the following :

Data Sheet	-	Duly filled data sheet
GA drawings	-	Fully dimensioned, indicating foundation

		details, number and size of cable entries, frame sizes etc.
Terminal Box Drawing	-	Fully dimensioned, including arrangement of Terminals & auxiliaries
Performance Characterstics	-	As specified in data sheet

Terminal Wiring Diagram

Calculation for cost effectiveness for energy efficient motors

10 CERTIFICATION

The motors and associated equipment shall have test certificates issued by recognized independent test house (CMRI/ BASEEFA/ LCIE/ UL/ FM or equivalent). All indigenous motors shall confirm to the Indian standards and shall be certified by Indian testing agencies. All motors (indigenous & imported) shall also have valid statutory approvals as applicable for the specified location. All indigenous flameproof motors shall have valid BIS license & marking as required by statutory authorities.

11 SPARES

The Vendor shall provide with his quotation, separate priced list of recommended commissioning and operating spares.

12 QUALITY ASSURANCE

12.1 Quality Assurance shall follow the requirements of Jacobs QA documents.

12.2 Quality Assurance will commence at the enquiry stage and follow through to completion and acceptance, thus ensuring total conformity to Purchaser's requirements.

13 DEVIATIONS

13.1 Deviations from specification must be stated separately in writing at the quotation stage.

13.2 In the absence of such a statement, it will be assumed that the requirements of the specification are met without exception.

JACOBS

DATA SHEET FOR LV INDUCTION MOTOR

		DOC. NO.	A133-086-16-50-DS-5015 REV.0			
		REQN. NO.	A133-86-KA-PR-5015 REV.0			
		APPD. BY	SA	SA		
PROJECT NO	A133	CHKD. BY	PK	ANPS		
PROJECT LOCATION	MANALI	PRPD. BY	VB	VB		
PROJECT TITLE	RESID UPGRADATION PROJECT	DATE	25.06.13	06.02.14		
CLIENT	CPCL	REV.	A	0	1	2

A	**SERVICE CONDITIONS**	
1	DRIVEN MACHINE REF. NO.	
2	DRIVEN MACHINE TYPE	
3	DESIGN AMBIENT TEMP. (MIN. & MAX)	18 DEG. C AND 45 DEG C
4	ALTITUDE ABOVE M.S.L.	3.5 M
5	RELATIVE HUMIDITY (MIN & MAX.)	80 % AT t_{max}
6	MAX. RAIN FALL PER DAY	LATER
7	ENVIRONMENT	CORROSIVE
8	SEISMIC ZONE	ZONE - III
B	**AREA CLASSIFICATION :**	i) ~~UNCLASSIFIED SAFE / ZONE 1~~ / ZONE 2
		ii) GAS GROUP OF ENCLOSURE: ~~I /~~ IIA / IIB ~~/ IIC~~ (as applicable)
		iii) TEMPERATURE CLASS : ~~T1 / T2 /~~ T3 ~~/ T4 / T5 / T6~~
C	**SYSTEM CHARACTERISTICS**	
1	SYSTEM VOLTAGE, FREQUENCY, PHASES	415 V, 50 HERTZ, THREE PHASE
2	VOLTAGE VARIATION	± 10 %
3	FREQUENCY VARIATION	± 3 %
4	COMBINED VARIATION	± 10 %
5	EARTHING SYSTEM	SOLIDLY EARTHED
D	**MOTOR TYPE & RATING**	
1	TYPE	~~WOUND ROTOR~~/SQUIRREL CAGE INDUCTION MOTOR
2	DUTY	CONTINUOUS (S1)
3	CLASS OF INSULATION	CLASS F WITH TEMP. RISE LTD. TO CLASS B
4	RATED SPEED (SYN.) AT RATED FREQ. & VOLTAGE	RPM
5	SPEED VARIATION	~~REQUIRED /~~ NOT REQUIRED TO SUIT APPLICATION
5.1	IF REQUIRED BY	VFD/SOFT STARTER/MULTISPEED BY CHANGE OF MOTOR CONNECTION
5.2	SPEED RANGE	
5.3	DRIVE CONTROL	CONSTANT TORQUE / VARIABLE TORQUE / CONSTANT HP
6	WINDING TREATMENT	MOISTURE PROTECTION VARNISH / ANTI CORROSIVE TREATMENT (SEE JOB SPEC.)
7	STARTING	
7.1	METHOD	DIRECT ON LINE
7.2	STARTING CURRENT (INCLUSIVE OF +VE TOLE.)	600%
8	STARTING PERFORMANCE	
9	SHAFT EXTENSION	STANDARD/ MM
10	EARTH TERMINALS	TWO NOS. EXTERNAL
11	DIRECTION OF ROTATION (VIEWED FROM COUPLING)	BI-DIRECTIONAL / ~~CLOCKWISE / ANTI-CLOCKWISE~~ (REFER Cl. 5.1.15 OF STD. SPEC.)
12	GREASING ARRANGEMENT	~~GREASE NIPPLES WITH GREASE RELIEF VALVE OR PLUG /~~ SELF LUBRICATED
13	MAIN NAME PLATE	STAINLESS STEEL (300 SERIES) / ANY OTHER NON-CORROSIVE METAL
14	AUXILIARY NAME PLATE	REQUIRED / ~~NOT REQUIRED~~ (STAINLESS STEEL)
15	TYPE OF COUPLING	
16	BED PLATE / SOLE PLATE	REQUIRED / ~~NOT REQUIRED~~
E	**ENCLOSURE**	
1	FEATURE OF PROTECTION (W.R.T. TO AREA CLASSIFICATION)	~~FLP (Ex'd') /~~ NON-SPARKING (Ex'n') TEFC ~~/ SPDP / CACA~~
2	DEGREE OF PROTECTION OF ENCLOSURE	IPW-55 (MIN.)
3	TYPE OF MOUNTING	TO SUIT DRIVEN EQUIPMENT

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F	**TERMINAL BOX (SUITABLE FOR SPECIFIEDCABLE SIZE / TYPE)**	
1	TERMINAL Nos.	NOS. TERMINALS TO BE BROUGHT OUT FOR MOTOR ABOVE Kw (AS PER CL. 5.5.3 OF STD. SPEC. ESS001A)
2	SIZE OF TERMINALS	
3	LOCATION OF TERMINAL BOX SEEN FROM DRIVEN END	RIGHT HAND SIDE
4	SEPARATE TERMINAL BOX FOR SPACE HEATER & PTC THERMISTORS	REQUIRED FOR ~~VFD DRIVEN MOTORS FOR PTC THERMISTORS AND~~ FOR SPACE HEATERS IN MOTORS ABOVE 22 KW : RHS / LHS
G	**INSPECTION**	FINAL
	TESTS -- ROUTINE TESTS	SHALL BE WITNESSED AS PER MENTIONED ELSEWHERE IN FEED DOCUMENT
	-- TYPE TESTS	SHALL / SHALL NOT BE WITNESSED (SUBJECT TO APPROVAL OF TYPE TEST CERTIFICATE)
H	**SPECIAL REQUIREMENTS :**	
1	ANTICONDENSATION HEATERS	FOR RATING ABOVE 22 KW
2	PTC THERMISTORS	NOT APPLICABLE
3	VOLTAGE RATING OF SPACE HEATER	240V, 1-PHASE, AC SUPPLY
4	RTDs	NOT APPLICABLE
5	EARTH TERMINALS	REQUIRED ON MOTOR FRAME AND IN THE TERMINAL BOX
I	**PAINTING**	
	-- TYPE	632 AS PER IS-5
	-- SHADE	
J	**CABLES**	
	TYPE & SIZE	
	CABLE LUGS -- TYPE	HEAVY DUTY CRIMPING TYPE, TINNED COPPER
	CABLE GLANDS -- TYPE	Ex(d) - DOUBLE COMPRESSION TYPE
K	**DRAWINGS & DATA (TO BE FURNISHED BY MANUFACTURER)**	i) DULY FILLED UP DATA SHEET ii) GA DRAWING OF MOTOR WITH DIEMENSIONS, FRAME SIZE & FOUNDATION DETAILS iii) GA DRAWING OF MOTOR TERMINAL BOX WITH SIZE OF CABLE ENTRIES AND TERMINAL ARRANGEMENT DETAILS iv) T-S CURVES AT 80 %, 100 % & 110 % VOLTAGE SUPERINMPOSED ON EQUIPMENT T-S CURVES & CALCULATION OF ACCELERATION TIME. v) STARTING CURRENT -TIME CURVES AT 80 %, 100 % & 110 % VOLTAGE. vi STARTING CURRENT -SPEED CURVES AT 80 %, 100 % & 110 % VOLTAGE. vii) THERMAL WITHSTAND CURVE (HOT & COLD) AT 100 % VOLTAGE. viii) PERFORMANCE CURVES SUCH AS LOAD VS EFFICIENCY, VS POWER FACTOR , VS CURRENT, VS %SLIP. ix) NECESSARY CERTIFICATION x) LIST OF OPERATIONAL AND COMMISSIONING SPARES xi) CALCULATON FOR ACCELERATION TIME AT 85% VOLTAGE.

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L	**PERFORMANCE PARTICULARS (BY MANUFACTURER)**		
1	MOTOR TAG NO. & MAKE		
2	ENCLOSURE		
3	RATED OUTPUT AT DESIGN AMBIENT TEMPERATURE		kW
4	CURRENT AT 50%, 75% & FULL LOAD		A
5	ACCELERATION TIME TO RATED SPEED WITH RATED LOAD AT 75 % & 100 % RATED VOLATGE		SEC.
6	FRAME SIZE & WEIGHT		
7	RATED SPEED AT RATED FREQUENCY & VOLTAGE		RPM
8	LOCKED ROTOR CURRENT (% OF FULL LOAD CURRENT FOR SLIPRING MOTOR WITH SLIPRING SHORTED)		
9	POWER FACTOR OF STARTING CURRENT WITH 100 % FULL VOLTAGE		%
10	TEMPEARURE RISE OVER DESIGN AMBIENT TEMPERATURE AT FULL LOAD		°C
11	NO LOAD CURRENT		A
12	STARTING TORQUE		N-M
13	FULL LOAD TORQUE		N-M
14	BREAKDOWN TORQUE		N-M
15	STALLING TORQUE		N-M
16	EFFICIENCY	: 50 % LOAD	%
		: 75 % LOAD	%
		: 100 % LOAD	%
17	POWER FACTOR	: 50 % LOAD	
		: 75 % LOAD	
		: 100 % LOAD	
18	NO. OF PERMISSIBLE SUCCESSIVE D.O.L. STARTS WITH MOTOR IN ' HOT ' CONDITION		
19	SAFE STALL TIME WITH MOTOR IN ' HOT CONDTION		
20	LOCKED ROTOR WITHSTAND TIME AT 100 % OF RATED VOLTAGE IN HOT & COLD CONDITION		
21	NO. OF DOL STARTS PER HOUR WITH ALLOWABLE MINIMUM INTERVAL BETWEEN STARTS		
22	THERMAL TIME CONSTANT		
23	COOLING TIME CONSTANT		
24	DETAILS OF RATING OF SPACE HEATERS		
25	STATOR WINDING CONNECTION		
26	GD^2 OF ROTOR		
27	DETAILS OF EMBEDDED DETECTOR		
27.1	TYPE		
27.2	NO. & LOCATION		
27.3	MATERIAL		
27.4	RESISTANCE VALUE		
28	HEATING UP TIME (tE) IN CASE OF		
29	INCREASED SAFETY MOTORS		

JACOBS	DATA SHEET FOR LV INDUCTION MOTOR		DOC. NO.	A133-086-16-50-DS-5015 REV.0			
			REQN. NO.	A133-86-KA-PR-5015 REV.0			
			APPD. BY	SA	SA		
	PROJECT NO	A133	CHKD. BY	PK	ANPS		
	PROJECT LOCATION	MANALI	PRPD. BY	VB	VB		
	PROJECT TITLE	RESID UPGRADATION PROJECT	DATE	25.06.13	06.02.14		
	CLIENT	CPCL	REV.	A	0	1	2

L	**PERFORMANCE PARTICULARS (BY MANUFACTURER) (CONTD.)**	
30	TYPE OF BEARINGS & RECOMMENDED LUBRICANT	
30.1	INTERVAL OF LUBRICATION	
31	PAINT SHADE	
32	VIBERATION LEVEL ON MOTORS AT NO LOAD & FULL LOAD	
33	NOISE LEVEL	
31	COOLING FAN ROTATION	UNIDIRECTIONAL / BIDIRECTIONAL
32	COOLING FAN ROTATION	
33	ACCESSORIES	
33.1	SPACE HEATER, SHAFT KEY	
33.2	LIFTING EYE BOLT	
33.3	NALE PLATE DETAILS	
33.4	CANOPY	
35	MAXIMUM AXIAL PLAY (BOTH HORIZONTAL & VERTICAL)	

NOTE : **1) THE EXPLOSION PROTETCION FOR LV INDCUTION MOTORS SHALL BE NON-SPARKING TYPE FOR THE WET GAS COMPRESSOR PACKAGE.**

2) MOTOR SHALL BE ENERGY EFFICIENT CLASS 'IE2' AS PER IS 12615.

3) SAFE STALLING TIME OF MOTOR SHALL BE 2.5 SECS MORE THAN THE STARTING TIME OF MOTOR AT 80% VOLTAGE.