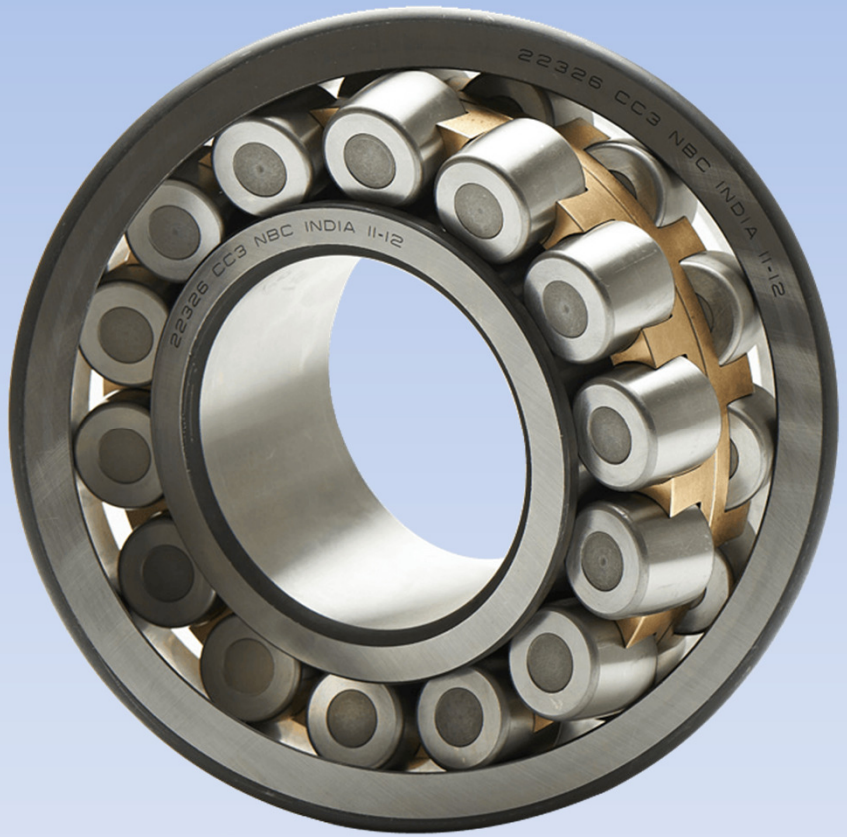
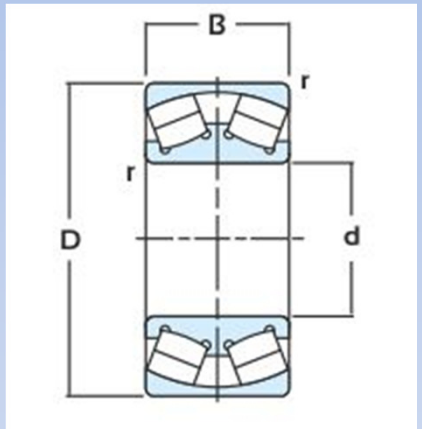
Presentation on Roller Bearing



Introduction

Spherical roller bearings are self-aligning bearings designed for heavy radial loading. The rollers are barrel shaped. These bearings automatically compensate for large angular errors commonly called shaft misalignments. They are usually of double row design, both the rows of the rollers having common spherical raceways in the outer ring. This feature has great practical importance in those cases where it is difficult to obtain exact parallelism between the shaft and housing both axes.



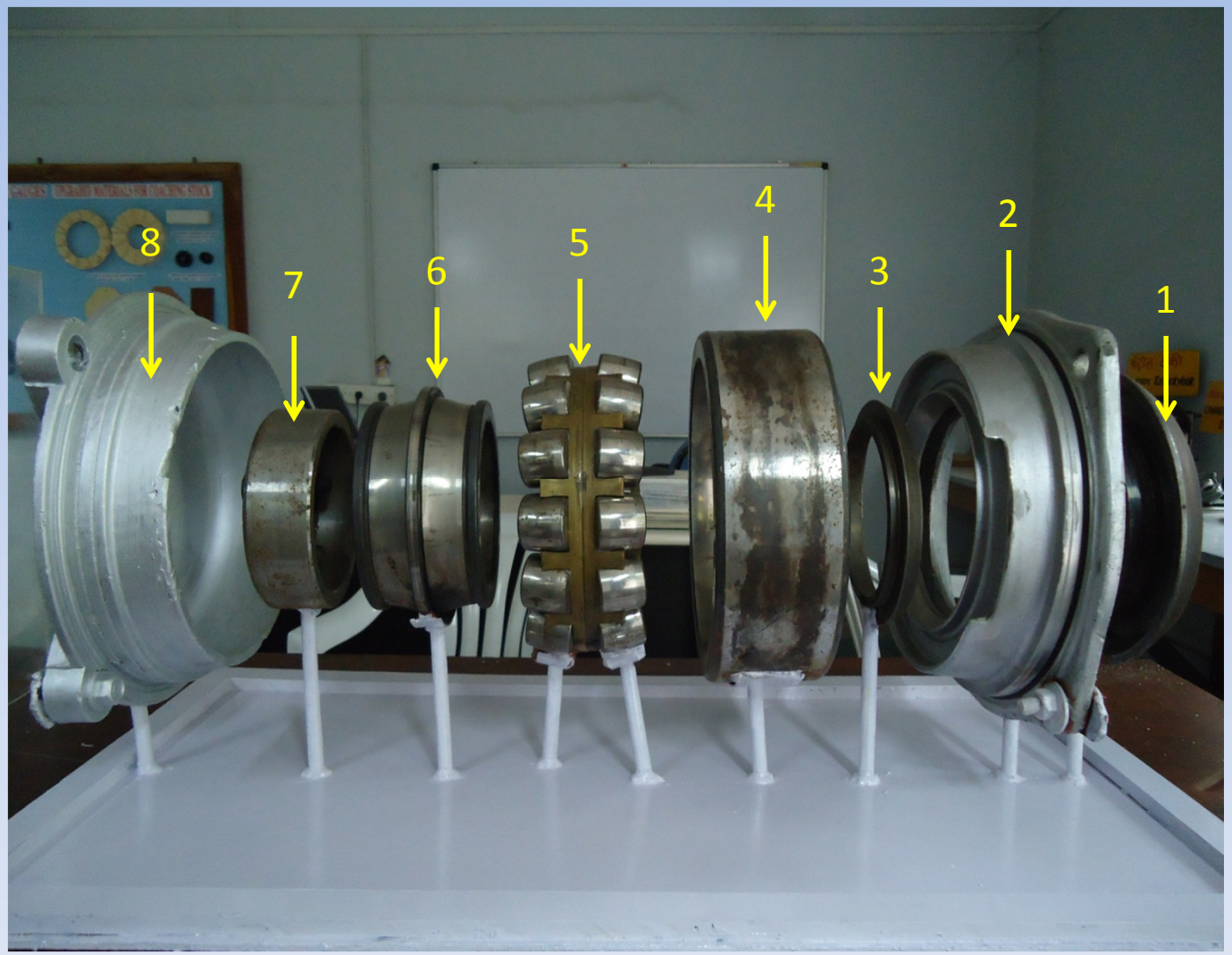
Bearing

Bearing is a machine element used between two parts that allows rotational movement, reducing friction and enhancing performance to save energy.

Types of Bearings

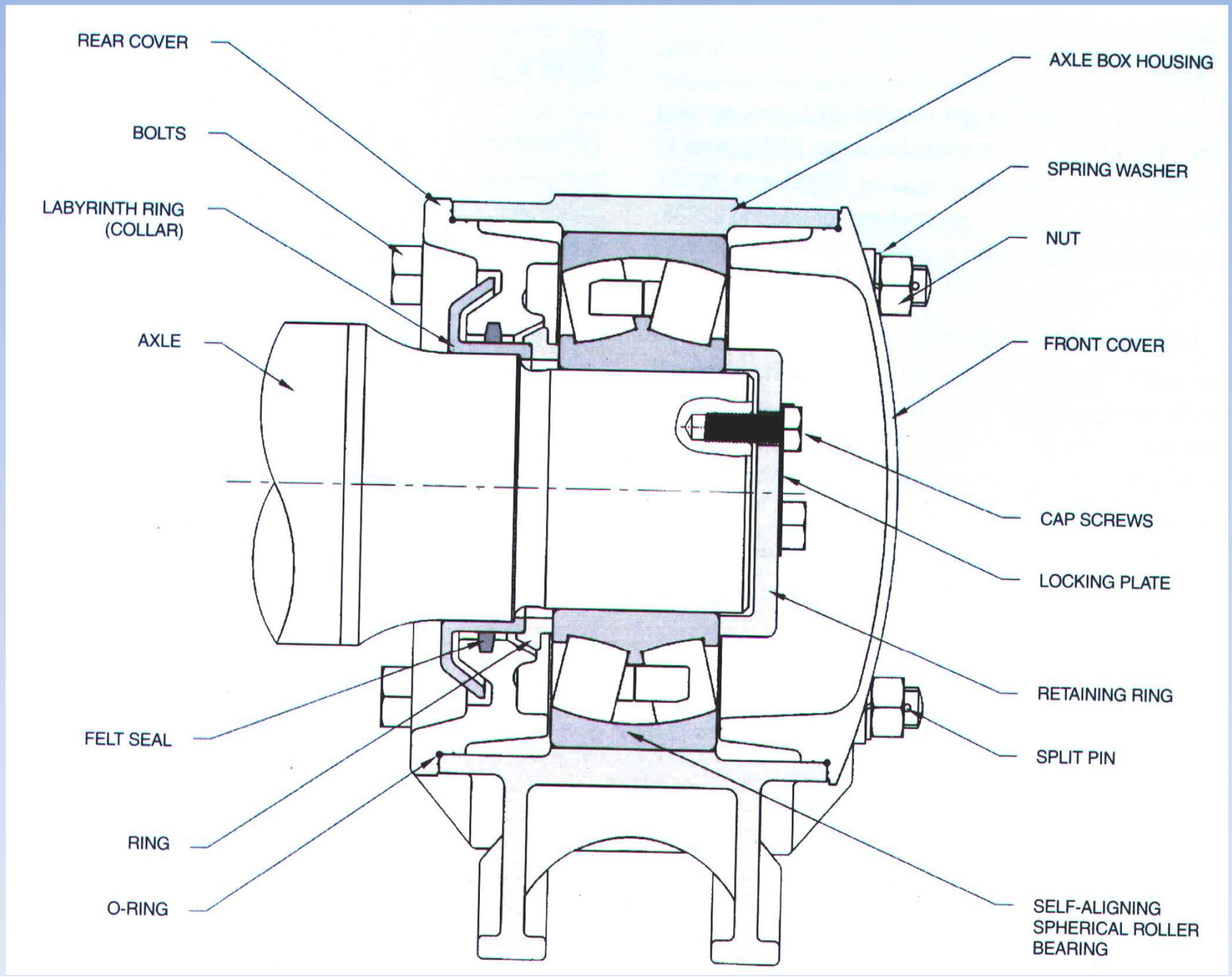
S. No.	Type of Bearing	Application in Rolling Stock
1	Self aligned Spherical Roller Bearing – 22326/C3 & 22328/C3	ICF coaching stock & MEMU PC
2	CTRB	LHB type coaching stock and wagon
3	Cylindrical roller bearings	Locomotives.

Exploded view of Double row self aligned Spherical Roller Bearing



1. Collar
2. Rear Cover with felt ring.
3. DM ring
4. Outer Race
5. Rollers with cage
6. Inner Race
7. Retaining ring with locking plate & M16 screws
8. Front cover

Spherical Roller bearing & Axle box assembly



Nomenclature

- Double row Spherical roller bearing No:22326 /C3 (For BG Passenger coach, 16.25 Ton axle load).

  Dimensions : 130x280x93.
- Double row Spherical roller bearing No:22328 MB,C3, F2 (For BG EMU, 20.32 ton axle load)

  Dimensions : 140x300x102.

S.. No.	Code / No.	Description / Terminology
1	MB	Machined brass cage.
2	C3	Radial internal clearance higher than normal. (C1 < C2< C0 < C3<C4<C5)
3	F2	suitable for Railway coach application
4	223	Spherical roller bearing medium duty.
5	26	Bore size 26x5 = 130 mm
6	28	Bore size 28x5 = 140 mm

Manuals / Instructions on Roller Bearings

List of Instructions/Manuals

S. No	Instruction/Manual No.	Description	No. of Pages
1	Maintenance manual for BG coaches of ICF Design	Chapter-10 on Rolling Gear	23
2	C-7817	Instruction for Inspection and maintenance of DM Roller Bearing Axle Boxes of BG ICF Coaches	26
3	IRCAMTECH /M/12-13 Axle Box /1.0, June 2012	Hand Book on Instruction on axle box Bearing maintenance and Guidelines to minimize hot axle in ICF design	53
4	Maintenance Manual for Roller Bearing	a) **FAG**- Spherical Roller Bearings for BG & MG Coaches	36
		b) **NBC**- Self aligning Spherical Roller Bearings for Passenger Coaches. CAT No: SRBMM-1 (Aug: 2003)	36
5	C-8527 (Rev-1) , June-2006. Ref No: CGW 0001 (Rev.3)	Specification for DM Double row self aligned spherical Roller Bearings for use on ICF type All Coil Bogies for Passenger coaches.	22

List of Drawings

S. No.	Drawing No. (Issued by ICF)	Description of component
1	T-0-2-628	Collar
2	T-0-2-603	Rear cover for Axle Box
3	T-0-2-005	Felt Ring for RB Arrangement
4	T-0-2-625	Sealing Ring for axle Box
5	T-0-2-629	Ring
6	T-0-2-621	Retaining Ring
7	T-0-2-637	Locking Plate for wheel and axle
8	T-0-2-619	Hex. Head screw
9	T-0-2-608	Bolt & nut for Axle Box
10	T-0-2-633	Axle Box Front cover
11	T-0-2-602	Axle Box housing

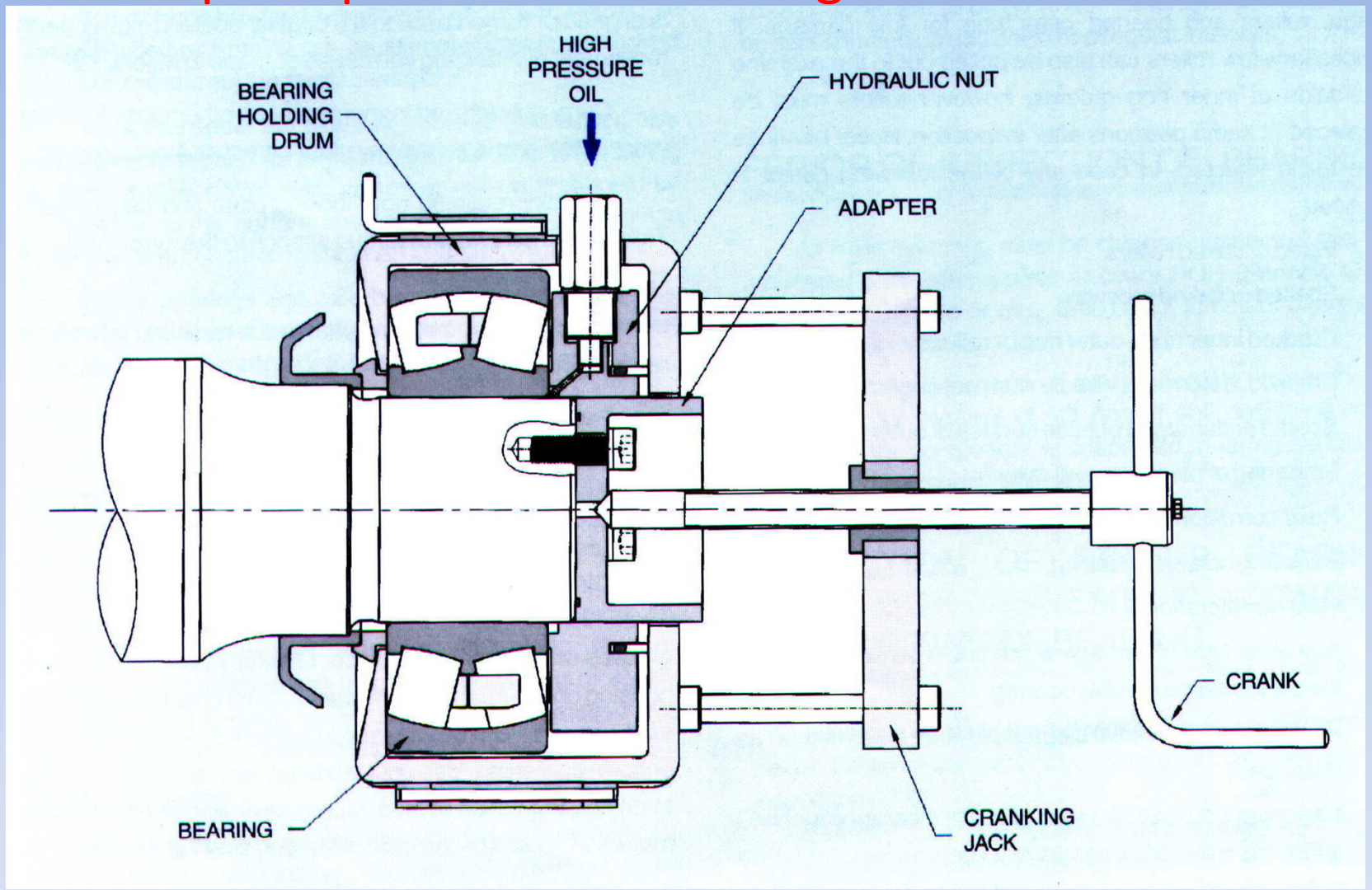
Procedure

1. Extraction of Roller Bearing
2. Cleaning - i. Manual
   ii. Mechanized - M/s Global, M/s Proceco
3. Inspection – For detection of defects by
   i. Zyglo
   ii. Magnifying glass (4X/10X)
   iii. Air plug gauge for bore dia.(Bakers)
   iv. Feeler gauge for radial clearances
4. Matching of bearing with Journal (125-150 three legged digital bore micrometer & 125-150 outside digital micrometer)
5. Mounting of bearing – Using Induction heater 11 KVA capacity (temp. up to 120^{o} C in 5 to 7min)
6. Final checking of clearances – Using feeler gauge
7. Grease packing

Axle Box De-Boxing & Extraction of Roller bearing

1. Remove split pin, M20 nuts and front cover.
2. Remove Axle Box housing by using Mechanical Puller.
3. Remove M16 screws, locking plates and retaining ring.
4. Record Bearing details.
5. Extract the bearing by using Power driven Bearing extractor.
6. Remove ring & rear cover along with Axle box bolts.

Extraction principle of Roller bearing

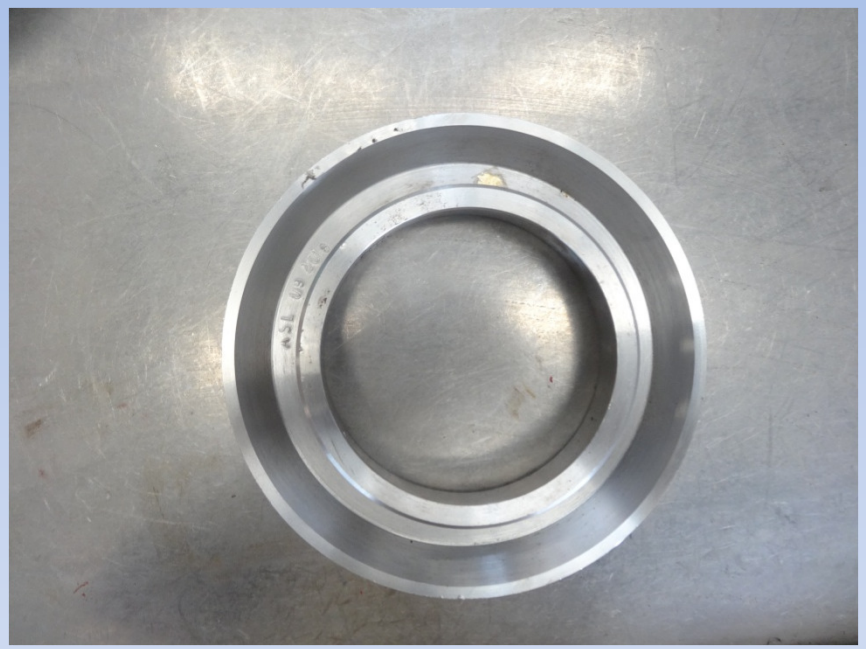


Drum locking pressure: 400 Kg/cm^2 ,
Bearing extraction pressure: 500 Kg/cm^{2,}
Hydraulic oil used : Servo -68

Other roller bearing components

i. Collar
ii. Rear cover
iii. Axle box long bolts (M20x295mm)
iv. Felt ring
v. Ring
vi. Rubber Sealing Rings
vii. Retaining ring
viii. End locking plates
ix. End locking screws (M16x1.5x50mm)
x. Front cover

i. Collar



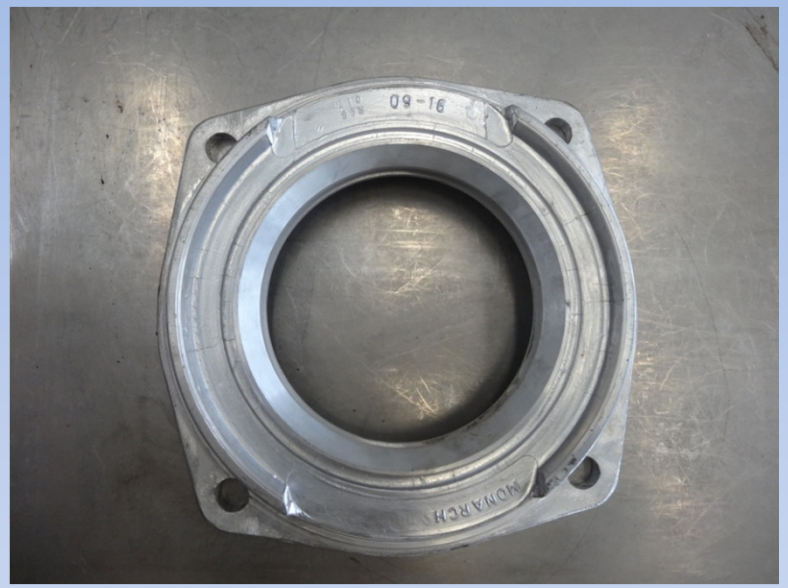
- Drg. No: T-0-2-637
  Alt. c/3

- The collar should not be dismounted unless it is damaged or lost interference with the axle. Once dismounted , it should be in invariably replaced.
- Parameters:

A) Bore : 145-H7

B) Rear cover seating: 160-J6.

ii. Rear & Front covers



- These covers are generally made from aluminum die casting
- Cover should be cleaned with k.oil and inspected for cracks , mechanical damages , wear and correct dimensions.
- Worn out covers should be replaced with new.

- Parameters of Rear cover :

A) Bore Dia : 168 +0.2/-0.0 mm
B) Height : 60 +0/-0.1 mm
C) Long Bolt Hole dia: 21.5 mm
D) Material: IS617-94,4600-m

- Parameters of Front cover :

A) Height : 60+1/-0.1 mm.

- Rear cover Drg. No: T-0-2-603 Alt. c/14
- Front cover Drg No: T-0-2-603 Alt c/14
- Mtrl. Spec. IS 617-94 ,4600-M

Axle Box Long Bolts (M20X295mm)

- Examine the long bolt visually for its straightness, thread damage, Split pin hole & Hex. Head damages.

- Drg. No: T-0-2-608 Alt. q/10
- Mtrl. Spec : IS 2062 -99, Fe 410 WA

Felt ring

- Drg. No: T-0-2-005

Alt. t/14

- The felt ring should be replaced when ever rear cover is removed from the roller bearing assembly.
- New felt ring should be soaked in warm cylinder oil to IS:1589-60 type-I grade III heated to 40 to 50 degree centigrade for 30 minutes before fitting into rear cover.

- Parameters:

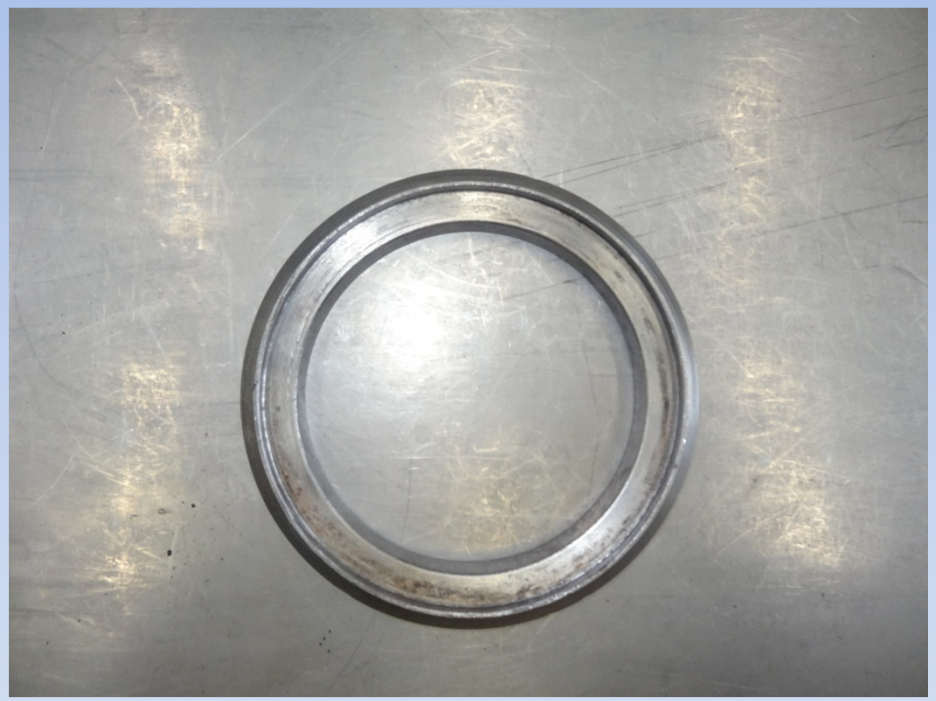
A) Thickness : 12-13 mm

B) Width : 15.5-16.5 mm

C) Outer dia : 193 +1/-0

D) Material specification : RDSO/2007/CG-09

Ring



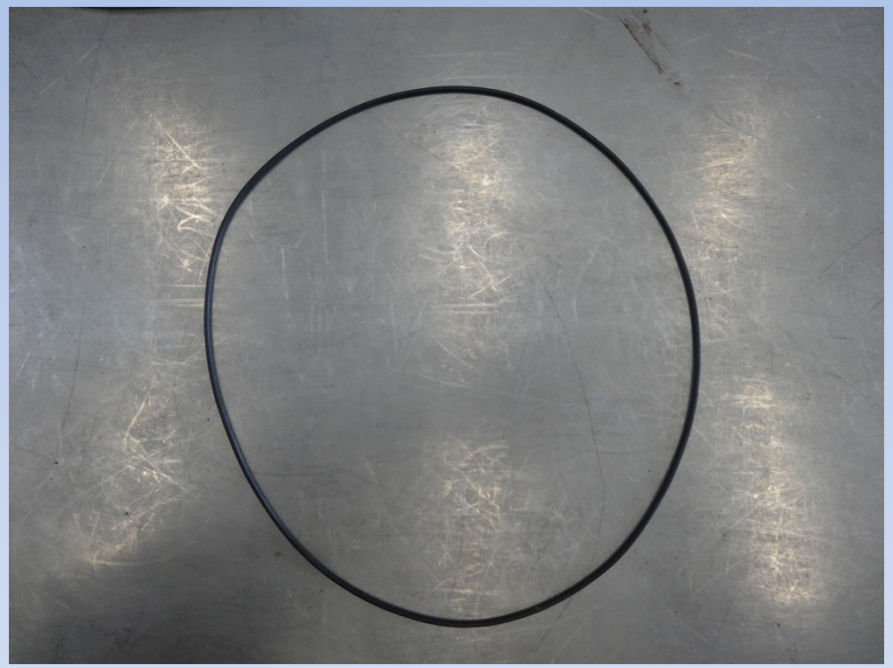
- Drg. No: T-0-2-629 Alt. h/3
- Mtrl. Spec : IS1875-92 CL.2

- Clean and wipe the ring.
- Ensure that faces are parallel, flat & free from burr, rust etc.,
- Parameters:

A) Collar seating dia : 160 H7 mm

B) Depth : 6 mm

Rubber Sealing Rings



- Replace the rubber sealing ring with new in every attention.
- Parameters:

A) Inner diameter: 288 ± 1

B) Sealing ring dia: 3 + 0.2/-0.0 mm

- Drg. No: T-0-2-625 Alt. b/8
- Mtrl. Spec. IRS R 48-88

RETAINING RING

- The retaining should be cleaned and inspected for flatness and correct dimensions
- The mating surface must be free from bur, sharp edge, rust or any other type of defect that will prevent proper seating with matting part

- Parameters:

A) Bore :132+0/-1 mm
B) Hole dia: 18 mm
C) PCD : 75 $\pm$ 0.5 mm
D) Height : 50 $\pm$ 0.5 mm

- Drg. No: T-0-2-621 Alt. g/4
- Mtrl. Spec. IS 1875-92 St.Cl.2

End locking plate

- Drg. No: T-0-2-637

Alt. c/3

- End locking plates should be replaced every time.
- It should be procured from RDSO approved sources.(AE,ME & UEW)
- Parameters:

A) Hole dia : 17 mm

B) Thickness : 1.6 mm

C) Material : IS1079/94 Gr.DD

End locking screws

- End locking screws should be of high tensile steel of reputed brand/RDSO approved manufactures (TUFF,SKD,POOJA,UNBRAKO)
- The condition of threads should be checked Go-NoGo ring gauges and worn out bolts are replaced.
- The bolt head should be free from damages and should have proper spanner grip.

- Drg. No: T-0-2-619 Alt. s/12
- Mtrl. Spec : RDSO Spec. No.: C-9307 (High tensile steel 8.8 Gr.)

Machines for cleaning of Roller Bearing

M/s. Global Engineering R.B cleaning plant:

The chemicals used in the cleaning plant

- Unikleen 15R
- Unikleen 401
- Unikleen 500
- MSP 51

Temperature of the bath is 90^{o} c

Inspect the bearing for thorough cleaning ,free from grease.

M/s.Proceco R.B cleaning plant:

- Stages-Pre wash, Wash, Rinse Tank
- Chemicals Used:
- Orion 334 –Wash tank
- Orion 550- Rinse Tank
- Orion 445- Anti corrosive oil

Temperature of the bath is 180^{o} F

Zyglo Test

Inspecting with UV Light

Application of Penetrant

Bearing Visual Inspection & Roller track Inspection

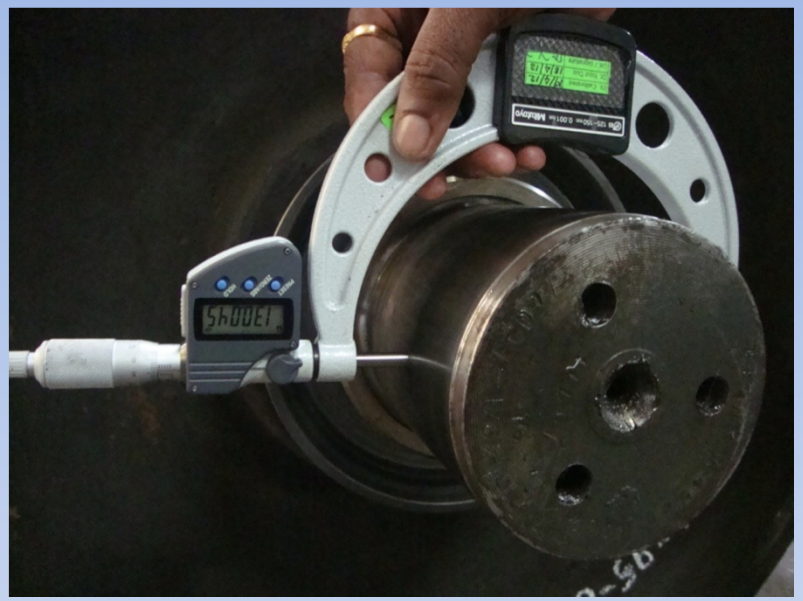
- Check each roller for flakes, pitting, corrosion & cracks with the help of magnifying glass(4X/10X)under concentrated light
- Remove one roller in a row and check visually the inner race outer surface with the help of magnifying glass.
- If any defects are found condemn the bearing.

Radial clearances in Dismounted condition

Feeler gauge range:
0.03 – 0.50 mm (13 leaves of 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.10, 0.15, 0.20, 0.30, 0.40, 0.50 mm)

S. No	Description		In mm		In μ	
			Min.	Max.	Min.	Max.
1	New Bearings (Make-FAG,NBC&SKF)		0.145	0.190	145	190
2	Serviceable Bearings	FAG	0.145	0.270	145	270
		NBC	0.145	0.290	145	290
		SKF	0.145	0.330	145	330

Bearing Bore Size & Interference

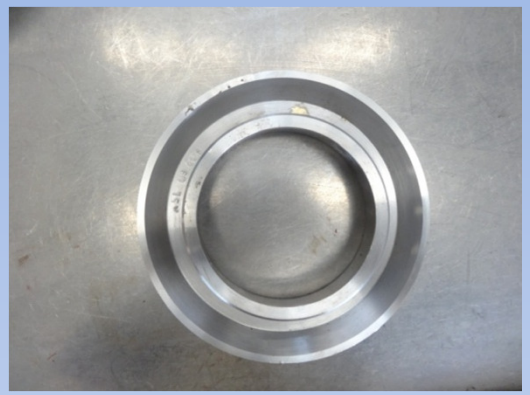


Measurement of journal diameter with digital Outside micrometer (130.043 to 130.068 mm), Bearing bore diameter with 3-legged digital micrometer.

S. No	Description	Min.(mm)	Max.(mm)
1	Bearing Bore	129.975	130.00
2	Journal size	130.043	130.068
3	Interference	0.043	0.093

Measurement of Bore parameters with Baker's Air Plug gauge

Mounting of collar (Labyrinth Ring)



Drg. No: T-0-2-637

Alt. c/3

a) Collar Bore : 145-H7

b) Collar seat dia.:145-t7
(145.174 to 145.134)
Shrink fit

- Check Journal, shoulder diameter and condition of end holes of the axle.
- Collar should not be dismounted unless it is damaged or the interference fit with the axle is lost.
- Labyrinth ring or collar should be heated to 100º C in a induction heater.
- Push the heated collar on the seating and hold it till it cools and fits on the seating.
- Light application of grease in collar.

Mounting of rear cover

- Check Rear cover for dimensional accuracy.
- Whenever rear cover is removed, replace felt ring.
- Soak new felt seal in worm cylinder oil (SAE-50) at around 40 to 50 degrees centigrade for about 30 minutes.
- Smear the same grease (Servogem RR3) of the axle box on the felt ring.
- Slide and push the rear cover in position against the collar along with Axle box bolts and rubber O-ring.

Mounting of DM Ring

- Clean and wipe the ring
- Ensure that faces are flat and parallel and free from burr, rust .
- Insert the ring into its position by using a pushing jig.

Mounting of bearing on Journal

- Heat the inspected bearing in the induction heater (with de-magnetization facility) to the temperature of 120^{o}C in a span of 5-7 minutes duly maintaining the interference fit.
- Mount the heated bearing on to the journal by using tongs and ensure its butting with the DM ring.

Mounting of Retaining ring, locking plate & cap screws

GO & No-GO Ring gauges

GO & No-GO Plug gauge

- Check End locking bolts with GO, No-GO thread ring gauge and end holes should be checked with GO, No-GO thread plug gauge (M16x1.5mm).
- Assemble the retaining ring, secure with end locking plate and pre-tighten the M16 screws with battery operated impact wrench.

Torquing of Cap screws

- The cap screws must be tightened to 12 Kg-m torque by using torque wrench(7-35 kg-m).
- Fold the tabs of the locking plate against the sides of the bolt by using adjustable rib joint pliers.

Checking bearing radial clearance in mounted condition with feeler gauge

Description		Radial Clearance (mm)		Radial Clearance (µ)	
		Min.	Max.	Min.	Max.
New and Serviceable Bearings	FAG	0.080	0.190	80	190
	NBC	0.080	0.190	80	190
	SKF	0.105	0.296	105	296

Reduction clearance 0.03 to 0.06 mm (30 to 60 µ)

Lubrication

- Quantity of grease filled per axle box (bearing)

  SKF make (ICF) - 2.00 kg

  FAG, NBC make (ICF) - 1.75 kg

  MMTS,DEMU – 2.00 kg

- Recommended brands of grease

  Servogem RR3 (IOC)

  Lithon 3 (HPCL)

Only lithium base grease of approved brands should be used.

Lubrication

- Excellent resistance to water washout.
- Superior oxidation and structural stability.
- High degree of anti-rust and anti-corrosion properties.
- Give outstanding performance under varying operating conditions.
- Suitable for lubrication under subzero(-25^{0}C) and reasonably high temperature (140^{0}C) conditions and has been approved by RDSO, Lucknow.
- Packs available:500g,1kg,2kg,3kg,5k,20kg and 182kg drums.
- Colour of grease: Brown
- Structure: Smooth
- Soap type : Lithium
- The grease is specially developed for lubrication of anti-friction bearings of railway axle boxes

Mounting of Axle box

Bearing outside dia. in mm		Axle box housing bore dia. In mm		Fit with housing in mm		Class of fit
Max	Min	Max	Min	Loose	Tight	J7
280.000	279.965	280.052	280.030	0.087	0.030	

Fitment of front cover, tagging and sealing

Details on tag

Name of the Shop:

Axle No.:

Bearing No.:

Month & Year of fitment:

Wheel set No.:

Roller Bearing Defects

Pitted/ Flaking

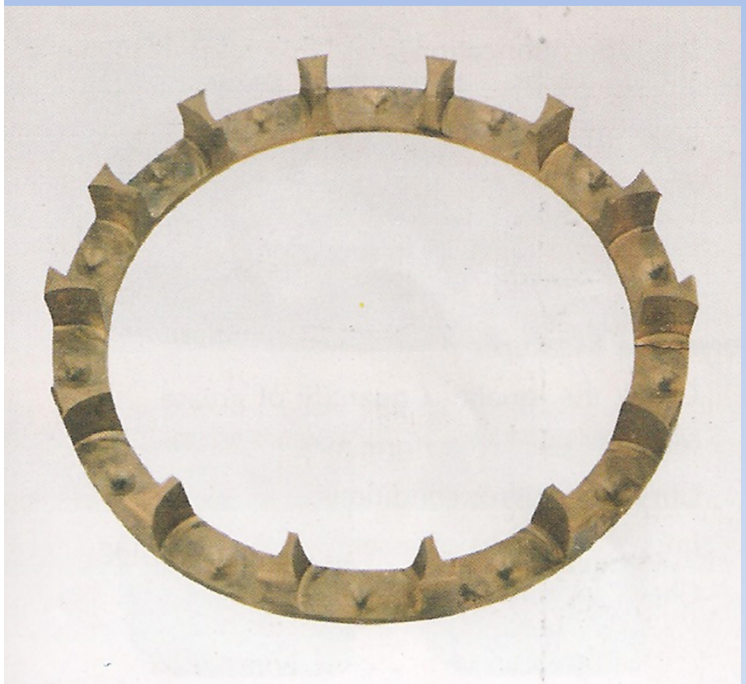
Causes:

- Excessive loads, metal fatigue, improper handling
- Improper mounting
- Insufficient precision of journal or housing
- Insufficient clearance
- Contamination
- Rusting
- Passing of electric current through bearing
- Softening due to abnormal temperature rise

Corrective Measures:

- Find the cause of heavy load
- Check internal clearance regularly
- Improve precision of journal and housing
- Improve operating conditions
- Improve method of assembly and handling
- Check grease and greasing method
- Do not use worn out or damaged housings

Cage Damage



Causes:

- Excessive moment load
- Excessive fluctuation of speed
- Trapping of foreign objects
- Excessive vibration
- Improper mounting (misalignment)

Corrective Measures:

- Investigate rigidity of system
- Reconsider operating conditions
- Improve method of assembly and handling
- Improve sealing efficiency
- Check for any grease contamination

Inner Race Pitted/ Flaked

Causes:

- Passing of electric current through bearing
- Insufficient rust preventative oil
- Invasion of moisture, acid etc.

Corrective Measures:

- Take measure to prevent welding without proper earthing
- Improve sealing performance
- Soak felt seal in warm oil before installation

Outer Race Pitted/ Flaked

Causes:

- Over size housing bore
- Insufficient lubrication
- Fluctuating load
- Vibration during transport or when not operating conditions

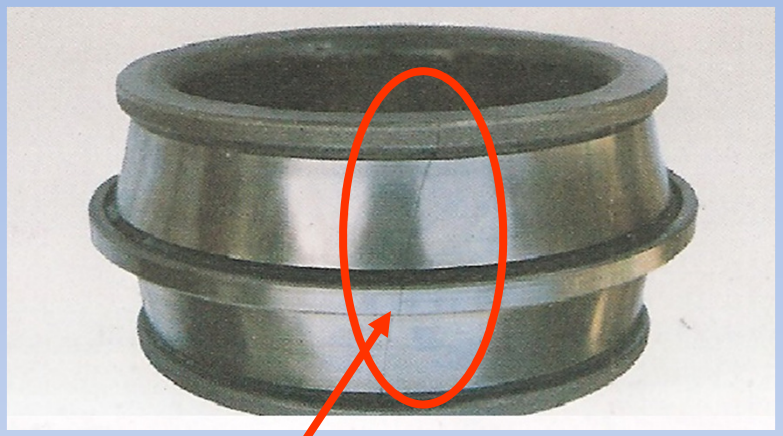
Corrective Measures:

- Use only those housing which have correct bore dia.
- Check surface roughness of journal and housing
- Check consistency of grease

Rollers drop

- Rollers may drop due to cage/roller worn out.
- This defect can be traced out during physical examination of Roller Bearing by rotating the inner race along with cage & rollers

Inner Race Cracked



Inner race Crack

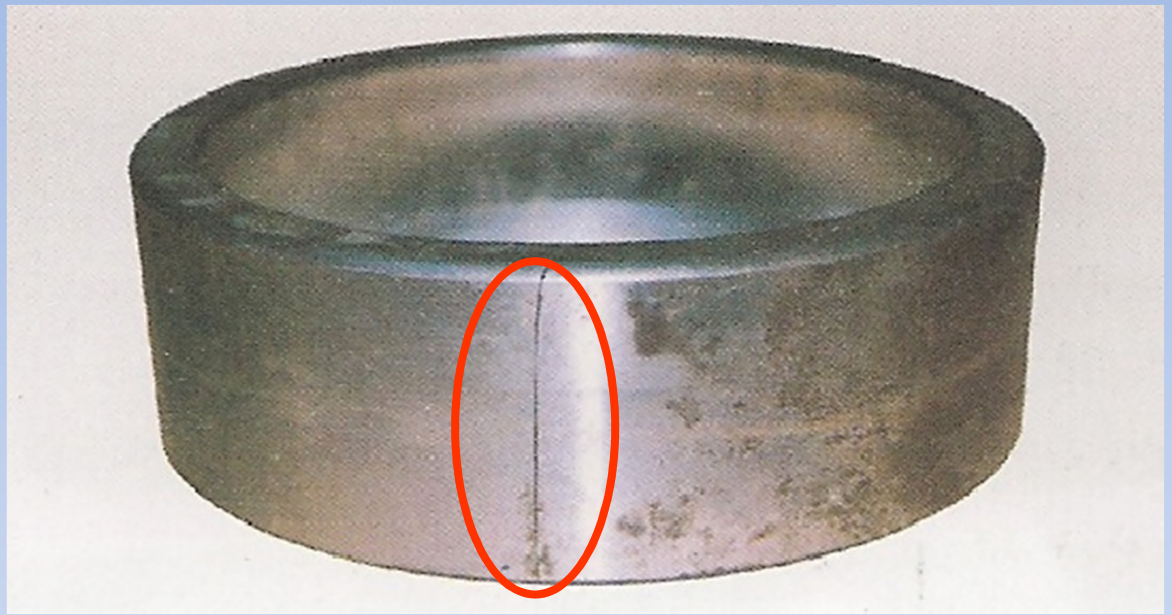
Causes:

- Rapid heating during mounting
- Excessive shock load
- Improper handling, use of steel hammer
- Ingress of large foreign particle
- Surface deformation due to improper lubrication.
- Excessive interference.

Remedies:

- Avoid Rapid heating during mounting
- Reconsider operating conditions.
- Improve method of assembly and handling.
- Do not use excessively worn out or deformed housing.

Outer Race cracks



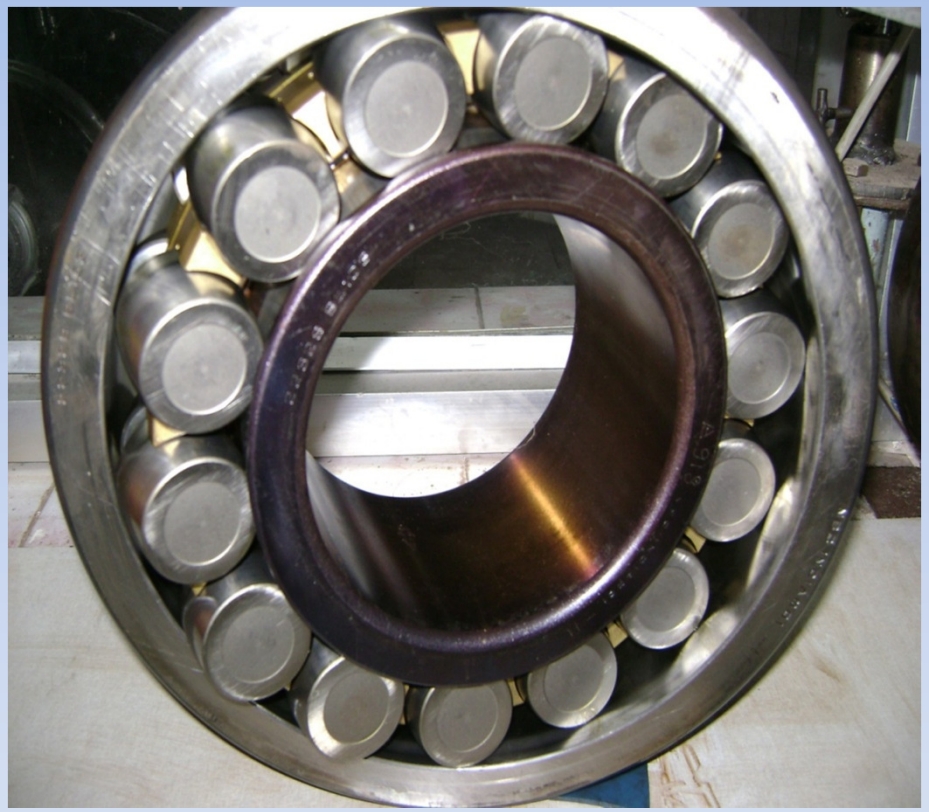
Causes:

- Rapid heating during mounting
- Excessive shock load
- Improper handling, use of steel hammer
- Ingress of large foreign particle
- Surface deformation due to improper lubrication.
- Excessive interference.

Remedies:

- Avoid Rapid heating during mounting
- Reconsider operating conditions.
- Improve method of assembly and handling.
- Do not use excessively worn out or deformed housing.

Discoloration



Condition:

- Change of race ways/ roller colour

Reasons:

- Temper color by overheating
- Deposition of deteriorated grease on surface
- Improper lubrication

Corrective measures:

- Use good quality of grease
- Replacement of grease after recommended intervals.
- Do not allow heating of bearing beyond 120° during mounting.

Rust and corrosion of inner race

Condition:

Surface becomes partially or fully rusted.

Reasons:

- Improper packaging.
- Handling with bare hands.
- Insufficient rust preventive oil.
- Due to presence of moisture & acid.
- Improper storage.

Corrective measures:

- Take measure to prevent rusting while in storage.
- Improve method of assembly and handling.
- Soak felt seal in warm oil before installation.
- Improve sealing performance.

Fretting on outer race

Condition:

- Fretting surfaces wear, producing red colored particles that form hollows..

Reasons:

- Over size housing bore.
- Insufficient lubrication.
- Fluctuating load.
- Vibration during transport or when operating conditions**.**

Corrective measures:

- Check surface roughness of journal and housing.
- Check consistency of grease.
- Use only those housing which have correct bore dia.
- Do not use warn out or damaged housings.

Effect of incorrect practices on performance of spherical RB axle boxes

S. No	Type of defect	Effect on performance	Corrective action
1	Felt seal perished	Grease starts oozing	Renew felt seal
2	Rubber "O" ring perished.	Ingress of dust, dirt of water inside the axle box.	Renew rubber O rings. Discard used O rings, and do not re-use.
3	Improper lubrication (excessive/inadequate)	Excessive temp rise, resulting conditions such as hot box,seizure	Fill only specified amount of grease without contamination.
4	Bearing radial clearance not within specification.	Excessive wear of rolling elements, temp rise, bearing seizure.	Follow maintenance instructions and maintain clearances as specified
5	Rapid or excessive heating of bearing.	Surface cracks & discolarated surface	It should be ensure that heating temp is within 120° C & heating time 5-7 minutes.

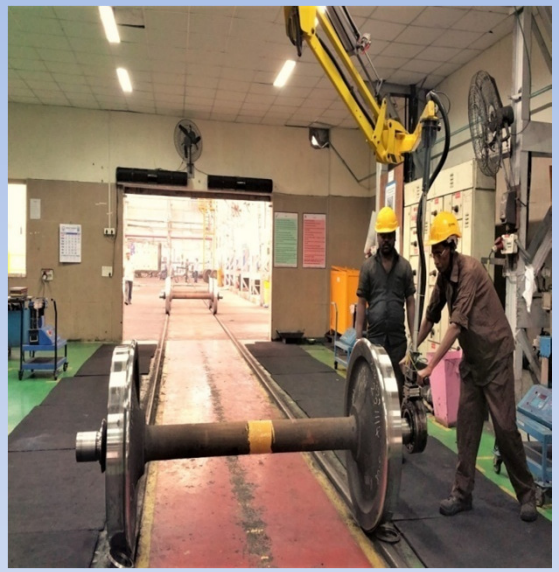
Innovations

Air Gauge to measure Inside Diameter of Roller Bearing

This is an instrument which measures Diameter of inner Race of Roller Bearing at 9 places simultaneously and calculates Ovality and taper of the Roller .Data will be saved for further analysis within minute. Due to this automation process measurement and evaluation of bearing made accurate and faster

Pneumatic Balancer for handling Roller Bearing

While mounting bearing, staff used to lift these 30 kg which is heated upto 120 C by bending which used to cause back problem. As a result of which few were willing to carry out this work. To reduce the load on the staff a PNEUMATIC balancer was installed with suitable gripping mechanism to handle the Roller Bearing in Wheel shop. With this staff will have to apply negligible effort to lift and handle Roller Bearing inside Wheel shop.



Pneumatic Balancer for handling Axle Box

While mounting Axle Box housing, staff used to lift these 75 kg by bending which used to cause back problem. As a result of which few were willing to carry out this work. To reduce the load on the staff a pneumatic balancer was installed with suitable gripping mechanism to handle the Axle Box housing in Wheel shop. With this staff will have to apply negligible effort to lift and handle Axle Box housing inside Wheel shop. Previously three people used to mount an Axle box housing, now it is being carried out with single person.

Kerosene Recycling Plant

This plant is conceptualised and installed to extract K-Oil from the used and discarded muddy oil bath. With the adoption of the procedure, wheel shop managed to save considerable amount of the precious and depleting energy source.

Offset Track

- To accommodate more wheels in less area offset track laid in new wheel shop extension area.

Safety Precautions

General safety instructions

- Do not drop the bearing to the gravity.
- Bearing should not be unpacked until it is ready for mounting.
- All plastic wedges must be removed prior to fitment.
- Bearing parts of different roller bearing units or different makes, never mixed or interchanged.

General safety instructions (Contd..)

- Never mix two different brands of grease or used grease with fresh grease.
- Electrical current must never be allowed to pass through roller bearings i.e there should not be any earthing on the rails where assembled wheel sets are placed.
- Cotton waste must never be used to clean roller bearing.

Storage and handling

Store the bearings :

- In original packing
- On clean and dry racks/dry place
- Away from wall and floor
- Away from storage of chemicals/solvents
- Bearings should be protected from heat, dust, moisture, direct sunlight, vibrations etc.
- Should not be stored one over the another.

M&P and T&P (Required Vs Available)
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S. No	Nature of Work	Equipment/Facility required	Availability Status	Remarks
1	Cleaning of Roller Bearing	Automatic roller bearing cleaning equipment with 3 stage cleaning of pre-wash, wash and water rinsing.	Yes, 2 Nos.	M/s Global Engineering & M/s Proceco
2	Cleaning of Axle Boxes	Axle box cleaning plant with Bosch tank and spray jet cleaning in a close chamber	Yes, 1 No.	M/s Global Engineering .
3	Axle Box extraction	Axle Box extractor	Yes, 4Nos.	Motorized extractors
4	Dismounting of Spherical Roller Bearings - taper bore	Hydraulic dismounting Equipment – Withdrawal Nut	Not applicable	Not required

M&P and T&P (Required Vs Available)
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S. No	Nature of Work	Equipment/Facility required	Availability Status	Remarks
5	Dismounting of Spherical Roller Bearings - straight bore	Hydraulic Dismounting equipment	Yes, 6 Nos.	Motorized extractors
6	Mounting of Roller Bearings	Induction heater with de-magnetizing device	Yes, 5 Nos.	11 kVA – 2 Nos. 6 kVA – 2 Nos.
7	Securing of end locking bolts	Torque wrench and torque wrench tester	Yes, 3 Nos.	7 – 35 kg-m.
8	Visual inspection of dismounted roller bearings	Magnifying glass with light	Yes, 3 No.	4X &10X magnification
9	Measuring/checking of radial clearance	Long feeler gauge set with number of leaves with different thickness	Yes, 3 Nos.	0.03 – 0.5 mm (13 leaves)
10	Measurement of journal/ shoulder diameter	Outside micrometers	Yes, 4 Nos.	125 – 150mm range (digital)

M&P and T&P (Required Vs Available)
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S. No	Nature of Work	Equipment/Facility required	Availability Status	Remarks
11	Inspection of axle end tapped holes	Thread plug gauges for M16X1.5 size tapped holes	Yes, 2 Nos.	
12	Inspection of locking bolts	Thread ring gauges for different sizes of Locking bolts	Yes, 2 Nos.	
13	Exact quantity of grease to be filled	Electronic Weighing Machine	Yes, 2 Nos.	
14	Identification of bearings, inspection details	Engraving / Etching machine	Yes, 2 Nos.	Etching Machine

M&P and T&P (Required Vs Available)
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Any Queries……

Thank You