



(Govt. of India)

(Ministry of Railways)

डब्ल्यू डी एम₂ डीजल लोकोमोटिव में लगने वाले
रोलर बियरिंग के अनुरक्षण पर हस्तपुस्तिका
MAINTENANCE HAND BOOK

ON

ROLLER BEARING

FITTED ON WDM₂ DIESEL LOCOMOTIVE

केवल कार्यालय प्रयोग हेतु
(For official use only)

केमटेक/2003/एम/रोलर बियरिंग/1.0
CAMTECH/2003/M/Roller Bearing/1.0

जुलाई 2003

JULY 2003

*Centre
for
Advanced
Maintenance
TECH*nology



Excellence in Maintenance

MAHARAJPUR, GWALIOR – 474020

महाराजपुर, ग्वालियर – 474020

डब्ल्यू डी एम₂ डीजल लोकोमोटिव में लगने वाले
रोलर बियरिंग के अनुरक्षण पर हस्तपुस्तिका

MAINTENANCE HAND BOOK

ON

ROLLER BEARING

FITTED ON WDM₂ DIESEL LOCOMOTIVE

FOREWORD

In diesel locomotives, maintenance of roller bearings is very important. The failure of roller bearings has a great impact on the reliability of the diesel locomotive. This handbook has been prepared for artisan staff of diesel sheds who are involved in the maintenance of WDM₂ locomotives.

This hand book not only describes maintenance but care has been taken to explain basic things about roller bearings including its storage and handling. Bearings of TG, TM and axle boxes have been covered in this handbook. The book is also useful for newly appointed artisan. With these important features, I am sure that the handbook will give necessary help to the concerned staff to ensure problem free service of the roller bearings.

**CAMTECH
GWALIOR
15.07.2003**

**C. B. MIDDHA
Exe. Director**

PREFACE

Roller bearings are the vital parts of a diesel electric locomotive. Various types of roller bearings are used in all diesel electric locomotives. Proper upkeeping and maintenance is necessary to ensure reliability and availability of locomotives. This handbook on maintenance of roller bearing of WDM₂ locomotive has been prepared by CAMTECH with the objective that those involved in maintenance of diesel electric locomotives in diesel loco sheds, must be aware of correct maintenance procedure of roller bearings and must know how to investigate cause of failure and what remedial action is required.

In preparation of this handbook Shri Sanjeev Kumar, Chief Technical Assistant, CAMTECH has given valuable contribution. I am thankful to officers and staff of motive power directorate of RDSO/LKO for their valuable comments.

It is clarified that this handbook does not supersede any existing procedures and practices laid down in the maintenance instructions issued by manufacturers or by RDSO/LKO.

Technological upgradation and learning is a continuous process. Hence feel free to write us any addition / modification in this handbook or in case you have any suggestion to improve the handbook. Your contribution in this direction shall be highly appreciated.

CAMTECH GWALIOR
15th JULY 2003

Anil Sharma
Director/Mech

CONTENTS

	Contents	Page No.
	<i>Forward</i>	I
	<i>Preface</i>	II
	<i>Correction Slip</i>	III
	<i>Contents</i>	IV
Chapter-1	Introduction	1 to 2
Chapter-2	Traction Motor Armature & Traction Generator Bearing Maintenance	3 to 17
	2.0 Introduction	3
	2.1 Specifications	3
	2.2 Common Defects, Characteristics & Causes	5
	2.3 Maintenance	9
	2.3.1 Removal Of Bearing	9
	2.3.2 Cleaning Of Bearing	9
	2.3.3 Inspection of bearings during overhauling & maintenance	10
	2.3.4 Examine The Outer Race As Follow	11
	2.3.5 Examine Cases As Follow	11
	2.3.6 Scrap the bearing if any one of the following cause/defects on bearing or its parts	11
	2.4 Repacking Grease	12

	Contains	Page No.
	2.5 Bearing Assembly	12
	2.6 Final Inspection & Testing	13
	2.7 Do's & Don'ts	14
	2.8 List of maintenance Tools	16
Chapter-3	Axle Box Roller Bearing Of WDM₂ Locomotive	18 to 50
	3.0 Introduction	18
	3.1 Terminology	19
	3.2 Tool List	21
	3.3 Maintenance	23
	3.3.1 Mounting/ Assembly Preparation	23
	3.3.2 Inspection Of Components	23
	3.3.3 Bearings And Their Inspection	27
	3.4 Assembly	29
	3.5 Re- Mounting Of The Bearing	33
	3.6 Dismounting/ Disassembly	35
	3.7 Lubrication	37
	3.8 Don'ts	40
	3.9 Storage & Handling	41
	3.10 Symptoms & trouble Shooting	44
Table-1		49
Table-2		50

CHAPTER-1

INTRODUCTION

Bearing plays a vital roll between two rotary moving parts. Bearing work as an anti frictional element and reduced frictional losses, heats produced and improves service life. Roller bearing components are manufactured to very close tolerance.

The roller bearing is composed of a cylindrical inner and an outer race along with rollers and cages. The cages while carrying no load keep the rolling elements axially apart and also prevent the latter from falling out while handling. The inner ring is an interference fit on the axle journal forming part of the axle when in place. The rollers are plain, straight, solid cylinders and are flat on both ends. The bearing parts are made of nickel - chromium alloy steels

Rolling bearings are generally composed of bearing rings, rolling elements and cages. Several rolling elements are placed between two bearing rings so that cages prevent the rolling elements from contact and such a structure; a smooth rolling action becomes possible.

Rolling bearings are divided into radial bearings and thrust bearings, mainly depending on the applicable load direction. Radial bearing mainly take radial loads. Most types of radial bearings can also take thrust loads. Thrust bearings generally take thrust loads only and not radial loads.

Rolling bearings are largely divided into ball bearings and roller bearings in accordance with the types of rolling elements, Roller bearings are further divided, depending on the shape of the roller, into cylindrical roller bearings, tapered roller bearings, spherical roller bearings and needle roller bearings. Ball bearings are divided into several types, depending on the shape of bearing rings and the contact position between the balls and the raceway.

The cages of rolling bearings are divided into pressed and machined once with the shapes differing according to the bearing type and conditions of use.

- a. Single Row Radial Ball Bearings
- b. Single Row Radial Ball Bearings with tapered bore
- c. Single Row angular Contact Ball Bearings
- d. Single Row Externally Aligning Ball Bearing
- e. Double Row self- Aligning Ball Bearings
- f. Double Row Self- Aligning Ball Bearing with tapered clamping sleeve and nut
- g. Thrust Ball Bearing
- h. Cylindrical Roller Bearing
- i. Tapered Roller bearing
- j. Spherical roller bearing

In this handbook covered roller bearing used in WDM-2 locomotive mainly axle box roller bearings, traction motor armature roller bearings and traction generator armature roller bearings.

CHAPTER-2

TRACTION MOTOR ARMATURE & TRACTION GENERATOR BEARING MAINTENANCE

2.0 INTRODUCTION

Cylindrical roller bearings are used at Traction Generator free end & both ends of the Traction Motor Armature i.e. Pinion end & commutator end. Roller bearings give long service life if they are correctly mounted & well maintained. Correct handling when mounting & dismounting bearings, cleanliness, accuracy & care is necessary, During maintenance the roller bearings must be protected from dirt & moisture and correctly lubricated.

2.1 SPECIFICATIONS

The particulars for WDM₂ locomotive traction motor bearings are as follows:

Bearing	Pinion End	Commutator End
Roller Bearing No.	NU330EM1C4F.1	NH320EF1
Bore	150	100
OD	320	215
Width	65	47

Radial Clearance of free bearing when new	0.165 to 0.215 mm	0.105 to 0.140 mm
Fit between inner races & shaft	0.035 to .08 mm interference	.025 to .06 mm interference
Fit between outer race & housing	0.025 mm interference to 0.035 mm	0.020 mm interference to 0.030mm
Min. permissible radial clearance when assembled	0.1 to 0.17 mm	0.06 to 0.1 mm
Quantity for first fill Replenished period	925gm 3 years	770 gm 3 years

Recommended Grease:

Lithon-3 of HPC and Cyprina RA of Bharat Shell Ltd.

Specified Torque Value: -

End shield both PE & CE - M24 - 40-42 Kg-M

Bearing Locking Plate CE - M20 - 24-25Kg-M

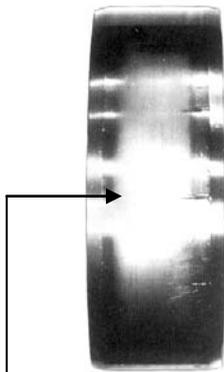
Outer Bearing Cap CE& PE, M16- 15-16 Kg-M

2.2 COMMON DEFECTS, CHARACTERISTICS & CAUSES

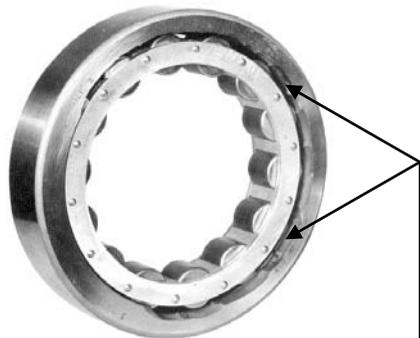
DEFECT	SYMPTOM	CAUSE
Strains	Superficial discoloration of bearing material Etching, Pitting, Corrosion & Rust on surface	Lubricant affected by rise in temperature a) Lubricant too stiff or too copious b) Creep c) Excessive load d) Incipient failure a) Free water in lubricant or corrosive lubricant b) Presence of moisture or acid while the bearing is stationary for long periods.
Spalling or flaking	Pit marks of surface corrosion pitting or lines etc. that has depth	a) Progressive fatigue b) Excessive Thrust load c) Inner ring expansion or outer ring construction due to bearing fit or temperature effects d) Excessive misalignment.

Smearing	Peeling or surface roughness	Transfer of metal from one surface to another due to material fracture.
Indentation	Visible recesses on surfaces of raceways or rollers	a) Blow in mounting or external violence b) Contaminant in lubricant.
Brinelling	Indentations on race way made by rollers under impact & disposition of material of the mating part	Bearing subjected to heavy impact load beyond its capacity. Rollers, Thus, being forced into surface.
Cracks	Surface indication of metal failure	a) Deformation or ovality of housing b) Creep c) Heavy overload
Fracture	Crack extending across entire width of rings or rollers, breakage of cages	a) Generally due to lubricant failure b) Smearing c) Inertia Forces

<p>Electric Burns</p>	<p>Surface damage from passage of electric current any unusual noise on the bearing while in service.</p>	<p>Passing of electric current through bearing while doing any welding work. Piping or Metallic Noise a) Inadequate lubrication b) Raceway marked by blows during careless mounting. Irregular Noise. a) Foreign material b) Incipient flaking or surface defects on the track.</p>
-----------------------	---	---



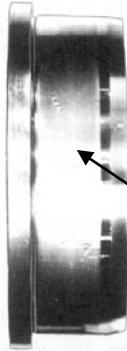
1. Inner race scored during assembly



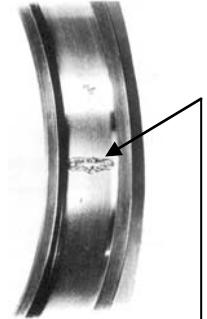
2. Broken flange on outer race caused by striking end of shaft with a hammer



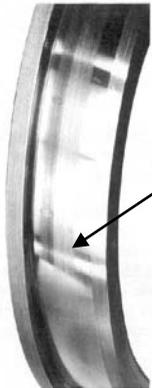
3. Abuse of inner race from over heating.



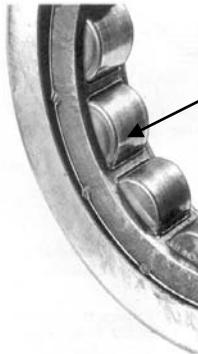
4. Electric pitting of inner race.



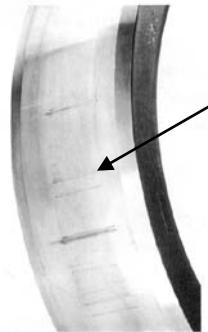
5. Outer race failure caused by fatigue flaking.



6. Dirt denting of inner race caused by flaked outer race.



7. Worn bearing caused by lack of lubrication



8. Brinelling of inner bearing race

2.3 MAINTENANCE (As per ALCO Instructions Manual)

2.3.1 Removal Of Bearing

Use special tools & extractors listed in para 2.8 to remove armature bearings.

2.3.2 Cleaning Of Bearing

Whenever bearings are removed from armature for overhauling, inspection, repair, replacement or re-lubrication, the following cleaning procedure to be invariably followed.

- ◆ Remove the bulk of grease from all bearings/ and its parts.
- ◆ Place roller bearings and its parts in a wire-mesh basket.
- ◆ Suspend the basket suitably in container of pure cleaning oil, preferably kerosene or motor oil.
- ◆ Allow bearing & its parts to soak, preferably overnight or until the grease has been sufficiently softened.
- ◆ Agitate the basket slowly through the oil from time to time as much as possible of dirt and grease, etc.
- ◆ Lift the basket & drain the oil.
- ◆ If any reason, it is necessary to ascertain the nature of the foreign material removed, stain the oil through a filter paper & collect the residue.
- ◆ Transfer all parts/bearings to a second container of cleaning oil.

- ◆ Clean each part individually with a brush, partially submerging in cleaning oil.
- ◆ Turn bearings slowly & work with a brush.
- ◆ Spin finally submerging in cleaning medium. Use shallow pans for cleaning medium
- ◆ Do repeated soaking & cleaning, if necessary until all grease, dirt, etc. is removed.
- ◆ Blow away adhering kerosene completely with dry air
- ◆ Sponge out all parts with a non-fluffy rag or with a wiping towel.
- ◆ Clean finally in petrol before re-assembly.

2.3.3 Inspection Of Bearings During Overhaul & Maintenance

Examine the inner race for the following:

- ◆ Flaking or cracks in the rollers. If found reject the bearings.
- ◆ Heavy electrical pitting : If found, reject the bearing
- ◆ Raised Craters around the edges - Stone off (do not file)
- ◆ Mottled, distributed pattern of dirt denting - Scrap the bearing or reject.
- ◆ Evidence of rubbing or turning on shaft - See for loose spacers or interference of the housing parts. If rubbing is heavy or if there is wear on the shaft, reject the bearing.

- ◆ Smearing on flange & thrust collar (CE) - If found, look for evidence of inadequate lubrication or wear on other parts caused by being cocked.

2.3.4 Examine the Outer Race As Follows:

- ◆ See for evidence of spinning in the housing. If turning is severe, replace the bearing, bush and re-bore frame head.
- ◆ Slide one of the rollers around the race by hand if the roller drag, scrap the bearing.

2.3.5 Examine Cages As Follows:

- ◆ Rest the bearing in vertical position & raise and lower the cage to check clearance.
- ◆ Rotate the roller to expose all surfaces. See for heavy denting. If dents, Rejects bearing.

2.3.6 Scrap The Bearing If Any One Of The Following Cause/Defect On Bearing Or Its Parts.

- ◆ Severe smearing caused by inadequate lubrication
- ◆ Corrosive pitting caused by moisture or other corrosive agents
- ◆ Distorted or soft parts caused by overheating during assembly
- ◆ Brinelling caused by vibration which result in depressions or grease
- ◆ Breaks or cracks.

2.4 Re-Packing Grease

- ◆ Make sure that the bearing compartment is clean & dry.
- ◆ Distribute proper type & proper amount of lubricant over rollers and in the grease chamber of the inner and outer bearing caps. Do not over grease.
- ◆ These bearings can be operated for 3 years without dismounting by refilling the bearing grease intermediately.
- ◆ It is suggested that about 40-60% of the open space in the housing is fitted with grease so that enough space is available for the grease to expel out of the bearing. This will also ensure that the bearing will not be starved of grease.

2.5 Bearing Assembly

Pack the specified amount of grease on the running surfaces & inner bearing cavities where required before and during assembly. Be sure that heated parts are tight against the adjacent parts when cold.

Commutator End Bearing

- ◆ Place inner cap on shaft.
- ◆ Heat inner bearing race to 110°C & shrink on the shaft, tight against the shaft shoulder. Assemble the bearing with the lip next to the shaft shoulder. Be sure the bearing race is tight against the shoulder when cold.

- ◆ Press outer bearing race with rollers into frame head fit. An alternate method is to heat frame-head to 100°C & place the bearing into the fit.

Pinion End Bearing

- ◆ Place inner bearing cap on shaft & shrink fit in place tight against the shaft sleeve.
- ◆ Heat inner race of bearing to 110°C & shrink it on shaft, tight against plunger.
- ◆ Press outer race & rollers bearing into frame-head fit.
- ◆ Pack the bearing & bearing cap with specified grease.
- ◆ Install pinion end bearing pilot on shaft to aid in assembling of frame head & bearing over inner bearing race on shaft.
- ◆ With a little amount of grease, stick gasket to inner bearing cap, then slide frame head with bearing into position on shaft. Remove bearing pilot from shaft.
- ◆ Assemble outer bearing cap & gasket to frame head & secure with bolts & lock washer through frame head into inner cap.
- ◆ Assemble outer sleeve on shaft after armature has been assembled into frame.

2.6 Final Inspection & Testing

- ◆ Optically examine the cleaned bearing during overhauling by optical magnifying lens on the test bench for indenting, burrs, etc.
- ◆ Measure the radial clearance with the help of gauge

2.7 Do's & Don'ts

Do's

- ◆ Work with clean tools in clean surroundings
- ◆ Remove all outside dirt from housing/shop before dismantling bearings.
- ◆ Keep your hands clean & dry while handling bearing.
- ◆ Treat an used bearing as carefully as new one.
- ◆ Use clean wiping towels.
- ◆ Use clean oil & flushing oil.
- ◆ Work on clean benches covered with clean papers.
- ◆ Protect disassembled bearing from dirt & moisture.
- ◆ Store all bearings in a dry & sheltered place.
- ◆ Inspect occasionally bearing in storage.
- ◆ Keep bearings wrapped in oil proof paper when not in use.
- ◆ Install new bearing as removed from packages without washing.
- ◆ Keep bearing lubricants clean when applying and cover containers when not in use.
- ◆ All bearings should be stored horizontally, store rooms should be cleaned.
- ◆ Use only the grease as approved & recommended.
- ◆ Only good quality cotton cloth & brushes should be used for cleaning.
- ◆ Avoid storage of bearings on floor.
- ◆ Do keep all tools gauges & instrument in working condition & in easily accessible & earmarked places.

- ◆ Use only recommended tools, gauges & instruments with due care.
- ◆ Carry tools & gauges in the tool box to working place.
- ◆ Wear shoes, helmet, and gloves for safety.
- ◆ Ensure use of torque wrench for tightening bolts whenever recommended.
- ◆ Follow recommended maintenance practice only.
- ◆ Use fresh grease/oil for lubrication.

Don'ts

- ◆ Don't work in dirty surroundings.
- ◆ Don't use dirty or brittle tools.
- ◆ Don't handle bearing with dirty moist hands.
- ◆ Don't spin uncleanness bearings.
- ◆ Don't use same container for cleaning & final rising of bearing.
- ◆ Don't use cotton waste or dirty cloths to wipe bearings.
- ◆ Don't expose bearing to moisture/dirt at any time.
- ◆ Don't clean new bearings.
- ◆ Don't use incorrect type & amount of lubricants
- ◆ Don't use wooden mallets.
- ◆ Don't interchange bearing parts.
- ◆ Never mix greases of different grade & qualities.
- ◆ Don't use excess grease for lubrication.
- ◆ Do not allow bearings to lie around uncovered or on bare floors.
- ◆ Don't remove bearing parts from original packing until immediately before assembly.

- ◆ Don't use defective tools, gauge & instruments.
- ◆ Don't carry loose tools, gauges, etc. separately.
- ◆ Don't re-use used grease.
- ◆ Don't re-use condemned bearings.
- ◆ Don't allow use of reconditioned bearings.

2.8 List of Maintenance Tools for Traction Motor and Traction Generator Bearings.

- a. Spirit level
- b. Wooden blocks
- c. Wooden 'V' block
- d. Chisel
- e. Light hammer
- f. Copper drift
- g. Screw press.
- h. Spanners Nos. 10, 13, 17, 19, 24, 30. 36, 47, 55
- i. Note: Box spanners with ratchet may be used to extent possible.
- j. Allen Keys : Size (A/F) 3, 5
- k. Set of Torque spanners with suitable adopters.

Special Tools	Used For
Extractor – CAT No. -6751547 G1	Bearing inner race puller Comm. end.
Extractor – CAT No.-6751547 G2	Flinger puller Comm. end.
Extractor – CAT No.-6751547 G3	Sleeve & retaining ring puller Comm. End.
Extractor – CAT No.-6751547 G4	Sleeve puller pinion end.
Extractor – CAT No.-6751547 G5	Bearing inner race puller pinion end
Extractor – CAT No.-6751547 G6	Flinger puller pinion end.
Extractor – CAT No.-6751547 G7	Sleeve and retaining ring puller pinion end

CHAPTER-3

AXLE BOX ROLLER BEARING OF WDM₂ LOCOMOTIVE

3.0 INTRODUCTION

Following types of bearings axle boxes are fitted on WDM₂ locomotives.

Timken Quad:

Timken Quad bearing having four row taper rollers in double arrangements. The rollers are un sealed and greasing is provided in time to time. It has a retainer.

Timken AP:

It is same as Timken Quad, but only the difference that it having two rows taper. Greasing is done from greasing nipple, which is provided in end cap.

NBC/NORMA :

It is fitted with two row cylindrical roller bearings with different cages. This type of axle boxes fitted on wide horn bogie frame.

SKF:

Axle box having two type of bearings

- ◆ Cylindrical bearing for radial load.
- ◆ Ball bearing for thrust load.

It is fitted with two inner and outer cages.

3.1 TERMINOLOGY (BEARING PARTS ETC.)

The following terminology shall be used for designating the bearing parts: -

◆ Terminology for Bearing Parts

a. Bearing rear cup

(The outer race or outer ring at rear end)

b. Bearing front cup

(The outer race or outer ring at front end.)

c. Single rear cone assembly

(The inner race or inner ring with rollers and cage at rear end)

d. Double centre cone assembly

(The inner race or inner ring with two sets of rollers and two cages at centre.)

e. Single front cone assembly

(The inner race or inner ring with rollers and cage at front end.)

f. Rollers

(The rolling elements.)

g. Cage

(The roller retainer.)

h. Spacer

(The two piece spacer ring.)

i. Enclosure

(The ring shaped flat end cover.)

j. Flinger

(Interference fit backing or dust guard ring.)

k. Axle end cap

(Cap at the end of journal or axle end cover.)

l. Locking plate

(Cap screw locking device.)

m. End cap, cap screw

(Axle end cap, fasteners.)

n. Bearing housing

(Axle box, the surrounding housing of bearing or journal box.)

o. Race ways

(Surfaces of cups and cones on which rollers operate.)

p. Cover

(The plain or flanged front cover of the bearing housing.)

q. Cover cap screws

(Cover fasteners.)

r. Pipe plug

(Lubrication hole plug.)

s. Lubricant filling

(The button head pressure grease filling.)

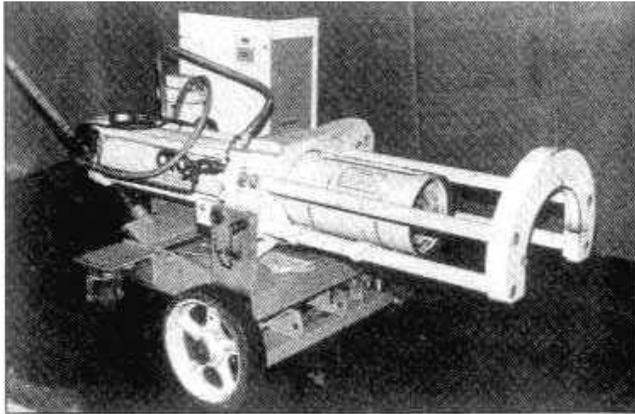
t. Gasket

(The non metallic sealing ring.)

3.2 TOOLS LIST

- ◆ Brass bar or copper bar
- ◆ Micrometers (inside and outside)
- ◆ Feeler Gauges
- ◆ Journal Gauges
- ◆ Wheel press, Portable mechanical or hydraulic press (with pilot sleeve, base plate reach rods, pulling shoe, adapter ring, assembly sleeve, hex. Bolt, guide sleeve, thrust rod etc.

- ◆ General Fitters tools
- ◆ Torque wrench
- ◆ Scraper
- ◆ Hand grinders, oil stone or electrical grinding pencils
- ◆ Dial indicators
- ◆ Magnifying glasses
- ◆ Deep and shallow washing pans
- ◆ Thin hart wood scoop
- ◆ Wooden blocks
- ◆ Brushes
- ◆ Shop, towels



Bearing puller/ Installer Equipment

3.3 MAINTENANCE

3.3.1 Mounting/ Assembly Preparations:

Prior to the mounting of the bearing and axle box components, cleanliness of all the components should be ensured. The components may be washed in MTO or petrol.

It is not necessary to clean new bearings. The rust preventive oil that the bearings are coated with helps in the initial run-in lubrication, until the grease reaches the functional parts of the Axle box bearing.

The mounting and dismounting of the rolling bearings is made easier and the generation of fretting corrosion is highly reduced if the bearing seat areas on the axle journal and the housing bore are coated with a thin layer of the mounting paste FAG Arcanol L144 or equivalent.

3.3.2 Inspection of Components

All axle boxes and components, whether used or new, should be inspected thoroughly, before they are assembled. Used axle boxes and components should be given special attention.

In the case of overhauling, all the dismantled components must be thoroughly cleaned with petrol or kerosene.

The following are the pertinent guidelines for inspection:

◆ **Axle Box Housing**

- I. Check for damage, score marks and corrosion.
- II. Check for dimensional accuracy as per the drawing.
- III. Check for ovality and taper.
- IV. Check width of the axle box.

An axle box, which has any discrepancy, should be withdrawn from further use.

a. Axle Journal

After thorough cleaning, the journal should be examined for dimensions, taper, ovality, surface finish and internal or superficial cracks.

b. End Covers

After cleaning, examine the end covers for cracks and trueness of dimension.

c. Labyrinth Ring

Once the labyrinth ring is dismantled, the same should

not be reused. Secondly, if the labyrinth ring is found damaged, the same should be replaced.

d. Felt Ring

The felt rings should be changed compulsorily during the overhauling of the Axle box.

e. Clamping Plates and Distance Rings

These components should be examined for dimensions and flatness before they are reused.

f. Locking Bolts/Studs and Locking Plates

If the bolts do not fit properly, they must be replaced. It is advisable to change the locking plate when the axle box is dismantled.

For new components, it is sufficient if the dimensions are as per the RDSO/ manufacture drawings. Attention must be given to the surface finish. Below mentioned are the details about the measurement of two dimensions, which are critical for mounting of the bearing.

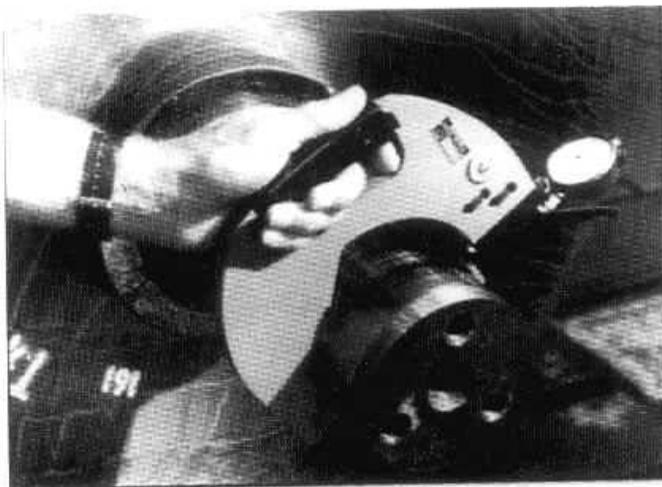
Journal

It is important to measure the journal diameters of the axle in order to get the proper radial clearance after mounting. The journal diameters should be as specified in Table. The

measurement should be taken at four places, 90 degrees apart. The method of measuring the journal diameter. It is suggested that a Dial Indicator Snap Gauge (See fig.) is used to measure the cylindrical seats of the journals.

Axle Boxes

It is essential to check the bore diameter and bore width in order to obtain proper fitment inside the axle box. The dimensions should be as per the relevant drawings and the diameters as specified by RDSO. Measuring points should be as indicated in the drawing. It is suggested that a dial bore gauge is used to get the correct values of the axle box bore



Dial Indicator Snap Gauge

3.3.3 Bearings and Their Inspection

All bearings are guaranteed for dimensional accuracy and metallurgical properties. These bearings are supplied in corrugated/cardboard cartons. To safeguard the bearings against transit damage, the bearing rings are packed with tower packing arrangement, where the inner & outer rings are separated with the partition of corrugated sheet.

Usually, no prior inspection of bearings is called for, provided the bearings are properly handled during transit. However, the following points may be looked into:

◆ **Any damage to the raceways, rollers and cages:**

Any damage to the rollers and raceways should be brought to notice of the concerned section engineer.

◆ **Free rotation of roller and cage assembly :**

In case the rotation is not free, this may be due to some dirt inside. The bearing may be washed with filtered MTO or petrol and re-dipped in rust preventive oil

Recommend RUSTOP 274 of HP or any equivalent rust preventive oil.

Appearance:

Any rust or marks on the non functional areas like bore, outer diameter and sides of the bearing can be overlooked. Frequently, the angular patch on the outer ring surface is mistaken as a defect. It is clarified that at the time of grinding, the outer rings are located on carbide shoes which leave this mark. This has got nothing to do with the quality.

Radial Clearance:

The radial clearance of a rolling bearing is defined as the amount of possible displacement of one ring relative to the other in radial direction.

This is checked by inserting a feeler gauge between the inner ring and the roller in the topmost or the bottommost position depending on the method of measurement. Care should be taken to see that the inner ring raceway is properly centered on the rollers. The bearing with inner ring as mentioned above, can be kept upright on a table or suspended from a mandrel when measuring the radial clearance. The feeler gauge should pass through the gap between roller and inner ring, with slight resistance. Do not over-cycle the feeler with the roller, when measuring the radial clearance.

The radial clearance of the bearing is determined by the thickest combination of feelers that can be passed through the bearing. Above illustrates the method for checking the radial clearance.

The radial clearance of a bearing which is mounted on a shaft with interference fit results in a reduction of the radial clearance, owing to the expansion of the inner ring due to the fit on the shaft. The radial clearance in the mounted bearing is further reduced during operation, owing to the fact that the rotating inner ring runs warmer than the outer ring and hence expands to a certain extent. It is hence important that the radial clearance in an un-mounted bearing is as per the recommendations of the designer. Here suggest the feeler gauges are checked in the standard room before putting to use.

It is strongly suggested that the radial clearance prior to mounting is checked and ascertained to be within the above limits. Any deviation may be reported to the manufacturer. Provided that the tolerances in the journal and on the housing are as specified in the drawings, the radial clearance of the mounted bearing will be as per the drawings. However, a bearing with insufficient clearance before mounting, will result in a bearing with insufficient clearance after mounting. This could lead to overheating and subsequent seizure.

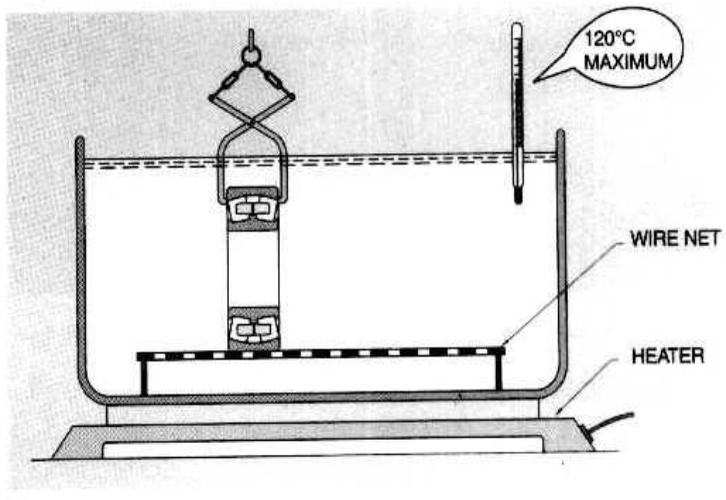
“Always check the radial clearance of the bearing prior to mounting.”

3.4 ASSEMBLY:

Assembly work starts with the heating of the labyrinth ring. Labyrinth rings have a tighter fit on the journal and should be heated up to 130° C for a period not exceeding 01 hour and then shrunk on the axle.

After ensuring that the tolerances on the shaft are as specified, the inner rings should be heated to 120° C maximum, in order that it is mounted onto the shaft.

Heating of *bearings / components* in an oil bath (Fig.) is simple and cheap. Oil used in an oil bath should be fortified with anti-oxidation, anti-corrosion, anti-wear and anti-foam additives. Enklo 68 of M/s Hindustan Petroleum or Servosystem 68 of M/s Indian Oil Corporationer Yantrol 150 of Hindustan Petroleum *or* Servoline 150 of M/s Indian Oil Corporation may be used.

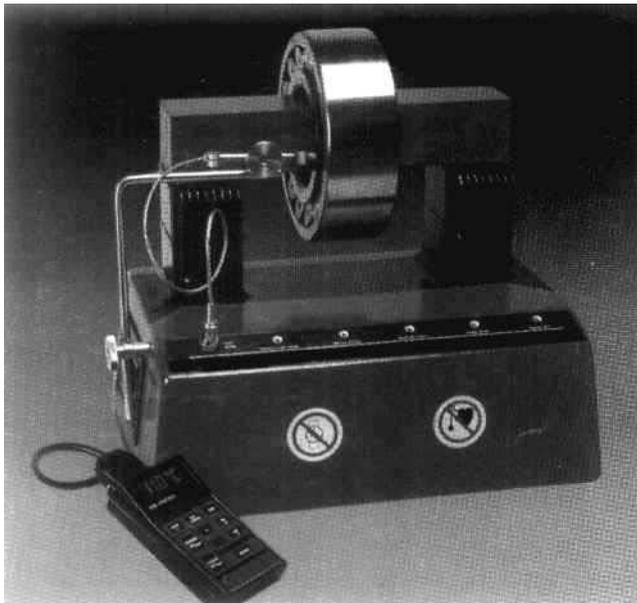


Oil Bath Heater

The Oil bath system should have the following:

- ◆ Temperature monitoring alongwith a cut-off system.
- ◆ Grids at the bottom to avoid direct heating, to ensure that the oil reaches all the surfaces of the bearing and to allow contaminants to settle underneath.

Recommend the use of induction heaters, in case the number of bearings to be mounted is large. Since the bearings/components can be heated economically and very accurately to the desired temperature by temperature control or by time control.



Induction Heaters

Inductions heating of bearings and components have the following advantages

- ◆ Fast, Energy Saving
- ◆ Suitable for metal parts of all shapes
- ◆ High degree of safety
- ◆ Environmental friendly
- ◆ Steady and controlled heating
- ◆ Easy to operate
- ◆ De-magnetization after heating

Induction heating devices supplied by reputed manufacturers incorporate temperature monitoring and cut-off devices.

Note: Bearings should be taken out of their packings prior to their heating for mounting.

The time required for the bearings to attain a temperature of about 100°C to 110°C should be ascertained from experience, when an oil bath is used. The induction-heating device should must have temperature display/de-magnetising facilities.

Though the bearing can be safely heated up to 120° C, it is seen from experience that temperature of about 100°C to 110°C provides sufficient expansion for smooth fitting. Overheating of bearings results in dimensional instability due to change in the microstructure, and should be avoided.

The heated rings are carried with tong or by wearing asbestos gloves and mounted on the journal. Care should be taken to ensure the proper seating/positive contact of the ring against the labyrinth ring. It is suggested that a mounting sleeve is manually pushed against the labyrinth ring or a few light hammer blows using a dolly are given to the labyrinth ring as it cools down, to avoid any possible gap at shaft collar due to shrinkage. Ensure that the bearing seat is free of all oil and dust before the inner-ring is mounted. Do not proceed any further until the rings have cooled down to room temperature.

The stamped face of the bearing should be kept outwards while fitting the bearing so that the stamping can be seen during inspection. The date, month and year of attention/mounting and the workshop code should be etched on the outer face of the outer ring by the concerned workshop.

3.5 RE-MOUNTING OF THE HOUSING:

While the inner-ring cools down i.e. shrink on completely, the axle box bearing housing is prepared for mounting. First, the front housing cover is screwed off (provided the housing was already bolted to the housing covers for painting etc.). Then the housing bore and the labyrinth housing area are cleaned from clinging grease and other contaminants.

Before the outer rings with the roller and cage assemblies are inserted into the axle box bearing housing, the

bearing seat is coated with a thin layer of the mounting paste FAG Arcanol L144V or equivalent paste. The outer rings are fitted into the housing with a sliding fit so that the insertion into the housing bore does not pose any problems.

If the outer ring of the rear bearing (at labyrinth bore side) tilts and gets jammed when inserted into the housing bore, the outer ring face of the bearing is lightly tapped several times with a plastic tip hammer. If the housing distance ring or the front outer ring (at end cover side) skews, the rear outer ring or the housing distance ring is lifted until it touches the front one and then lowered. Finally the outer spacing ring is inserted in such a way that it perfectly abuts against the front bearing

Taps on the rollers or on the cage must be avoided by all means; they cause damage (deformation of the cage) and premature failure of the bearings.

Then the outer rings, the rollers and the cages are greased with approx. half of the total grease quantity provided for the bearing. It has to be ensured that all spaces between cage, rollers and raceways are filled with grease to capacity. Approx. one-third of the space between the rear bearing and the labyrinth ring is packed with grease. The sealing area of the housing at the axle passage is also well greased so the labyrinth gaps are packed with grease after mounting.

On completion of above sub-assembly of the housing, the pre-mounted axle box bearing housing is pushed onto the

axle journal.

The face of the front inner ring must be free from grease. The bearing thrust collar is positioned against the inner ring and the distance plate is positioned against the axle face. Subsequently, the outer and inner thrust collars are abutted against the bearing thrust collar and the distance plate respectively. Finally, the hexagonal head bolts (M12) are screwed in with greased threads and tightened. The bolts are pre-tightened electrically or pneumatically and then tightened to the specified torque (as specified by RDSO) by means of a torque wrench.

After installing the greased sealing ring on front end cover, the cover is fitted on the housing and four hex, head bolts (M22) are pre-tightened electrically or pneumatically and then tightened to the specified torque by means of a torque wrench, with the first bolt having to be re-tightened once more.

Manually rotating and axially displacing the housing once more checks the smooth operation and the axial clearance of the installed thrust bearings.

3.6 DISMOUNTING/ DISASSEMBLY

The wheels set bearings are dismantled in the reverse order of mounting. It has to be ensured that the housing parts and their mating parts are cleaned prior to loosening the end cover bolts so that no dirt can penetrate into the bearings. The inner rings do not have to be removed for the regular

maintenance in the course of the main inspection. They have to be removed only if they are damaged.

If the inner rings are removed by means of a mechanical extractor, the shaft journals might get damaged. It is a better idea to first heat the inner rings to eliminate the interference for the duration of the extraction process.

Welding torches or multi-jet flame heating may by no means be used as the inner-rings might get locally overheated or heated non-uniformly. This will impair the uniform hardness of the rings.

For batch mounting or series inspection, the inner-rings should be heated by means of the induction-heating device (induction coil) as shown in figure.

Dismounting of the axle boxes and roller bearings is necessary during periodic overhauling and maintenance work. During overhauling of the axle box assembly, the following points should be followed:

Labyrinth Ring: Should be replaced if found broken or damaged.

Rubber seal Ring: Should always be replaced during remounting.

Felt Seal Ring: Should always be replaced during remounting.

Locking Plate Should always be replaced during remounting

Axle Box Housing: Should be cleaned probable always be replaced damages to ensure perfect remounting and trouble free service.

Dimensional Checks Bearings and axle box components should be checked for their dimensional correctness.

3.7 LUBRICATION

All axle box bearings are grease lubricated. Grease-lubrication has the advantage of easy maintenance. In addition, the grease protects the bearings from impurities and humidity. Grease also helps sealing and as such the axle box is generally filled with more grease than is necessary for lubrication of bearings.

A mixture of grease of different soap bases should be avoided. The use of mixture of greases with the same soap base but of different makes is also discouraged.

Axle box bearings lubricated by grease do not require any attention during normal service. Operating experience has shown that the grease retains its lubricating properties until the next periodic inspection of the vehicle.

We recommend the following greases:

- ◆ Servogem RR3 of Indian Oil Corporation
- ◆ Multi grease LL3 of Balmer Lawrie.

For Conventional and High-Speed axle boxes, the recommended quantity of grease should be as per RDSO recommendation.

- ◆ Remove the grease from the bearing, wash the bearing and components with Kerosene/MTO and finally with petrol. Care must be taken so that no hair from the brush or fluff from the cotton sticks to any surface of the bearing. Use of cotton waste is undesirable.
- ◆ During cleaning the bearing should be continuously rotated so that grease from every corner is taken out.
- ◆ All surfaces, especially those in rolling contact, should be checked. Condition of inner race should also be carefully examined.
- ◆ Bearings may be rejected due to the following defects :
 - Pitted /flaked rollers, raceways.
 - Inner ring/Outer ring cracked.
 - Cage damaged or broken.
 - Rust/Corrosion damage.
- ◆ In case the condition of the bearing is found to be all right in all respects, the bearing may be cleaned further to make it suitable for greasing.
- ◆ Pack fresh grease into the bearing. Fresh grease must

also be filled in the grooves of the labyrinth cover side of the axle box housing as per specified.

- ◆ Finally, carefully push the axle box housing over the bearing. Complete the assembly and tighten the axle box bolts. Check the axle box for free rotation by hand.
- ◆ Strictly follow the temperature range specified for heating the bearings and components in order to avoid overheating and finally, pre-mature failures.
- ◆ Apply *smearing / mounting* paste on the bearing seats in order to prevent fretting corrosion and facilitate smooth mounting/dis- mounting of bearings.
- ◆ Apply mounting/dis-mounting forces on the bearing or components as directed by the supplier.
- ◆ Ensure the stamped side of the bearing faces towards the outside to facilitate inspection and identification of the bearing.
- ◆ Always select the right lubricants (or consult the bearing supplier) for optimum service life of bearings.
- ◆ Tighten nuts and bolts fully by applying the specified torque. Always use the torque wrench, whenever recommended.
- ◆ Always optimize the duration for test run of bearings to achieve maximum service life.
- ◆ Records complete observations on the bearing failure and inform the supplier immediately.
- ◆ Use the standard format pertaining to bearing failure investigation, specified by the bearing supplier or RDSO.
- ◆ Strictly follow the maintenance practices prescribed by

the RDSO and insist for the maintenance manual.

3.8 DON'TS:

- ◆ Never put spurious /re-conditioned / re-worked / damage bearings into service.
- ◆ Strictly avoid the unsafe methods of working.
- ◆ Don't unnecessarily open the bearing cartons before its use and never disturb the original packing.
- ◆ Avoid mixing up of the components of different bearings or make.
- ◆ Strictly restrict use of non-standard mating components. Also, never mount the bearings on undersize or oversize mating components.
- ◆ Don't use compressed air for cleaning of bearings.
- ◆ Avoid overheating of bearings beyond 120° C.
- ◆ Never use flame heating or welding torches for extracting the bearings, which are to be reused or once again to be put into service.
- ◆ Don't recycle the used components viz. Rubber sealing ring, felt seals, locking plates, etc. which lose their original properties after dis-mounting.
- ◆ Prohibit the reuse of used grease. Never mix up the greases of different grades or even different make with same grades.
- ◆ Prevent direct exposure of greased bearings and other components directly with the atmosphere / sunlight.
- ◆ Never compromise with critical dimensions/tolerances on bearings and other mating components.

- ◆ Don't reuse the condemned bearings/components.
- ◆ Avoid use of cotton waste or dirty clothes to wipe the bearings.
- ◆ Never scratch or nick the bearing critical surfaces.

3.9 STORAGE AND HANDLING

Storage

Roller bearing components are manufactured to very close tolerance. Finishing is done on machines of superior accuracy. The amount of precision built and machined into any roller bearing is such that it should be handled with utmost care. Personnel handling roller bearings should, therefore, be given detailed instructions on storage and handling of roller bearings: The following are the principle points to be observed and effort should be made to practice them to the extent possible.

- ◆ Bearings should be kept in their original packing until they are actually needed for mounting. Minute dirt or dust particles can start bearing damage and lead to premature failure.
- ◆ The storeroom should be covered, clean and dry. Bearing packages should not be exposed to direct sunlight or any external source of heat, as this dries up the rust preventive oil.
- ◆ Bearings should be stored in dry places; Open water

places, water pipes giving rise to condensates are not permitted in the storage area. Wrapped bearings should be shelved on dry racks or bins so that the carton lid is on top. They should be placed on oil- paper or similar waterproof paddings.

- ◆ Roller bearings should not be stored against walls or directly on the floor. They should be stored flat and over their entire circumference.
- ◆ It is advisable to provide de-moisturising material on the shelves, to keep away moisture from the bearings.
- ◆ Bearings stored for a longer periods exceeding one year, should be carefully checked for aging of rust preventive oil and in such circumstances, the same should be cleaned and applied with fresh rust preventive oil.
- ◆ Any bearing which is not put into service within mention period, should be re-dipped in rust preventive oil and packed for further use. It is also in order to mention here that this rust preventive oil is compatible with all known commercial bearing greases.

Handling

The performance of rolling bearings depends to a large extent on the condition of the functional surfaces of the bearings, i.e. the surfaces that are in rolling contact. (Raceways of the inner and outer rings, and the surface of the rollers). The slightest damage of these surfaces can lead to premature failure. Hence, handling of bearings is an important aspect of

bearing service life. The following guidelines indicate precautions to be taken in this regard:

- ◆ Do not subject the bearings to shocks or jerks at the time of handling, either during storage or during transport from the stores to the shop floor for mounting, as this will cause damage to the raceways.
- ◆ Do not open the bearing cartons unnecessarily, and disturb the original wrapping. Entry of moisture into the bearings during re-wrapping will result in subsequent corrosion. The possibility of dust entering into the bearings also exists. With both the above possibilities the bearing begins to fail, even before it is effectively put into service.
- ◆ Avoid mixing up of the bearing components of different bearings, in case you desire to inspect a few bearings at random and at the same location.
- ◆ Open the bearing cartons for inspection only before mounting and avoid inspection on receipt if the bearings are not to be mounted immediately.

3.10 SYMPTOMS & TROUBLE SHOOTING

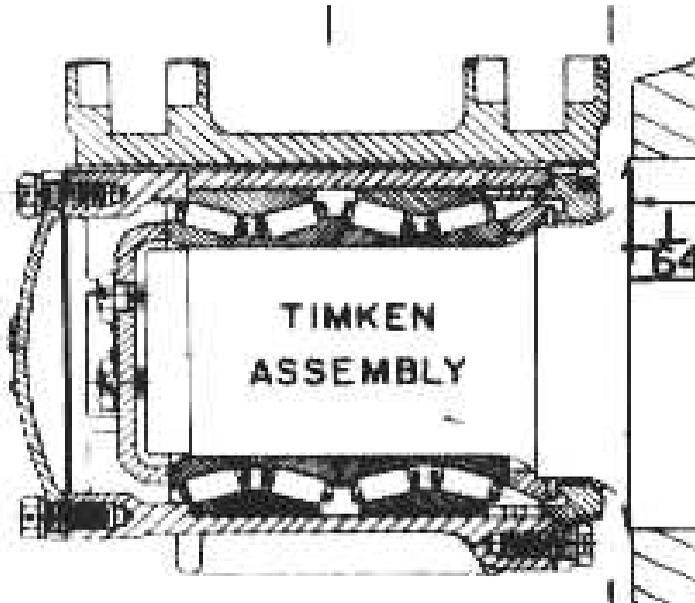
Some of the important defects that may affect the bearing and the remedial measures to be taken are given in the table below.

Defect	Effect	Remedy
Discolouration of grease	Colour of grease turning black within a short period.	Check the felt seal check if the labyrinth is touching other component.
Felt seal damaged	Oozing of grease ingress of dust, Water	Change the felt seal. Use felt seal of standard quality recommended by RDSO.
Damaged 'O' ring/Sealing ring	Dust and water may enter into the axle box.	Change the 'O' ring /sealing ring. Use 'O' ring /sealing ring recommended by RDSO.

Improper Lubrication	Increase of bearing temp. and subsequent seizure of the bearing.	Use grease approved by RDSO. Grease quantity should be as recommended by manufacturer or RDSO.
Bearing clearance in mounted position not within prescribed limits	Increase in temperature ,Excessive noise, bearing seizure, heavy wear of rollers and raceways	Checking bearing clearance in mounted position, it should be as specified. Also check clearance at the time of maintenance.
Use of substandard Locking Bolts	Locking Bolts may become loose and lead to early bearing failure.	Check the standard; it should be as per RDSO standards.

Use of sub standard/reused locking plates	Locking Bolts may become loose and lead to early bearing failure.	Check the standard, it should be as per RDSO standard. Use locking plates should not be reused.
Journal diameter/finish not as per the specification	Causes serious bearing problems leading to its premature failure.	Journal size tolerances, finish should strictly comply with RDSO drawing/specifications.
Increase ovality in the axle box housing	Flaking of rollers /raceway due to uneven loading in bearing leading to its premature failure.	Always measure Axle box housing bore prior to its mounting. Ovality should be within prescribed limits.

<p>Incorrect dimensions/ovality in labyrinth ring</p>	<p>Impedance/restriction in the rotation of labyrinth ring. Failure of labyrinth Ring /Axle box housing on labyrinth side bore.</p>	<p>Always measure critical dimensions of labyrinth ring and axle box housing on labyrinth side bore. Ensure smooth/free rotation lab. Ring in housing</p>
---	---	---



AXLE BOX ROLLER BEARING CROSS SECTION

Table- 1 Journal and Housing Dimensions

Locomotive	Shaft Dimension		Housing Dimension	
	Min.	Max.	Min.	Max.
Conventional Locomotive	150.065	150.090	270.000	270.052
High speed Locomotive	150.065	150.090	270.000	270.052

Table-2 Radial Clearance values for bearings before and after mounting

Bearing type	Before mounting Radial Clearance	After mounting Radial Clearance
WJ/WJP 150 *270M1.C4 (Conventional)	0.165mm to 0.215 mm	0.70mm to 0.160mm
WUJ 150* 270M1.C4 (High Speed)	0.165mm to 0.215 mm	0.70mm to 0.160mm

OUR OBJECTIVE

To Upgrade Maintenance Technologies and Methodologies and achieve Improvement in Productivity and Performance of all Railway Assets and Manpower which Interalia would cover Reliability, Availability, Utilisation and Efficiency.

If you have any suggestions and any specific comments, please write to us :

Contact Person : Director (Mech)

**Postal Address : Indian Railways ,
Centre for Advanced
Maintenance
Technology,
Maharajpur,Gwalior.**

Pin Code : 474020

Phone : 0751-2470890

Fax : 0751-2470841