



भारत सरकार रेल मन्त्रालय  
GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

# TECHNICAL SPECIFICATION FOR AXLE BOX ASSEMBLIES WITH AXLE JOURNAL BEARINGS FOR LOCOMOTIVES

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## SPECIFICATION FOR AXLE BOX ASSEMBLIES WITH AXLE JOURNAL BEARINGS FOR LOCOMOTIVES

### 1. SCOPE

- 1.1 This specification covers technical requirement for manufacture, supply, installation and inspection of axle box assemblies with axle journal bearings for locomotives.
- 1.2 Terminology: As given in IS: 2399-1988 "Roller Bearings – Vocabulary"

### 2. MINIMUM GENERAL REQUIREMENTS OF THE FIRM

The firm shall be met minimum testing & manufacturing infrastructure to RDSO STR No. MP.STR.BD-01.02.03 (Rev. -01 or Latest).

### 3. OPERATIONAL ENVIRONMENTAL & FUNCTIONAL REQUIREMENTS:

The bearings shall be able to meet the following general conditions –

- 3.1 Transfer of all vertical, lateral and longitudinal forces from the bogie to wheel and from wheel to bogie through axle box housing.
- 3.2 All types of services, i.e. passenger, goods, mixed and shunting.
- 3.3 Heavy impacts, vibrations emanating and shock loads from all types of Indian Railway track conditions (i.e. either continuously welded or jointed).
- 3.4 Varying loads and speeds, both in direction and magnitude with top speed close to limiting speed for grease lubrication.
- 3.5 Limitation on maintenance during operation - hence long running period before inspection and re-lubrication.
- 3.6 Limitation on maintenance during operation - hence long running period before inspection and re-lubrication.
- 3.7 Direct exposure to sun, rain and moisture.
- 3.8 Exposure to oil, grease, degreaser, fuel and dust or dirt etc.
- 3.9 High reliability in performance.

### 4. APPLICABLE DOCUMENTS

- 4.1 Relevant drawing(s) of RDSO for the governing dimensions, axle-load, speeds, wheel diameter, unsprung weight and dynamic-augment, etc.

#### 4.2 Specifications and Standards:

The issues of following specifications and standards, in effect on date of invitation of bids or request for proposal, shall form part of this specification to the extent specified herein:

S.No.	Standards	Description
1.	IS : 1030	Carbon steel casting for general engineering purposes
2.	IS : 1586	Method for Rockwell Hardness Test (B & C Scales) for Steel.
3.	IS : 2399 / ISO: 5593- 1984	Roller Bearings – Vocabulary

4.	IS : 3073	Assessment of Surface Roughness.
5.	IS : 3823 / ISO: 76 - 1987	Methods of Evaluating Static Load Ratings of Rolling Bearings.
6.	IS : 3824 /ISO: 281 - 1990	Methods of Evaluating Dynamic Load Ratings of Rolling Bearings.
7.	IS : 4163	Method for determination of inclusion content in steel by microscopic method.
8.	IS : 4397	Cold Rolled Carbon Steel Strips for Ball and Roller Bearing Cages.
9.	IS : 4398	Specification for Carbon Chromium Steel for the manufacture of balls, rollers and bearing races.
10.	IS : 4897	Deviations on un-toleranced dimension and mass of steel casting
11.	IS : 5669	General Plan of Boundary Dimensions for Radial Rolling Bearings.
12.	IS : 5692	Tolerances for Radial Rolling Bearings.
13.	IS : 5935	Radial Internal Clearances in Unloaded Radial Rolling Bearings.
14.	IS : 6453	Technical Supply Conditions for Rolling Bearings.
15.	IS : 7460	Tolerances for Tapered Roller Bearings.
16.	IS : 7461	General Plan of Boundary Dimensions for Tapered Roller Bearing.
17.	IS : 9202	Cylindrical rollers
18.	IRS M2	Indian Railway Standard Specification for Steel Casting.
19.	UIC 515-5	Powered and trailing stock bogies – Running gear “Tests for axle – boxes
20.	AAR M-934, Section – H	Freight Cars Journal Roller Bearings
21.	EN 12080:1998	Railway applications-Axle boxes-Rolling Bearings

## 5. **VENDOR'S SPECIAL RESPONSIBILITIES**

- 5.1 The Vendor shall be completely responsible for the satisfactory and efficient performance of the Axle Journal Bearings in service, notwithstanding any approval which the RDSO or the Inspecting Agency may have given to:
  - 5.1.1 The drawings of the Axle Journal Bearings and axle box assembly, incorporating all the design features, prepared by the firm.
  - 5.1.2 Assemblies, sub-assemblies and components during the course of manufacture at the Vendor's / Sub-Vendor's Works;
  - 5.1.3 The sub-Vendors for any material or fittings;
  - 5.1.4 Other parts of the work involved in the contract;
  - 5.1.5 The tests carried out either by the Vendor, RDSO or the Inspecting Officer.
- 5.2 Basic key Design Drawings provided by RDSO are only for guidance and may be modified to suit the requirements, as subsequently directed by the RDSO. It shall be the responsibility of the Vendor to ensure that the working drawings prepared by him are free from such discrepancies as are likely to affect the satisfactory performance/maintenance of the Axle Journal Bearings. No modifications to the Vendor Drawings or any other approved Drawings shall be made except with the prior approval of the RDSO.
- 5.3 The Vendor shall further, notwithstanding any exercise by the Inspecting Officer of the power of superintendence, be responsible for the sufficiency of packing, marking etc., of all the parts of work to ensure their delivery without damage. The Vendor shall comply with the instructions of the Inspecting

Officer, if in his opinion, further precautions than those taken by the Vendor are necessary for the proper execution and safe delivery of all the parts of the work.

- 5.4 The Vendor shall at his expense replace any part of the roller bearings and axle boxes failing or proving unsatisfactory in service and attributed to defective/faulty design, defective material or bad workmanship, within a period of 36 months or 3,60,000 kms from the date of its commissioning into service. The period of warranty shall stand extended by the duration for which the roller bearings remain inoperative under exercise of this clause. Further, should any design modification be made in any part of the device as a result of any defect/fault/lacuna/shortcoming in the original design features, the period of 36 months would commence from the date the modified part is commissioned into service. The sole judge in this regard will be the RDSO.
- 5.5 In the event of the Vendor failing to carry out any work for which he is liable under the above clause within a reasonable time, or if in the opinion of the RDSO the urgency of the case demands it, the Purchaser, without prejudice to his other rights under the Contract, may carry out the work himself at the expense of the Vendor.
- 5.6 The Vendor shall submit a list of components and equipment that is included in his scope of supply.
- 5.7 The Vendor shall supply a list of materials with quantities and facilities that would be needed from the Purchaser for installation and satisfactory operation of his equipment.

## 6. TECHNICAL REQUIREMENTS

- 6.1 Supply of drawings and Maintenance Manual :
  - 6.1.1 The vendor shall prepare, from the basic design requirements of RDSO, complete working drawing in metric units giving assembly and component details of roller bearings and axle-box, at his own cost, which shall be submitted to RDSO. Manufacture of bearing shall be done only after approval of basic design features of the bearings, as submitted by the vendor. But this approval shall not be construed as any kind of authorization/approval of the vendor for getting any purchase order.
  - 6.1.2 While submitting the drawing of a particular detail, other details depending on it shall be shown in juxtaposition and sufficient drawings of surrounding details shall be submitted to enable the design to be judged. All drawings shall be fully dimensioned. The requisite tolerances shall be shown on each dimension of the detailed drawings and the condemning sizes of wearing parts shall also be shown against the relevant dimensions. (Reference standard for tolerance shall be mentioned in drawing)
  - 6.1.3 Material specification for each component shall be indicated on the relevant drawings. If these are other than the IS or IRS, then copies of such specifications, in English, should the original be in a foreign language, shall be supplied to RDSO in duplicate.
  - 6.1.4 Full calculations in support of the design capacity (load rating) and life expectancy of the Roller Bearings shall be submitted.
  - 6.1.5 The vendor shall indicate the details of durability test including the standard, to which the offered bearing has been subjected. The vendor shall also submit results of such tests. Any validation done by agency like UIC, AAR etc shall be indicated by the vendor.
  - 6.1.6 A copy of the proposed Maintenance Manual of the bearing shall be supplied incorporating the following information:
    - a) Description of the bearings.
    - b) Procedure for initial mounting and lubrication of the bearings indicating quantity of lubricant per box.

- c) Maintenance checks in service such as grease topping, bearing examination, seal change and grease change, etc. between major examinations.
- d) Procedure of bearing extraction, examination and assembly, special tools, if any, for this purpose.
- e) Initial and condemning limits of the components.
- f) The types/brands of suitable grease/lubricants (also refer to clause 6.15).

## 7. DESIGN REQUIREMENTS

The roller bearings shall generally conform to the technical supply conditions for roller bearings as per IS: 6453.

### 7.1 Materials

- 7.1.1 Roller and bearing races shall be manufactured from suitable material conforming to IS: 4398 or equivalent. Test report of material shall be furnished by the manufacturers. If the vendor wants to use any other material, sufficient information about the alternative material shall be furnished and RDSO's approval shall be obtained for the same before using.
- 7.1.2 Rolling elements of bearings shall conform to IS: 9202 (Cylindrical rollers) or equivalent.
- 7.1.3 The metal employed for roller bearings shall be free from defects, such as pipes, seams, laminations, excessive inclusions of non-metallic impurities and such other internal defects as would render the material unsuitable for the purpose for which it is intended. On microscopic examination, it shall show fine grain size and shall be free from signs of overheating.
- 7.1.4 The inclusion rating of the bearing steel shall be declared by the manufacturer and in accordance with IS: 4398 or equivalent and shall be determined in accordance with IS: 4163.
- 7.1.5 Bearings shall be fitted with cages made of suitable material which can withstand high durability and provide service life. Vendor shall declare the specification of the material for the cage in the drawing at the time of approval. Cold rolled carbon steel strip cages shall conform to IS: 4397. The Vendor may use non-alloy steel or copper alloys or any other material for the cages, with the approval of the RDSO.
- 7.1.6 The materials for the axle box housing and end cover etc. shall conform to the specification no. IRS M2-65 or IS: 1030 or relevant RDSO drawings.
- 7.1.7 Axle box assembly fittings, such as thrower, distance rings, thrust rings and clamping plates etc. shall conform to vendor's drawings as approved by RDSO.
- 7.1.8 **For conical rubber thrust pad:**  
This shall conform to the specification no. IRS R-63-76 and RDSO drawing nos. SK.DL-2308 and SK.DL-2309 latest version.

### 7.2 Dimensions and Tolerances

- 7.2.1 **For Roller Bearings:** The dimensions, tolerances and internal clearances shall conform to IS:5669, IS:5692, IS:5935, IS:7460 & IS:7461 or any other published internal standards. The specific series or groups adopted in the design shall be shown in the Vendor's drawings.
- 7.2.2 **Axle box housings,** end covers and axle box assembly components shall conform to the RDSO drawings or approved vendor's drawings. Unless otherwise stated, the casting and machining dimensions of these components shall be as per IS: 4897 (deviations on un-toleranced dimension and mass of steel casting) and IS: 2102 (Medium) respectively.

- 7.3 Radial internal clearance for cylindrical roller bearing shall conform to IS: 5935 (Radial internal clearance in unloaded radial rolling bearings). Value of radial internal clearance of bearing for new condition, service and safety limit shall be declared by the vendor and same shall be approved by RDSO.
- 7.4 Fitting tolerance grade for axle journal and bearings, axle box housing and bearing shall be provided by the firm.
- 7.5 **Surface Finish:** The outer rings, the inner rings and the sides of the roller bearings shall have the maximum values of surface finish as specified in IS:6453, when measured in accordance with IS:3073. The functional surfaces shall have the required surface finish to ensure the performance of the bearing.

The surface finish of functional surface of axle box housings, end covers and axle box assembly components etc. shall be as per RDSO drawings or approved vendor's drawings.

- 7.6 **Hardness:** The rings and the rollers shall have the Rock Well C Hardness (HRC) of from 57 to 66 HRC and shall be measured in accordance with IS:1586

**Caution:** There shall be no impression of the test cone on the load bearing surfaces / raceways.

- 7.6.1 **Rings/Races:** There shall be no more than 3 HRC difference between the values measured on all the rings of one roller bearing.
- 7.6.2 **Rollers:** There shall be no more than 3 HRC difference between the values measured on all the rolling elements in one roller bearing.

## 7.7 Load Ratings:

- 7.7.1 The load rating and L10 life of the bearing shall be computed in accordance with IS: 3823- 1988 'Method of evaluating static load rating of rolling bearings and IS: 3824- 2002 'Method of evaluating dynamic load ratings of rolling Bearings and a copy of the calculations shall be submitted by the vendor.

- 7.7.2 The minimum L10 life rating of the roller bearing shall not be less than the value as given below :

S.No.	Type of locos	Travelled by locomotive wheels
1.	BG Mixed Traffic loco	4.50 x 10 <sup>6</sup> kms
2.	BG Goods loco	2.56 x 10 <sup>6</sup> kms
3.	MG Mixed Traffic loco	2.56 x 10 <sup>6</sup> kms
4.	MG Goods loco	1.61 x 10 <sup>6</sup> kms

- 7.8 **Running Noise:** The level of the running noise of the roller bearings shall be as agreed to between the Vendor and the Purchaser. Vendor shall furnish the acoustic data i.e. NVH analysis for prototype bearing to RDSO.
- 7.9 **Interchangeability:** The components of the bearings i.e., inner races and outer race assembly shall be fully interchangeable with the same make, without exceeding (on either side) the specified limits of radial clearance of the bearing.
- 7.10 **Soundness of manufactured bearings:**

- 7.10.1 The rolling elements shall be free from defects of workmanship, which may affect their serviceability. The surfaces for the bore, outside diameter, sides and load carrying areas shall be smooth and shall not show any damaged areas due to corrosion.
- 7.10.2 **Rings and rolling elements:** Rings and rolling elements shall be free of any defects, especially on working surfaces that may be harmful to their function (such as burrs, scratches, rust stains, nicks and dents).
- 7.10.3 **Cages:** Roller bearing cages shall exhibit no defects that might affect their function (such as burrs, scratches, rust). To avoid crack initiation, the connection between the cage bars and annular body shall be smooth and properly rounded off as per EN 12080:1998 or IS: 4397-1998.
- 7.10.4 **Soundness of rings and rolling elements:** Rings and rolling elements shall have no internal defects, nor any form of surface defect that may be harmful to their function. The soundness shall be inspected (ultrasonic inspection for inner race and outer race, MPI for ring surfaces, and Eddy current inspection for roller raceways) by the manufacturer as per EN 12080:1998. Any alternative methods to be used, which give equivalent results, shall have to be documented in the QAP, and approved by RDSO. The bearing can be through hardened or case hardened. In case of case hardening, the case depth shall be as per EN 12080:1998. There shall be no grinding burns during the different grinding operation.
- This test shall be applicable for prototype approval of new design of bearing for higher speed (more than 200 kmph) application.
- 7.11 **Retouching/Rework:** No retouching/rework is allowed without prior permission of RDSO. Any retouching/rework with the purpose of concealing a defect is not permitted.
- 7.12 **Marking:** Each bearing i.e. inner race, outer race assembly shall be visibly and indelibly marked for easy identification, with following description.
- Vendor's trade-mark;
  - Complete designation of the bearing, defining type; dimensions, radial internal clearances etc.;
  - Year of manufacture with batch number.
- 7.13 **Protection against corrosion:** The type of protection against corrosion shall be decided by the Vendor depending on the packing material used. Under proper storage conditions, the anti-corrosive treatment shall be effective for at least 12 months in order to ensure a satisfactory functioning of the rolling bearings.
- 7.14 Packing and labeling:**
- 7.14.1 The bearings shall be suitably packed to prevent damage during transit and handling. The packages shall also carry the markings as given in para 7.12.
- 7.14.2 In case non-interchangeable components of a bearing are packaged in different boxes, the latter shall be tied together so that they cannot be separated before the bearing is used. Additionally, the boxes shall carry any reference marks necessary to enable re-assembly of the bearing
- 7.14.3 The packed containers shall be marked with the following:
- Vendor's trade-mark;
  - Complete designation of the bearing;
  - Batch number, month and year of Manufacturing;
  - Quantity.



### **7.15 Lubrication:**

- 7.15.1 The lubricant recommended for use shall be normally available in India.
- 7.15.2 The bearing shall be capable of working for a minimum period of three years without any examination or grease change.
- 7.15.3 No attention (including grease topping) shall be required between two examinations. If this requirement cannot be met by the Vendor, he shall submit specific recommendations regarding minimum period for (i) grease topping, (ii) bearing examination, (iii) seal change and (iv) grease change to the RDSO for acceptance.
- 7.15.4 The Vendor shall be responsible for correct mounting, locking and initial lubrication of the roller bearings.

### **8. QUALITY ASSURANCE**

- 8.1 The whole of the material or fittings used in the construction of the work shall be subject to inspection by the Inspecting Officer and shall be as per relevant specification.
- 8.2 The Inspecting Officer shall have the power to:
  - 8.2.1 Adopt any means he may consider necessary to satisfy himself that all the materials or fittings specified are actually used throughout the construction;
  - 8.2.2 Visit in working hours without previous notice, either Vendor's Works or his Sub-Vendor's Works to inspect the manufacture and quality of the work at any stage;
  - 8.2.3 Reject any material or fittings that do not conform to the relevant standard specifications or have not been manufactured in accordance with approved practices. The rejected materials or fittings shall be marked in a distinguishable manner and shall be disposed off in such a manner as the Inspecting Officer may instruct.
- 8.3 Tests of materials and fittings shall, as far as possible, be carried out at firm's premises. The Vendor shall provide, free of cost, such materials or fittings as may be required for testing, or arrange for test pieces of forgings and castings used in bearing assembly.
- 8.4 The Vendor shall provide, free of cost, labour and appliances required by the Inspecting Officer for inspecting and testing of the whole of the work under the Contract, whether inspected at his own or his Sub-Vendor's premises, and shall make provisions in his orders to his sub-Vendor's for the inspection and testing of materials or fittings at their works, unless permission is given by the Inspecting Officer for the same to be inspected after delivery at the Vendor's Works.
- 8.5 All materials and fittings required for tests and analysis shall be selected by the Inspecting Officer, and these tests shall be carried out in his presence. No test piece shall be cut from any material or fittings until it has been stamped with such identifying marks as the Inspecting Officer may require.

### **9. INSPECTION PLAN FOR AXLE JOURNAL BEARINGS, AXLE BOX ASSEMBLY AND THEIR COMPONENTS**

#### **9.1 General Aspects**

On completion of manufacture, the bearings, which are ready for use, shall be presented for inspection. Bearings shall normally be offered in un-lubricated condition. However, according to previous agreement between Purchaser and Vendor, bearings may be presented in lubricated or un-lubricated, packaged or unpackaged.

Bearings with the same designation, belonging to the same manufacturing batch and presented at the same time, shall constitute a lot.

- 9.1.1 Internal inspection report of the complete lot shall be produced to the inspecting authority before inspection of material.
- 9.1.2 **Place of inspection:** Inspection of the bearings shall be carried out at the Vendor's premises, except for the examination of inclusions and chemical analysis, which, unless otherwise specified, shall be carried out in the Purchaser's Laboratory.
- 9.1.3 **Appearance of lot:** All essential portions of the roller bearings shall be clean and free from defects such as porosity, burrs, hardening cracks, grinding marks, indentations, rust marks etc. The examination shall be carried out visually.
- 9.1.4 Surfaces other than those portions of the roller faces which are not in contact with the ring ribs, the roller chamfers, and the reliefs at the ends of the outer and inner ring raceways shall be smooth.
- 9.1.5 **Temperature of the area where measurements are done:** Measurements shall be carried out at the ambient temperature. The measurement room shall have controlled environment. The gauges and measuring instruments and the parts to be inspected shall be stabilized at this temperature before any test is carried out.
- 9.1.6 **Gauges:** All the measuring instruments and gauges to be used for inspection shall be calibrated, and they shall not be due for calibration. Calibration details of all the measuring equipment's shall be submitted by the firm.

## 9.2 Sampling:

The Purchaser or the inspecting agency shall select at random from each lot presented, the bearings intended for the sampling inspection described below. The number of sample bearings is indicated in the table below:

Table – Number of samples

No. of bearings in the lot	No. of bearings to be selected for tests
Upto 100	2 *
From 101 to 250	3
Over 250	4

\* The number of samples for a lot equal to or less than 50 bearings will be 2 no. or as specified otherwise as per agreement between Purchaser and Vendor.

For developmental order the sample size shall be twice of the normal sample size or as specified by the contract.

The bearings selected for sampling inspection shall be degreased, if necessary.

## 9.3 Dimensional Inspection of Axle Journal Bearing

The dimensions and tolerances of the bearings shall be as stated on the drawings furnished by the vendor (refer clause 7.2). Dimensional tests shall be carried out on the selected samples as mentioned below. If there is any other superior well established method in vogue, the same shall be brought to notice by the vendor, and get the same approved.

### 9.3.1 Bore diameter $d$ (cylindrical bore) and outside diameter $D$ of bearing:

For these measurements the bearing shall preferably be placed on a substantially horizontal plane surface (see fig. 1 and 2).

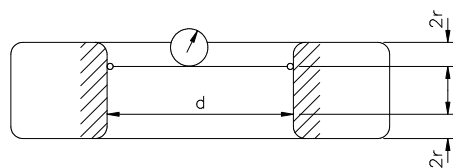


FIG. 1

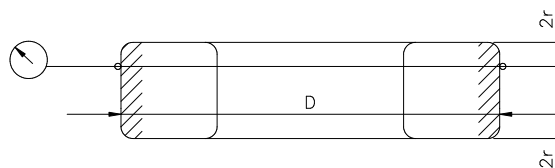


FIG. 2

The measurements shall be made in two planes parallel to the sides and at a distance of  $2r$  from the adjacent side ( $r$  = nominal ring chamfer dimension).

For both dimensions  $d$  and  $D$ , the **smallest single** diameter ( $d_{\min}$  and  $D_{\min}$ ) and the largest single diameter ( $d_{\max}$  and  $D_{\max}$ ) found in either of the two planes are determined, **using a measuring instrument with two points of contact**. The mean diameter ( $d_m$  and  $D_m$ ) of a ring is the arithmetical mean value of the smallest and the largest single diameter.

$$d_m = \frac{d_{\min} + d_{\max}}{2}$$

$$D_m = \frac{D_{\min} + D_{\max}}{2}$$

### 9.3.2 Inner ring width and outer ring width: (Except for tapered roller bearings where the bearing width is measured).

For both the rings, the distance between the side faces shall be checked using a measuring instrument **with two points** of contact. At every point the distance shall be within the stipulated limits.

### 9.3.3 Inner ring and outer ring width variation: The variation is placed on three equal-distance supports

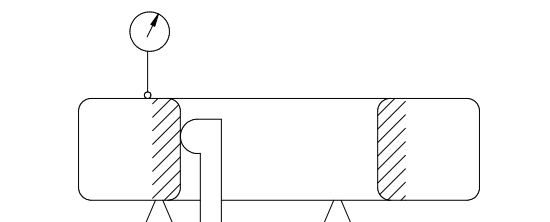


FIG. 3

which are in contact only with the inner rings or outer rings (see fig. 3)

### 9.3.4 Radial run-out of inner and outer rings in the assembled bearing:

Cylindrical roller and self-aligning roller bearings	Tapered roller bearings.
The bearing is mounted without clearance or deformation on a tapered * mandrel set horizontally between centres (see fig. 4)	The bearing is mounted without clearance or deformation on a tapered* mandrel set vertically between centres (see fig. 5).

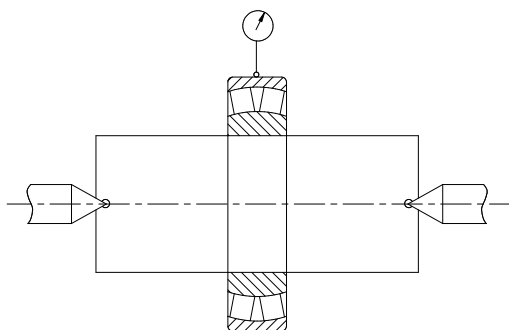


FIG. 4

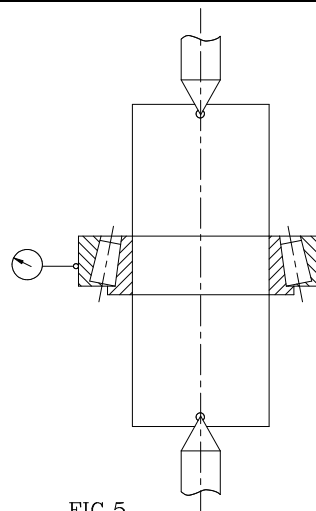


FIG. 5

\* Taper of about 0.03 mm on diameter per 100 mm length. If the bore is slightly tapered, its taper shall be positioned in the same direction as that of the mandrel. Beforehand, the radial runout of the mandrel shall be measured and located, and the readings of the dial gauge corrected, if necessary.

A dial gauge is placed in contact with the outer ring outside surface in the plane containing the middle of the raceway.

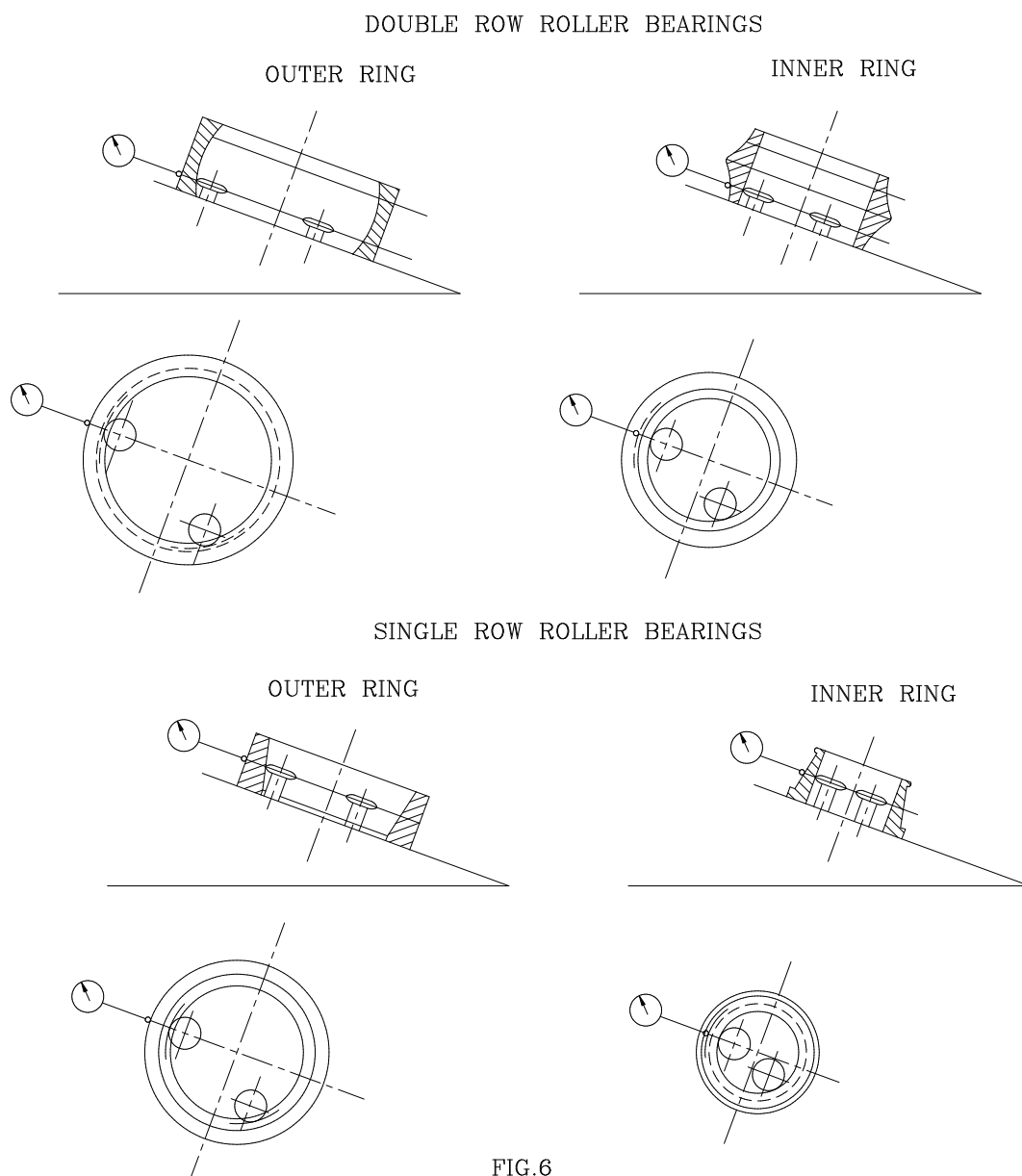
On cylindrical roller bearings without ribs, tapered roller bearings and self-aligning roller bearings, the outer ring shall be guided laterally.

- (a) **Radial runout of inner ring (all bearing types):** The radial runout is equal to the differences between the maximum and the minimum reading of the dial gauge in contact with the outer ring, when rotating the mandrel and the inner ring through one revolution, the outer ring being stationary.
- (b) **Radial runout of the outer ring (all bearing types):** The radial run out is equal to the difference between the maximum and the minimum reading of the dial gauge in contact with the outer ring, when rotating this ring through one revolution the inner ring being stationary.

For tapered roller bearings other equivalent methods may be used for this inspection.

### 9.3.5 Radial runout of inner and outer ring raceways :

The ring is placed on an inclined plane surface and is guided in its bore at two points situated in a plane parallel to the supporting surface and containing the middle of the roller raceway. A dial gauge is applied to the outside surface of the ring in line with one of the internal guides (see fig. 6).



The radial runout is equal to the difference between the maximum and the minimum reading of the dial gauge when rotating the ring through one revolution

### 9.3.6 Radial internal clearance: (except for tapered roller bearings).

With the bearing standing on a reasonably horizontal plane surface, the clearance in the upper part of the bearing, between the two rollers adjacent to the vertical plane and either the outer ring or the inner ring as applicable shall be measured with feeler gauges of known thickness (see fig. 7).

Three measurements shall be carried out, the outer ring being rotated through  $120^\circ$  between measurements while the inner ring is kept stationary.

The bearing clearance is the arithmetical mean value of the clearances measured.

For double row roller bearings, these measurements are made on both rows.



FIG. 7

### 9.3.7 Interchangeability of inner ring of cylindrical roller bearings:

In a given complete bearing the inner ring is changed and the radial internal clearance measured according to clause 7.9.

## 9.4 Destructive Tests of Axle Journal Bearing

Destructive tests shall be on disassembled Axle Journal Bearing for following tests

- 9.4.1 **Surface finish:** The outer rings, the inner rings and the sides of the roller bearings shall have the maximum values of surface finish as specified in IS:6453, when measured in accordance with IS:3073.
- 9.4.2 **Soundness tests of both rings and rollers of each bearing:** Soundness tests of both rings and rollers of each bearing shall be done as per clause 7.10.4. The rings and rollers shall not show any signs of cracks or harmful defects. This test shall be applicable for prototype approval of new design of bearing for higher speed application (more than 200 kmph).
- 9.4.3 **Hardness testing:** The test shall be carried out according to the Rockwell hardness test (B&C scales) for steel (IS: 1586), as per provisions in clause 7.6.
- 9.4.3.1 **Rings:** The test shall be done on both rings of each bearing. The Rockwell hardness shall be measured on one of the side faces of the ring at both ends of two diameters perpendicular to each other. The hardness values measured on one ring shall not differ by more than 3 HRC units.
- 9.4.3.2 **Rollers:** The test shall be done on three rollers of each bearing. The Rockwell Hardness shall be measured at one point on the surface of one end of the roller. The hardness values measured on three rollers of one bearing should not differ by more than 3 HRC units
- 9.4.4 **Expansion testing of inner rings:** The test shall involve the expansion of the bore of the ring by means of a tapered mandrel. The expansion shall be such that the bore diameter increase is 0.0015 times the bore diameter. The expansion shall be rapid. The use of an eccentric press is considered suitable and it is recommended that necessary precautions be taken during the test, since ejected fragments, if fracture occurs may be dangerous. An equivalent method may also be used.
- After completion of the test, the ring shall show no signs of failure, as may be detected by any of the method as specified in clause 7.10.4.
- Expansion testing of inner rings is not required in case of case-hardened and bainite hardened rings.
- 9.4.5 **Examination of structure and carburization:** The examination shall be done on both rings and three rollers of one bearing out of 1000 bearings inspected. The ring or the roller shall be fractured by a method chosen by the manufacturer and accepted by RDSO during the qualifying procedure to show

the structure of a brittle fracture. A regent may be used to permit accurate measurement of the thickness of the carburized layer.

The fractured sections shall not show any discontinuity, laminations, flaws, shrinkage cavities or other material defects. When case-hardening is one of the manufacturing operations, the thickness of the carburized layer shall be in accordance with the specifications.

The structure shall be examined visually (without magnification).

9.4.6 **Chemical analysis:** The chemical analysis shall be performed as follows:

1. Ladle analysis micro structure and inclusion rating of steel for each heat. This shall correspond to the stipulations in the approved drawings
2. Actual chemical composition of cage material for each heat out of which cages on bearings in lot offered have been manufactured, by spectroscopy or wet method. This shall correspond to the stipulations in the approved drawings.
3. Inspector may order retest on rings, rollers and cage of one bearing out of every 1000 bearings inspected."

## 9.5 Inspection Plan for Axle Box Housings and Axle Box Assembly Components

9.5.1 **Material:** The material shall conform to clause 7.1.6, 7.1.7 & 7.1.8 of this specification. The casting shall be free from defects like sponginess, blow and pin holes and sand inclusions, etc.

9.5.2 Dimensional and Squareness Checks, etc. of axle-boxes:

9.5.3 The dimensions of the axle box shall conform to relevant approved drawings.

9.5.4 The following main aspects of the axle box shall be checked meticulously:

- a) Axle Box Housing wall thickness – At a number of locations.
- b) Axle Box Housing Bore – Size, taper, ovality and surface finish of bore.
- c) Bearing Seating Face – Distance from end face for ensuring central location of the bearing to journal i.e. main bore depth.
- d) Suspension seating area – Size, height and centrality of suspension seat from the journal Centre.
- e) **Face Liners** – Over liners distance, parallelism and squareness of the faces to the suspension seating area.
- f) **Side Liners** – Lateral location (distance from the box front face to the liner face), parallelism and squareness of side liners to the face liner.
- g) **Thrower End Cover** – Sizes for adequate clearance from thrower after assembly.

9.5.5 **Dimensional checks for axle box assembly components:**

Thrower, end cover, distance rings, thrust rings locking plates, etc. shall conform to dimensions of relevant approved drawings of vendor.

## 9.6 TESTING OF ASSEMBLED AXLE BOXES

Tests as mentioned in this clause may be exempted, if the offered bearing is already approved by UIC, AAR or equivalent, and has successfully given field service for two years in at least 50 numbers of locomotives. Approval certificate shall be submitted by the vendor.

These tests shall be applicable for new design of bearing during prototype approval of the item.

### 9.6.1 General tests

9.6.1.1 Clearance between the thrower and thrower end cover of the box shall be adequate as per the approved drawing.

9.6.1.2 Centrality and parallelism of the horn faces to the axle of the journal.

### 9.6.2 Water tightness/ seal test

After successful completion of above tests, one or two complete axle box assemblies shall be tested for water tightness/ seal test as per UIC Code 515-5 for cylindrical roller bearing.

### 9.6.3 Endurance / Durability Test

After water tightness or seal test, the bearing shall be subjected to endurance test as per UIC Code 515-5.

## 10. INSPECTION SCHEDULE FOR AXLE JOURNAL BEARINGS, AXLE BOX ASSEMBLY AND THEIR COMPONENTS

Check sheet for Prototype and Regular inspection of Axle Journal Bearings, Axle Box Housing and Axle Box Assembly Components is given at Annexure 'A'. Inspection schedule shall be followed as given below:

S. No.	Parameter	Reference para	Prototype	Routine
1	<b>Dimensional Inspection of Axle Journal Bearing</b>	9.3	--	--
	Bore diameter d (cylindrical bore) and outside diameter D of bearing:	9.3.1	✓	✓
	Inner ring width and outer ring width: (Except for tapered roller bearings where the bearing width is measured)	9.3.2	✓	✓
	Inner ring and outer ring width variation	9.3.3	✓	✓
	Radial run-out of inner and outer rings in the assembled bearing:	9.3.4	✓	✓
	Radial runout of inner and outer ring raceways	9.3.5	✓	✗
	Radial internal clearance: (except for tapered roller bearings)	9.3.6	✓	✓
	Interchangeability of inner ring of cylindrical roller bearings	9.3.7	✓	✓
2	<b>Destructive Tests of Axle Journal Bearing</b>	9.4	--	--
	Surface finish	9.4.1	✓	✓
	Soundness tests of both rings and rollers of each bearing	9.4.2	✓	✗



	Hardness testing	9.4.3	✓	✓
	Expansion testing of inner rings	9.4.4	✓	✓
	Examination of structure and carburization	9.4.5	✓	✓
	Chemical analysis	9.4.6	✓	✓
3.	Inspection Plan for Axle Box Housings and Axle Box Assembly Components	9.5	✓	✓
4.	Marking	7.12	✓	✓
5	Protection against corrosion	7.13	✓	✓
6	Packing and labeling	7.14	✓	✓
7	Lubrication	7.15	✓	✓
8	<b>TESTING OF ASSEMBLED AXLE BOXES</b>	<b>9.6</b>	--	--
	General tests	9.6.1	✓	✗
	Water tightness/ seal test	9.6.2	✓	✗
	Endurance / Durability Test	9.6.3	✓	✗

#### 11. FIELD TRIAL

11.1 Field performance shall be monitored as per format at Annexure-B.

11.2 After successful completion of field trial approval may be considered.

#### 12. ACCEPTANCE CRITERIA

12.1 The Vendor shall not withdraw the material offered for inspection during the course of inspection. Any move by the firm in any way to withdraw the material or interfere/ hinder the inspection, shall render rejection of the entire quantity of material offered for inspection.

12.2 If any sample fails in one or more criteria of inspection, double the sample size shall be drawn and tested against the criteria in which the sample had failed. If all the samples of double sampling pass the criteria, the entire quantity shall be accepted.

12.3 Failure of any sample of the double samples will, however, result in rejection of the entire offered quantity.

12.4 In the event of rejection, the entire quantity offered for inspection shall be made unusable for Railway application in presence of the Inspecting Official either by gas cutting or cross marking on one of the rejected sample do not get mixed up with the other subjected items/ passed items at any stage.

#### 13. PREFERENCE TO MAKE IN INDIA

The Government of India policy on 'Make in India' shall apply.

#### 14. DATE OF ENFORCEMENT

For all the firms, the time frame for implementation of revised requirement/ facilities in the Specification shall be with effect from 01.01.2021.

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**Annexure - A****CHECK SHEET FOR INSPECTION OF AXLE JOURNAL BEARINGS, AXLE BOX HOUSING AND AXLE BOX ASSEMBLY COMPONENTS****1. Common parameters for all type of Axle Journal Bearings:**

1.	P.O. No., D.P. detail	
2.	Reference Axle Box Assembly Drawing No. as per P.O.	
3.	Detail of lot with nos.	
4.	Date of inspection	
5.	Place of inspection	
6.	Internal Inspection report of raw material of complete lot	
7.	Inspection of appearance of lot	
8.	Temperature of Inspection Place	
9.	Condition of Gauges with calibration details to be used for inspection	
10.	Surface finish test	
11.	Soundness test of inner and outer rings and rollers	
12.	Hardness testing of inner rings, outer rings, angle ring and three rollers of one bearing	
13.	Expansion test of inner rings test	
14.	Examination of structure and carburization test	
15.	Chemical analysis test for Bearing Materials	
16.	Type of grease, if supplied by firm with bearing	
17.	<b>Endurance / durability test (applicable for prototype Ins.)</b>	

**2. Checking of Axle Journal Roller Bearing (Cylindrical Roller Bearing) as per RDSO approved vendor drawing no ..... :**

Sl.	Details of tests for Cylindrical Roller Bearing		Recommended Value (in mm)	Bearing Sample No.			
				--	--	--	--
1.	Bore diameter of inner ring						
	Outside diameter of outer ring						
	Bore diameter of angle ring						
	Outer diameter of angle ring						
	Inner diameter of angle of angle ring						
2.	Width of outer ring						
	Width of inner ring						
	Total width of angle ring						
	Width of angle						
	Small width of angle ring						
3.	Inner ring width variation						
	Outer ring width variation						
	Angle ring width variation						
4.	Radial run out of assembled bearing	Rotating inner ring					
		Rotating outer ring					
5.	Radial internal clearance						
6.	Interchangeability test with inner races						
7.	Weight of bearing						

3. Checking of Axle Journal Roller Bearing (CRU) as per RDSO approved vendor drawing no .....:

Sl.	Details of tests for CRU Bearing		Recommended Value (in mm)	Bearing Sample No.			
				--	--	--	--
1.	Bore diameter of plain inner ring						
	Bore diameter of Lipped inner ring						
	Bore diameter of angle ring						
	Outside diameter of outer ring						
	Outer diameter of angle ring						
	Inner ring shoulder diameter						
	Inner diameter of inside seal (During proto)						
	Inner diameter of outside seal (During proto)						
2.	Width from lipped inner ring to angle ring						
	Small width from seal to seal face						
	Large width from seal to seal faces						
3.	Lipped Inner ring width variation						
	Plain Inner ring width variation						
	Angle ring width variation						
	Outer ring width variation						
4.	Radial run out of assembled bearing	Rotating inner ring					
		Rotating outer ring					
5.	Radial internal clearance						
6.	Interchangeability test with inner races						
7.	Weight of CRU bearing (in Kg.)						
8.	Weight of grease (in Kg.)						

## 4. Checking of Axle box housing as per RDSO drawing or RDSO approved vendor drawing no .....:

Sl.	Details of tests for Axle box housing		Recommended value (in mm)	Housing sample Nos.			
				--	--	--	--
1.	Material of axle box						
2.	Wall thickness	Location 1 at top					
		Location 2 at bottom					
		Location 3 at left					
		Location 4 at right					
3.	Bore	Bearing Seat Diameter					
		Bore Diameter					
		Taper					
		Ovality					
		Surface finish					
4.	Bearing seating face	Overall width of Box					
		Distance from end face of axle box to bearing seating face					
		Bearing seating width					
5.	Suspension seating area	Vertical distance from axle box bore centre to suspension seating centre					
		Longitudinal distance of suspension seating centre to axle box bore centre					
		Lateral distance of suspension seating centre to axle box bore centre					
		Suspension seating dimensions					

6.	Face liners	Distance over liners					
		Longitudinal location					
		Squareness					
		Parallelism					
7.	Side liners	Distance between liners					
		Lateral location					
		Squareness from face liner					
		Parallelism					
8.	Thrower End Cover	Inner bore diameter					
		Labyrinth width from bearing seating face					
		Over all width from bearing seating face					
		Under cut depth from outside face of box					
		Under cut inner diameter					
		Under cut outer diameter					

**5. Checking of Axle box Assembly components as per RDSO drawing or RDSO approved vendor drawing:**

Sl.	Details of tests for Axle box Assembly components		Recommended value (in mm)	Assembly component sample no.			
				--	--	--	--
1.	Thrower End Cover (in case of CRU bearing) (Drg.no.-----)	Material		Copy of material T.C. to be attached.			
		Outer Seating dia.					
		Over all width					
		Outer seating width					
		Inner bore dia.					

		Width					
		Labyrinth width					
		Under cut depth					
		Under cut inner dia.					
		Under cut outer dia.					
		Drilled hole dia./PCD					
2.	Finish Thrower (Drg.no.-----)	Material		Copy of material T.C. to be attached			
		Seating dia					
		Seating width					
		Seating Radius					
		Over hang dia					
		Over hang width					
		Over all width					
		Depth dimension					
		Depth dimension					
		Outer dia.					
		Under cut outer dia					
		Under cut inner dia.					
		Seal groove width					
		Seal groove dia					
3.	Journal Distance Ring (Drg.no.-----)	Material		Copy of material T.C. to be attached			
		Width					
		Bore dia					



		Outer dia.					
		Groove detail					
4.	Housing Distance Ring (Drg.no.-----)	Material		Copy of material T.C. to be attached			
		Width					
		Bore dia					
		Outer dia.					
		Groove detail					
		Greasing hole					
5.	Outer Thrust Collar (Drg.no.-----)	Material		Copy of material T.C. to be attached			
		Overall Width					
		Outside Dia.					
		Inside Dia.					
		Depth for Thrust Pad					
		Dia for Thrust Pad					
		Angle for Thrust Pad					
		Depth for Collar					
		Dia over Collar					
6.	Inner Thrust Collar (Drg.no.-----)	Material		Copy of material T.C. to be attached			
		Overall Width					
		Outside Dia.					
		Inside Dia.					
		Dia for Thrust Pad					
		Depth for Thrust Pad					

		Angle for Thrust Pad					
		Depth for Bolt Head					
		Dia for Bolt Head					
		No. of Holes/Holes Dia / PCD					
7.	Inner Thrust Collar Distance Piece (Plain to Drg. no.-----) (Hasler to drg. no. -----)	Material		Copy of material T.C. to be attached.			
		Overall Width					
		Outside Dia.					
		Centre Hole Dia.					
		OD for Inner Thrust Collar					
		Depth for Collar					
		Outer Dia for Axle					
		Depth for Axle					
		Tapped Hole/PCD					
		No. of Holes/Holes Dia / PCD					
8.	Outer Spacing Piece (Drg No.-----)	Material		Copy of material T.C. to be attached.			
		Overall width					
		Inside Dia					
		Outside Dia					
		Groove Depth					
		Groove Width at Bottom					

		Undercut OD					
		Undercut ID					
9.	Clamping Plate (Drg.no.-----)	Material		Copy of material T.C. to be attached.			
		Overall Width					
		Width over Axle area					
		Outside Dia					
		Centre Hole Dia					
		Outer Dia for Axle					
		Inner Dia for Axle					
		No. of Holes/Holes Dia / PCD					
10.	Conical Rubber Thrust Pad (Drg.no.-----)	Material		Copy of material T. C. attached.			
		ID Small					
		OD Small					
		ID Large					
		OD Large					
		Width Large					
11.	End Cover (Plain to Drg.no. -----) (Hasler to Drg.no. -----) (Alternator to Drg.no. -----)	Material		Copy of material T.C. attached			
		OD for Axle Box					
		Seating Width					
		Flange Thickness at Bolt					
		Overall Depth					

		Holes Dia / PCD / No. of Holes					
		Center Hole Dia.					
		Tapped Holes / PCD / No. of Holes					
		Center Hole Dia.					
		Tapped Hole / PCD / No. of Holes					

## Annexure - B

## FORMAT FOR PERFORMANCE FEEDBACK OF AXLE BOX ASSEMBLY WITH CYLINDRICAL ROLLER BEARINGS ON LOCOMOTIVES

Based shed: \_\_\_\_\_ Loco type and their holding: \_\_\_\_\_ Period: from \_\_\_\_\_ to \_\_\_\_\_

[illegible]