



SPECIFICATION
FOR
DC MOTOR BLOWER SET FOR
RECTIFIER
FOR
UNDER SLUNG DETC

Ref.: CEE/01028

Rev.: 03 dated: 05.12.2018 (Refer last sheet for details of Revision)

PREPARED BY:

(Diwaker Kumar)
Sr. Engineer(D)/CEE

APPROVED BY:

(Sanjay Kumar Rai)
DGM(D)/CEE

CONTROL EQUIPMENT ENGINEERING DIVISION
BHARAT HEAVY ELECTRICALS LIMITED BHOPAL

SPECIFICATIONS FOR DC MOTOR BLOWER SET FOR COOLING OF RECTIFIER FOR UNDER SLUNG DETC

INTRODUCTION:

Under slung Diesel Electric Tower Car is a 350 HP Twin Power pack DC Traction Motor power car used for Over head inspection and accident relief. The Rectifiers used in this tower cars are forced cooled through a DC Motor driven Axial blower set. This specification covers general features & requirements of a blower unit required for Rectifiers.

Technical specification (Part A for Blower Motor & Part B for Blower)

Service Conditions for complete unit

- | | | |
|----|--|----------------------------|
| 1 | Ambient temp | 0-55 Deg.C |
| 2 | Relative humidity | 100% to work in rain |
| 3 | Altitude | 1000m Above Mean Sea Level |
| 4 | Atmosphere | Dusty |
| 5 | The blower set shall be designed to be able to withstand in service without deterioration the following vibration level. | |
| a) | Maximum vertical acceleration | - 1.0 g |
| b) | Maximum longitudinal acceleration due to shock | - 3.0 g |
| c) | Maximum transverse acceleration | - 1.0 g |

The vibrations are of sine wave form and the frequency of vibration is between 1 Hz and 50 Hz. The amplitude a, expressed in millimeters is given as a function of f, by the equations –

$$a = \frac{25}{f} \quad \text{for values of } f \text{ from 1 Hz to 10 Hz}$$

$$a = \frac{250}{f} \quad \text{for values of } f \text{ exceeding 10 Hz and upto 50 Hz.}$$

NOTE: Although no test to assess the suitability of motors under vibration levels as indicated in clauses 5 of Service Conditions has been proposed the manufacturer shall take these factors into consideration while designing various components e.g. shaft bearings mounting arrangements etc. and other necessary mechanical features.

Note : If a supplier is offering a standard blower motor set meeting the specification requirements only type test certificates shall be required to be furnished and repetition of type test shall not be required.

PART A

Specifications for Blower Motor

- 1 Blower motor shall be generally in line with IS 4722
- 2 Blower motor shall be rated continuously for following parameters.
 - a Voltage (Nominal) - 110 VDC
 - b Variation in Voltage - 77 VDC to 136 VDC
 - c Power source - 110 V DC Battery
 - d Rated Power - Max. 1.0 KW
 - e Speed - 3000 RPM max (If supplier is Offering a motor with different RPM same may be mentioned in the offer however air delivery thru the blower shall be as per our requirement.
 - f Type - DC Compound
 - g Insulation - Class 'F'
- 3 TERMINAL BOX

The three terminal lead wires shall be brought from motor to the blower casing and suitably terminated. The terminals shall be clearly marked 110 V +VE and 110 V -Ve. Adequate creepage distance shall be provided between the terminals. Suitably compression cable type glands shall be provided to accommodate the supply cables.
- 3.1 Terminal block shall be made of epoxy reinforced glass or similar Moulding conforming to BS-3815 and have the following additional Characteristics:-
 - It shall be anti-moisture absorbent and free from porosity.
 - It shall not deteriorate when working continuously at an ambient of 55°C and when tested at 120°C for 24 hours.
 - The terminal block will have conducting part which should be made of cadmium plated steel as per IS:226 and IS:1572 and all the threaded portions should be mechanically strong, so that even with 100 operations of tightening and loosening, the threads should not wear out nor shall there be any loosening of the inserts. The terminal stud threads shall not be worn out even after 100 operation of tightening and loosening at the specified torque. Bakelite or Hylam terminal boards shall not be used for terminal box.
- 3.2 TERMINAL LEADS
- 3.2.1 Flexible insulated Fibre glass copper connecting lead wire with fire retardant silicon elastomer for temperatures - 50°C to + 180°C as per

BS 6195/1969 type 8 'b' category D (84/0.4 i.e 10sqmm) with B.D.V. of 6KV minimum.

The flexible leads shall be covered with suitable flexible insulated fibre glass sleeve with coating of fire retardant silicon elastomer applied by extrusion or multi-dip process having temperature index of 180°C as per BS 2848 type 1/180 Tb having overall thickness of 0.9 mm and capable to withstand minimum B.D.V. of 5 KV for one minute.

3.2.2 Silver brazed joints / fused for connection terminal leads shall only be used. soldered joints are not acceptable.

3.2.3 Flexible cable shall be will gripped by the insulated socket tube while doing crimping.

3.2.4 A compression type (rubber) gland shall be used for securing the flexible leads at the entry of terminal block and rubber grommet should also be used.

3.2.5 The terminal sockets used shall be of annealed electrolytic copper. The minimum radius between palm and tube shall be 2 mm. Thickness of socket tube shall be at least 1 mm.

4 CONSTRUCTION

4.1 The driving motor for the blower shall be a DC motor. It shall be self ventilated and the motor frame shall preferably be of integral cast steel construction.

4.2 Shaft

Shaft material used shall be EN-24 suitably heat treated to achieve improve hardness to avoid wear and tear in service.

The various shaft dimensions such as surface finish, shoulder and fillet shall be as per recommendations of the bearing manufacturers.

4.3 Bearings

The bearing sizes to be adopted shall be for designs meeting with the requirements for the severest requirements. The bearing design shall have following features:

- i) In addition to provisions of required interference / tolerances on bearing housing, the bearing covers shall grip the bearing faces to prevent outer race rotation in the housing for fixed bearings. floating side of the bearings shall be suitably preloaded.

- ii) The minimum L10 life of bearings shall be 1,00,000 hours, L10 life design shall be worked out based on parameters as per Clause 5 of Service Conditions.
- iii) Only SKF/FAG (Imported) bearings shall be used.

4.3.1 All bearing shall be inspected for boundary dimensions, radial clearance, free running surface finish etc. The bearings shall also be checked with shock pulse meter for noise / vibrations. All bearings shall have radial clearance of "C3".

4.3.2 Re-greasing facilities with industrial type round head nipple as per IS:4009 shall be provided so as to ensure ease of re-greasing and no dismantling of any parts of motor or its driven unit are needed. Suitable outlet for escape of old grease shall also be provided. Greasing nipples should be provided on the blower housing. If considered necessary sealed type bearings may also be used.

5 TEMPERATURE-RISE

5.1 The temperature of Armature, Field and commutator above ambient of 55°C during continuous duty at rated output shall not exceed in following limits:

Field	Armature	Commutator
T - 80 Deg C	T - 80 Deg C	85 Deg C

T is the temperature index of the insulating material used in the blower.

6 FINISH

The motor shall be treated suitably for rust removal and coated with anti-rust Primer and finished with two coats of light grey paint to shade no 631 of IS 5 1994.

7 INTERCHAGEABILITY

The various components of the motor shall be manufactured with such a tolerance so as to enable complete interchangeability of components from one motor to another of the same design.

8 MARKINGS

8.1 Name Plate – each motor shall have name plate, containing in following information:

- a) Manufacturer's name, type and serial number.

- b) Rated voltage and voltage range.
 - c) Rated current.
 - d) Rated speed.
 - e) Rated output in KW and hp.
 - f) Class of insulation.
 - g) Weight
- 8.2 Direction of rotation – An arrow indicating the correct direction of rotation shall be permanently fixed on the motor body & Blower housing.
- 8.3 Lubrication - Plate giving lubricating instructions shall be affixed at a convenient location near the greasing nipples on blower housing indicating the type, quantity and the frequency of the lubrication.

9 TESTS

The type and routine tests to be conducted on motor and blower are indicated below.

S No	Description of test	Type	Routine
01	Measurement of Resistance (Cold)	*	*
02	Direction of rotation test	*	*
03	No Load test	*	*
04	Temperature rise test	*	*
05	Over speed test	*	
06	Starting test	*	
07	Commutation test	*	*
08	Weight	*	
09	Dielectric test	*	*

The test method shall generally be in line with IEC 349 / IS 4722 for DC Motors. Supplier shall furnish in detail the test procedure to be followed during testing at their works.

10 MAINTENANCE INSTRUCTIONS

The manufacturer shall supply detailed maintenance instructions and maintenance schedule based on monthly, bimonthly, quarterly and annual overhauling.

11 QUALITY ASSURANCE PLAN

The manufacturers shall supply the detailed quality Assurance Plan followed by them for their product.

PART B

SPECIFICATION FOR MOTOR DRIVEN BLOWER

- 1.0 In preparing this specification assistance has been taken from the following specifications :
IS : 3588 Axial Flow Fans
BS : 848 Method of testing of fans for general purposes.

2.0 Ratings

- 2.1 Blower shall be designed for continuous rating for following parameters.

a	Volume flow	0.8 cu m/sec minimum at 20 deg C
b	Total Pressure	45 mm of water column at 20 deg C
c	Speed	3000 RPM max (or as specified by supplier)
d	Internal dia of blower casing.	398 mm max.
e	Impeller dia	To be decided by manufacturer.

3.0 DESIGN AND GENERAL CONSTRUCTION :

- 3.1 Drive and Coupling : The fan impeller shall be directly mounted on the motor shaft. In case of cast aluminum impellers a steel boss of hexagonal shape should be cast integrally with the impeller. The drive may be by a key of adequate strength with the impeller locked in position by a securing bolt and washer at the shaft end. The bolt shall be further locked against, unscrewing in service by locking plates. Alternatively a tapered shaft without a key but with locking arrangement by bolt and locking plate may be used. If supplier has to offer a different arrangement same shall be specified.
- 3.2 Direction of rotation : An arrow indicating the direction of rotation shall be permanently marked on the blower casing.
- 3.3 Balancing : The rotor and the blower impeller shall be dynamically balanced individually.

- 3.4 Vibration : The vibration level when blower is coupled with motor shall not exceed 25 microns (peak to peak) on the bearings and 40 microns on blower casing.
- 3.5 Mounting Arrangement : The mounting arrangement shall be as per drgs enclosed.
- 3.6 Lifting arrangements : Suitable lifting arrangement for the blower unit and the motor separately shall be provided.

4.0 SPECIAL CONSTRUCTION FEATURES :

- 4.1 Special manufacturing processes : As the blowers operate for long periods at high speeds, the end rings, the impeller blade etc. should be designed with a higher margin of safety as compared to normal industrial designs. Non cast impellers shall be fabricated out of high tensile steel of weldable quality conforming to either Domex 400E or ST-55-HTW of IS : 961 or ST 52 of IS 1079 or SAILMA 350 of 'SAIL' or any other steel having superior or similar quality which has been adequately tested to ensure mechanical strength and dimensional uniformity. The cold pressed blades shall be stress relieved. The blades shall be welded. The welded joints should be free from undue stress either by stress relieving or by improved welding techniques. The quality of welding shall be also tested by the purchaser from time to time. Necessary test certificates should be produced as and when required. Alternatively cast aluminum impeller can be used if meeting technical requirements.
- 4.2 Casing : Casing should be of heavy duty industrial design. It should not deform during lifting. It should be of single side intake. Mixed flow form with axial intake direction and axial discharge direction. It should be of welded construction of mild steel. Intake side and discharge side flange are bolted together corresponding to dimensional drawing. Intake side dismantling cover for impeller, Guide plate for streamlined air flow, mounting plate for flange mounted motors should be provided. All out side welds of the housing should be welded continuously.
- 4.3 The mounting arrangement of the motor on the casing shall be properly secured so as to avoid loosening during the vibrations encountered in service.

5.0 Finish :

The fan motor, the blades and the casing shall be suitably treated to remove rust and should be coated with an anti rust primer and finished with two coats of light grey paint to shade no 631 of IS 5 1994. All hardware shall be zinc plated and passivated.

6.0 Inter- Changeability :

6.1 The motor blowers, impellers and casings shall be interchangeable such that the performance of the blower is kept within the limits of the standard.

7.0 Marking Plate :

7.1 Each blower shall have a suitable name plate having the following information engraved on it :

- a - Manufacturer's name, type and serial number.
- b - Air delivery
- c - Total head at 20°C.
- d - Rated Speed.
- e - Make of the motor.
- f - Power consumption in 'KW'.
- g - Impeller diameter.
- h - Weight of the unit.
- i - Manufacturing date and year.

8.0 Maintenance Instruction :

8.1 The manufacturer shall supply detailed maintenance instructions.

9.0 Drawings :

9.1 The drawings giving the overall dimensions of the blower shall be supplied with the offer.

10.0 Data:

The particulars of the blower set shall be furnished in a data sheet at Annexure 1.

11. Tests :

General : Tests are classified as type and routine tests.

11.1 The following are different tests on the complete blower unit :-

a) TYPE TESTS

- i) Air Delivery Test
- ii) Starting time test.
- iii) Starting Duty test.

- iv) Endurance test.
- v) Vibration level test.
- vi) Weighment.
- vii) Checking of bearing by shock pulse meter.
- viii) Checking of dimensions workmanship, clearance of impeller fixing and locking arrangement.

b) ROUTINE TESTS :

- i) Checking of obligatory dimensions and clearance of impeller fixing and locking arrangement.
- ii) Starting time test.
- iv) Condition of bearing by shock pulse meter.

11.2. Unless otherwise specified in the contract the test and the method of measurement adopted shall comply with Indian Standards specifications for axial flow fans.

11.3 Air Delivery Test :

11.3.1 Type Test : Test shall be carried out with the supply to the driving motor maintained at 110VDC. Adequate number of observations shall be made on both sides of the operating point to plot the characteristic curve. Measure the following quantities.

- i) Line voltage.
- ii) Line current.
- iii) Power input.
- iv) Speed.
- v) Total Pressure.
- vi) Ambient Temperature.

The manometer pressure readings shall be taken atleast at 4 points to arrive at a mean value.

Calculate the blower output at standard conditions $WT = 1.2 \text{ Kg/m}^3$.
Record method of test, details of equipment used and their calibration for observed and calculated results.

Plot curves of total head developed in mm water gauge, static head in mm WG, speed, efficiency air horse power input to the motor in KW against output in cubic metre per minute.

11.4 Starting time test :

11.4.1 Type Test : With a test installation similar to that adopted for the air delivery test, start the blower at 110VDC.

Measure oscillographically or by any other accurate methods starting time of the motor blower unit to come upto full speed from zero speed. Record final load current and voltage reading.

11.5 Starting Duty Test :

The blower unit shall be subjected to repeated start and stop cycling for 1000 times at a supply voltage of 110VDC. The 'ON' and 'OFF' period shall be 1 minute in each case. If the unit takes more than 1 minute to stop freely the next start shall commence immediately after the unit has stopped.

At the end of the test the efficacy of impeller locking device shall be checked the impeller shall then be dismantled and various parts like key, key way and the fit of the impeller on the shaft shall be examined for abnormal wear.

11.6 Endurance Test :

11.6.1 Type Test : This test shall be conducted for a period of 8 hours with rated output and head and with a 110VDC supply at the motor terminals.

After the test, the blower and then motor shall be dismantled and examined for wear and tear of the parts condition of rings and bearings etc.

11.7 Measurement of vibration intensity.

11.7.1 Type Test : For the measurement of vibration intensity on electronic vibration measurement equipment having a frequency range of 5 to 2000 CPS shall be employed. The machine under test shall be mounted in accordance with IS: 4729. Vibration measurement shall be made at the bearing housing of the machine which shall operate at no load at rated voltage and at rated speed.

11.8 Condition of bearing by shock pulse meter.

11.8.1 Type test : Condition of bearing shall be checked at rated voltage. The deflection shall be within green zone of the instrument.

11.8.2 Routine Test. : Condition of bearing shall be checked at balanced 110VDC on each machine. The deflection shall be within the green zone of the instrument.

DATA SHEET FOR BLOWER

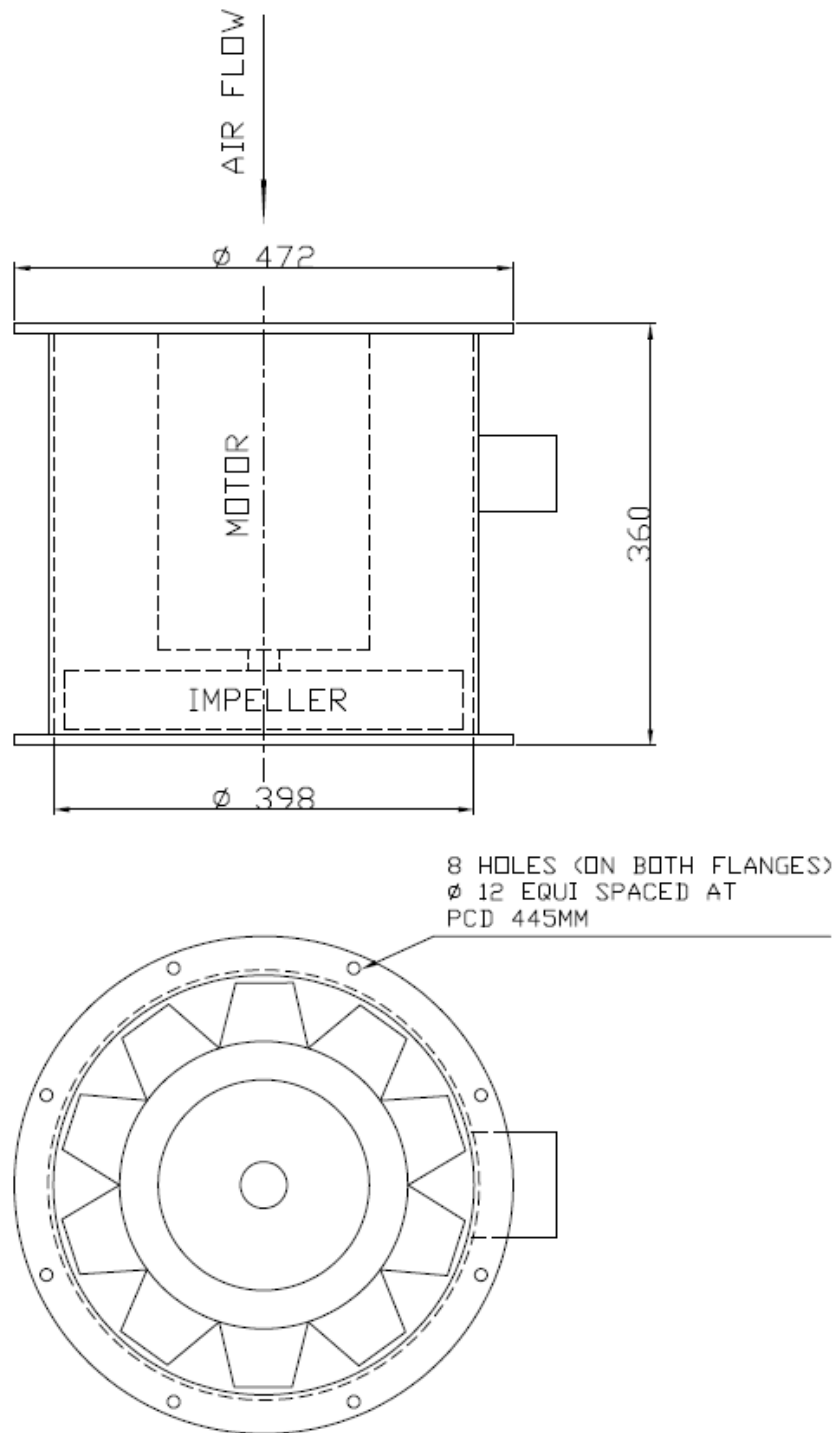
- A.1 Type, Model and make.
- A.2 Air delivered in cubic meter per sec at rated voltage and total head in mm. WG was corrected to 20 C and 760mm. barometric pressure.
- A.3 Design Data :
- a) Impeller diameter.
 - b) Type of impeller blades.
 - c) Number of blades.
 - d) Method of fixing of the blades.
 - e) Clearance between inlet cone and impeller.
(maximum and minimum).
 - f) maximum shaft speed of the impeller.
 - g) motor shaft and impeller bore diameter.
(maximum and minimum).
 - h) Method of fixing of impeller on motor shaft and locking arrangement.
 - i) GD^2 value of the impeller (indicate the maximum variation in manufacture).

NOTE : GD^2 value of the impeller will be made use of for calculating the starting performance of the blower with regard to the specified electric motor. As such the value to be furnished should take into account the inertia, the friction and the resistive torque of the impeller while it is being started.

- A.4 The manufacturer shall furnish the speed-torque characteristic of the blower. This is required for matching the motor and the impeller.
- A.5 Torque necessary for the blower when working against constant rated head and delivering the rated output.
- A.6 The supplier shall enclose the following characteristic curves at 10°C and 55°C.
- a) total and static head vs. air delivery.
 - b) total and static efficiency vs. air delivery.
 - c) air horse power vs. air delivery.
 - d) power absorbed vs. air delivery.
 - e) speed vs. Air quantity in m³/sec.

- A.7 Vibration level in microns.
- A.8 Furnish the welding strength calculation for the joint between impeller and base plate and core.
- A.9 Calculation for locking strength calculation for impeller locking arrangement and key strength.
- A.10 Necessary dimensioned drawings of the blowers and its all components showing the constructional and material specification as per IS, BS etc. and assembly details should be submitted.

Annexure



OUT LINE OF DC MOTOR DRIVEN BLOWER FOR RECTIFIER FOR
UNDER SLUNG DIESEL ELECTRIC TOWER CAR

Details of Rev 01:

- 1) Motor was 1.6 KW with class H insulation.
- 2) Blower out put was 1.0 cum/sec at 50 mm WG at 20 Deg C
- 3) Spec generally revised.

Details of Rev 02 dated 20.01.2018

Annexure –Outline of Blower Motor added.

Details of Rev 03 dated 05.12.2018

Annexure –Height of Blower was 400 mm.