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**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

**बृ।ड गेज लोकोमोटिव
के पिछले कर्षण मोटरों में प्रयोग होने वाले ब्लोअर
(मोहर बन्द बियरिंग युक्त)
का तकनीकी विशिष्ट**

**TECHNICAL SPECIFICATION FOR RTTM BLOWERS WITH
SEALED BEARINGS HOUSINGS
FOR
BROAD GAUGE AC-DC DIESEL-ELECTRIC ALCo LOCOMOTIVES**

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**TECHNICAL SPECIFICATION FOR RTTM BLOWERS
WITH SEALED BEARINGS HOUSINGS FOR BROAD GAUGE AC-DC DIESEL-
ELECTRIC ALCo LOCOMOTIVES**

1. SCOPE

This specification covers the schedule of technical requirement for supply, performance and testing of sealed bearing housings type centrifugal blowers for fitment on the free end of broad gauge AC-DC diesel-electric ALCo locomotives provided for supplying cooling air to rear truck traction motors.

2. TERMINOLOGY, SYMBOLS & UNITS

Terminology, symbols and units used in design and manufacture of the blower and its related components shall be as per latest IS: 4894 'Specification for centrifugal fans'.

3. SERVICE CONDITION:

- 3.1 Ambient temperature of air at inlet to the blower is 5°C to 60°C. Relative humidity ranging upto 100% saturation. Maximum altitude 1000 m above sea level.
- 3.2 The equipment shall be robust design for traction duty and shall withstand satisfactorily the vibrations and shocks normally experienced in service as indicated below:
- a) Maximum vertical acceleration 1.0 g.
 - b) Maximum longitudinal acceleration 3.0 g due to shock
 - c) Maximum transverse acceleration 0.5 g.
- 3.3 Sine wave vibrations are encountered with frequency between 1 Hz and 50 Hz. The amplitude 'a' expressed in millimeters is given as a function of f by the equation
- $$\begin{array}{ll} \text{Amplitude } a=25/f & f \text{ between 1 Hz to 10 Hz} \\ a=25/f^2 & f \text{ between 10 Hz to 50 Hz} \end{array}$$

4. DIMENSIONS, DESIGN AND FITMENT

- 4.1 The blower covered by this specification is for use on broad gauge AC-DC diesel electric ALCo locomotives. The blower is mounted in the radiator compartment of the locomotive. The blower is driven by a pulley driven through a driver pulley mounted on the (horizontal) shaft. The PCD of the pulley on horizontal shaft which is rotated at 1050 RPM on full load is 372 mm. The blower supplies air to the rear traction motors through a plenum chamber in the locomotive's under frame. The discharge of the blower is connected to a cut out in the plenum chamber. The inlet of the blower is taken from the engine compartment through a circular cut out in the bulkhead between engine room and radiator room.
- 4.2 The drive end mounting details, envelope dimensions and other details shall conform to latest DLW drawing No. TPL-2578. Other details shall also conform to this drawing unless stated otherwise in this specification.
- 4.3 The manufacturer is free to offer a modified/ new design of inlet cone, impeller, bearing housings arrangement, involute casing etc. subject to the provision in clause 4.2. Minor modifications in location/size of the cut outs in plenum chamber and bulk head can be made subject to the approval by the purchaser, with the condition that the blower would remain mechanically interchangeable with other manufacturers.
- 4.4 The blower shall be of single width single inlet type centrifugal blower with statically and dynamically balanced rotor. The direction of discharge and rotation looking from drive side shall be clockwise down blast.

4.5 Mounting dimensions and location of holes are essential for interchangeability of blower from one manufacture to other manufacture.

5. MATERIALS AND CONSTRUCTION

5.1 The blower and its related components shall be made of suitable steel conforming to relevant standards as per requirement given below:

- a) **Casing:** Shall be fabricated of mild steel conforming to IS: 2062 grade 'B'. The thickness of both side plates and scroll shall be minimum 3 mm.
- b) **Impeller:** The impeller of the blower shall be made of mild steel conforming to IS:2062 grade 'B' of welded construction. Good welding techniques like CO₂ welding or low Hydrogen electrode welding with DC welding machine shall be employed for fabricating the impeller to ensure that welds are free from undue stresses. Stress relieving procedure or Dye penetration test employed after welding for checking the quality of weld shall be carried out by the tenderers.
- c) **Pulley:** The pulley mounted on the blower shaft shall be made of suitable class of cast iron conforming to DLW drawing no. TPL-0019, Part no. 11050664 and Specification no. D 8054 with the modification that the pulley angle shall conform to IS:3142 and the pulley PCD shall be 132mm. Pulley shall be purchased from DLW approved source by the manufacturers.
- d) **Shaft:** Shaft shall be manufactured as per DLW part no. 11239062- and material of the shaft shall conform to BS 970 EN 19 as shown in relevant drawing.
- e) **Vane Setting:** Due to the constraint of space for mounting the blower, a forward curved vane setting is permitted for achieving the specified performance.
- f) **Hardware:** The hardware used shall be made of high tensile class of steel Gr 8.8 and should be Zinc plated to resist corrosion. The approved brands are GKW, Sunderam fasteners (TVS), LPS or Unbrako (PFL). The fasteners to be tightened with required torque recommended by the manufacturer.
- g) The impeller and casing shall be suitably treated to remove rust and should be coated with an anti- rust primer and finished with smoke gray paint.
- h) An arrow indicating the direction of rotation shall be permanently marked on the blower casing.

5.2 The manufacturer can use a superior material for the above items subject to prior approval by the purchaser.

5.3 Bearings:

- a) **Drive end:** Double row self align spherical roller bearing with parallel bore mounted on the shaft and housed in dust proof of cast iron casted housing. The bearing size shall be 22211E as mentioned in DLW drawing. The bearing housing cover shall be removable type to facilitate inspection of the bearing as well as removal of old grease.
- b) **Non Drive end:** The non- drive end bearing shall be double row self aligning ball bearing with taper adopter sleeve. The bearing size shall be 2211K as mentioned in DLW drawing with inbuilt axial expansion facility. The bearing shall be mounted on the shaft through an adopter sleeve and the assembly should be housed in standard design dust proof mild steel housing with inbuilt facility to permit axial expansion/contraction of the shaft due to temperature variation. The bearing housing cover shall be removable type to facilitate inspection of the bearing as well as removal of old grease.

c) Details of the housing and sealing arrangement employed shall be indicated. Endless felt seal shall be provided by the manufacturers. A grease pipe shall be provided on top of bearing housings with a grease plug at the bottom of the housing cover for recharging and discharging of the grease. These bearings shall not require regreasing before 120 days. The grease used shall be of specification Servogem-RR3 of IOC. Exact grease quantity for initial charging and replenishment shall be indicated.

5.4 The bearings used shall be of SKF make (imported). The manufacturer shall provide documentary evidence to establish that the bearings used have been procured/imported directly from the said company. An alternate make FAG (imported) may be on merit with prior approval of RDSO.

6 DESIGN AND GENERAL GUIDELINES

- 6.1 Strip edges of the impeller shall be properly grounded and ensuring that no burrs and another defects to match with the base plate.
- 6.2 All welds and standards shall be as per ASME section VIII.
- 6.3 Welding is to be done by a qualified welder.
- 6.4 Dye penetration test to be carried out at all critical welds like impeller etc.
- 6.5 Casing scroll shall be designed to withstand impeller disintegration at 125% of rated rpm.
- 6.6 The blower impeller shall be statically and dynamically balanced as per ISO: 1940 Grade Q 6.3.
- 6.7 All fan assemblies except shaft shall be sand blasted and painted with smoke gray colour and minimum DFT of the paints shall be in between 60 to 80 microns.
- 6.8 These blowers shall operate for extended periods on high speeds. Therefore the impeller blades have to be designed with higher margins of safety as compared to standard industrial design.
- 6.9 The maximum clearance between inlet cone and impeller shall be 6 mm.
- 6.10 Provision of aerodynamically profiled guards shall be preferred to prevent accidental contact with rotating impeller and at the same time not restricting the inlet of air into blower substantially.
- 6.11 An arrow indicating the direction of rotation shall be permanently marked on the blower casing.
- 6.12 Suitable lifting arrangement shall be provided on the blower casing.
- 6.13 Stainless steel nameplates shall be provided.
- 6.14 Manufacturer has to furnish the blower details like blade angle, curvature details, impeller hub base diameter etc before conducting the type test.
- 6.15 Shaft shall be checked for internal defects through ultrasonic test.

7. PERFORMANCE DATA & CHARACTERISTICS

- 7.1 The blower characteristics shall generally match the curve given in Annexure-1 at reference site condition (20°C and 760 mm of Hg) with the condition that the air flow, in the operating range shown on the curve, shall not be less than 2% as specified in operating range of that shown in the said curve at any point and simultaneously power consumed shall not be more than 5% as specified in the operating range.
- 7.2 The average fan total efficiency in the operating range of the blower shall not be less than 45 %.

8. TYPE TESTS

- 8.1 The blower shall be type tested at the manufacturer's premises for its air delivery, static pressure and power consumption in accordance with latest IS: 4894. Following type tests shall be carried out in the presence of the representatives of RDSO and the purchaser.
- a) **Visual examination:** The blower shall be examined for workmanship and other provisions of this specification.
 - b) **Dimensional check:** The verification of blower dimensions and clearances with respect to mounting/space requirements and the assembly drawing submitted by the manufacturer shall be checked.
 - c) **Air delivery test:** It shall be carried out as per latest IS: 4894.
 - d) **'ON' and 'OFF' test:** This test shall be done at 120% of rated RPM for at least 1000 cycles, each cycle the blower being accelerated to 120% of rated rpm then decelerated to about 700 RPM followed by the next cycle of acceleration and deceleration. Manufacturers shall provide a suitable automatic counter to record no. of cycles, date & time of starting, break down of power and time of completion of test. At the end of the test the efficiency of impeller locking on shaft shall be checked. The impeller shall be dismantled and examined for damage or abnormal wear. Bearing temperature and vibration shall be recorded after every 100 cycles. These shall be found to be within the maximum permissible limits.
 - e) **Over speed test:** The blower shall be run at 120% at rated RPM for a period of one hour against rated air delivery. After the run, the impeller shall be examined for any damage.
 - f) **Endurance test:** This test shall be conducted for a period of 50 hours with rated volume flow, and RPM. Manufactures shall provide suitable counter to record no. of hours, date and time of starting, breakdown of power etc for conducting test. After the test the blower shall be dismantled and examined for wear and tear of the parts and deterioration/degradation of components.
 - g) **Vibration test:** The blower shall also be tested for vibrations as per ISO 2372 in horizontal, vertical, and axial planes on the blower casing which shall not exceed 75 microns on rated speed. Vibration on bearing housing should not exceed 50 micron.
 - h) **Noise level:** The blower shall be tested for noise level at a distance of 1 meter from front side at rated RPM. The noise level shall not be more than 90 db from inlet with ducted outlet.

- i) **Temperature rise on bearings:** Blower shall be run at rated RPM for a minimum of 90 minute or until the temperature of the bearings has stabilized whichever is longer and temperature measured at this time shall not exceed 45 deg. centigrade or above the ambient temperature.
 - j) **Dye penetration test:** This test shall be conducted on the impeller before and after endurance test to ensure that there is no crack formation on the impeller.
 - k) **Balancing:** The blower impeller shall be dynamically balanced before and after endurance test in quality grade 6.3 as per ISO 1940. It should not be more than 1 gm. Impeller shall be balanced in two planes.
- 8.2 After the above tests, if it is felt by RDSO to repeat the tests or carry out some more tests on the prototypes, the same shall be arranged by the manufacturer at their own cost.
- 8.3 Type tests shall normally be carried out before execution of the first development order and every three years subsequently. In addition, RDSO may require to conduct fresh type test, should a need arise based on performance feed back.

9. SERVICE TRIALS

- 9.1 The manufacturer seeking for approval will supply two prototypes to the purchaser after successful type testing for their correct fitment on broad gauge diesel-electric ALCo locomotive. Any modification if required on the blower shall be checked up and carried out by the manufacturer.
- 9.2 These blowers will be subjected to extensive service trials for a period of 6 months or more as deemed necessary by the RDSO and the purchaser to prove the design, equipment performance, maintainability and reliability. Field trial report shall be sent to RDSO for scrutiny. If field trial found satisfactory, balance quantity of the blowers as mentioned in purchase order shall be supplied to the purchaser. All modifications found necessary based on the service trials to improve upon the blower design and physical construction and as mutually agreed shall be incorporated in the prototypes and in the series supplies of the equipment, at the cost of the supplier and in the manner approved by the purchaser.
- 9.3 The detailed scheme of prototype trials to satisfy the above shall be indicated by the supplier and mutually finalised in consultation with the purchaser. Special instrumentation, if any, for correct appreciation of the various data will have to be arranged by the tenderer.
- 9.4 The prototypes shall be cleared in type tests as well as in service trials before granting final approval to the manufacturer.
- 9.5 Series production shall be started only after successful type tests and field trials.

10. MARKING

The blower shall be indelibly marked with at least the following on stainless steel sheet:

- a) Manufacturer's name, trade name of fan (if any) and Serial No., Date of manufacture Year.
- b) Rated speed of fan in rev/min.
- c) Direction of rotation and direction of air flow

- d) Air delivery at stated duty
- e) Type of bearings & its make
- f) Size of impeller
- g) Fan total efficiency

11. TECHNICAL PARTICULARS TO BE FURNISHED BY THE SUPPLIER

11.1 A complete set of detailed drawings of blower and its related components showing overall dimensions and material etc. shall be submitted to RDSO and the purchaser for prior approval and for the purpose of carrying out inspection.

11.2 The supplier shall submit the following characteristic curves at 20deg. centigrade & 760 mm of Hg of atmospheric pressure at rated rpm:

- a) Total & Static pressure vs Air delivery.
- b) Horsepower consumption vs Air delivery.
- c) Total & static Efficiency vs Air delivery.

11.3 The supplier shall also furnish the following characteristic curves at 20 deg. centigrade & 760 mm of Hg of atmospheric pressure for Broad gauge AC-DC diesel-electric locomotives:

- a) Total & static pressure vs Air delivery (notch wise).
- b) Power consumption vs Air delivery (notch wise).

Notch wise engine RPM and blower RPM of the 3100 HP & 3300 HP diesel electric locomotives are as under:

Notch position	Idle	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Engine RPM	400	400	493	586	679	772	865	958	1050
Blower RPM	1082	1082	1334	1585	1837	2088	2340	2592	2840

11.4 Full calculation in support of the design capacity of the blower offered shall be submitted by the manufacturer to RDSO for scrutiny.

11.5 Detailed Marking scheme on each individual blower.

12. DEVIATION STATEMENT

The supplier shall submit item wise deviation statement seeking approval for marking deviation from the above drawings and specification. In case no relaxation is sought, 'NIL' statement shall be submitted.

13. QUALITY ASSURANCE PROGRAMME (QAP)

The supplier shall submit his internal quality assurance programme to RDSO and the purchaser before conducting type test to ensure the quality of product. In the said QAP, infrastructure facilities (comprising of testing and manufacturing facilities), frequency of various checks, details of nature of work involved in the checks and record maintained regarding these checks should be indicated. The supplier shall, on demand by RDSO or the purchaser or the Inspecting authority nominated by the purchaser, supply the records of checks carried out during internal quality assurance available for scrutiny.

14. MAINTENANCE

The manufacturer shall supply free copies of the approved maintenance manual for overhauling and running maintenance purpose at the rate of ten copies per purchase order.

Overhauling: Either based on 24 months or its multiples
If there are any special checks, shall be indicated by the manufacturer.

15. COLOUR

The blower shall be supplied in smoke gray colour as per relevant specification indicated in DLW drawing no. TPL-2578.

16. WARRANTY

The blower shall be warranted for satisfactory and trouble free operation for a period of 3 years from the date of receipt or 2 years from the date of commissioning whichever is earlier.

17. ACCEPTANCE

The acceptance test of the blower shall constitute the following on the sample basis.

S.No	Parameter	Quantity checked
1	Visual Examination	100%
2	Dimensional Check	100%, Conforming to DLW dwg. No. TPL-2578 and manufacture's approved components drawings.
3	Air Delivery test	Every 75 th unit shall be taken up for air-delivery test
4	Vibration test	Conforming to para-8.1(g), 2 no. or 10% of the lot whichever is higher
5	Noise level	Conforming to para-8.1(h), 2 no. or 10% of the lot whichever is higher
6	Temperature rise on bearing Housings	Conforming to para-8.1(i), 1 no. or 5% of the lot whichever is higher
7	Run test	1 no. blower of lot shall be run at rated rpm for 2 hours. After that blower shall be examined for wear/tear of the components and detoriation/degradation of parts. Dye Penetration test shall be carried out to ensure that there is no crack formation on impeller and casing.

Final acceptance of all purchase materials shall be made at purchaser premises.

18. PACKING

The blower and its related components shall be properly covered individually in polythene to avoid sippage of water and should be packed in wooden box to permit convenient handling and to protect against loss or damage during transit and storage.

19. TEST CERTIFICATE

Three copies of test certificates shall be supplied unless otherwise stated in the purchase order.

