# A Brief History

- Wheel is considered an important invention
- Bearings have helped exploit this invention
- Bearings “Bear” load
- Permits Relative Motion between Components
- Load can be radial and axial

# A Brief History

- Rolling Contact Bearings

  Load Transfer through

  Elements in rolling contact

  Starting Friction about twice of Rolling Friction

  Starting Friction is negligible as compared

  with that of Plain Bearing

  Frictional Characteristics affected by Load

  Speed Viscosity of Lubricants

# A Brief History

- Rolling Resistance

  Application of Load – Contact Area

  Caused by Non-Elastic Effect

  Hysteresis Plastic Deformation Slippage

  Rubber Tire on Paved Road

  More Rolling Resistance than

  Steel Wheel on Steel Rail

# Design criteria

- Rolling Contact Bearings
  - Space Available
  - Load with Characteristics
  - Life
  - Specific Operating Condition
  - Friction
  - Heat
  - Machining Tolerance
  - Cost
  - Material Property
  - Lubrication

# Design criteria

- Rolling Contact Bearings

  Life is defined as

  No. of Revolution

  or

  No. of Hours of use at

  Standard Angular Velocity

  until first Tangible Evidence of Fatigue

  Tangible Fatigue Creteria

  Spalling or Pitting - 6.5 $mm^2$

# Design criteria

- Rolling Contact Bearings

  $L_{10}$ Life

  No. of Revolutions that

  90% will achieve before

  Failure Criteria develop

  Average Life or Median Life about

- 4-5 times of $L_{10}$ Life **LIFE EXPECTANCY**

- The **'$L_{10}$ Life'** is defined as that life at which no more than 10% of the bearings may have been replaced **solely due to fatigue of metal.** The L10 life of bearing is the theoretical fatigue life.

# Rolling contact bearing

- Rolling Contact Bearings used in C&W
  Spherical Roller Bearing
    Fit for Heavy Radial Load
    Outer Raceway a portion of Sphere
    Internally Self Aligning
    Permit Angular Displacement of Shaft
    Because of Non-Zero Contact Angle
      Can takes Axial Load – Double Row
    Two Rows inclined to Axis of Bearing

# Rolling contact bearing

- Rolling Contact Bearings used in C&W
  Spherical Roller Bearing (Contd…)
  - More Conformity of Rollers with Raceways
    - Suitable for Heavy Radial Load
  - True Rolling Motion cannot be achieved
  - Higher Friction as certain amount of
    - Sliding Friction present between
      - Rolling Element and Races
  - Not Suitable for High Speed
  - ICF Coach

# Rolling contact bearing

- Rolling Contact Bearings used in C&W

  Cartridge Taper Roller Bearing

  Fit for Heavy Radial and Axial Load

  Rolling of Cone over another

  Different Angle of Inner and Outer Raceways

  Inner Raceway Outer Raceway and Rollers

  Converge at Common Apex Point

  In Axis of Rotation

  Sliding Motion between Collar and Roller

# Rolling contact bearing

- Rolling Contact Bearings used in C&W

Cartridge Taper Roller Bearing (Contd…)

Inclination of Taper affects

Axial Load Carrying Capacity

Long Roller Raceway results in

High Load Carrying Capacity

Used in Pair to achieve desired End Play

FIAT Bogie

CASNUB Bogie

# Rolling contact bearing

- Rolling Contact Bearings used in C&W

Bearing Material

Max Stress – 4000 MPa

Rockwell Hardness – 58-65

To withstand High Contact Pressure

Thorough Hardened

High Carbon

Case Hardened

Low Carbon

Surface Hard and Core Soft

Fit for Shock Resistance

# Rolling contact bearing

- Rolling Contact Bearings Performance

  Combined Radial and Thrust Load

  Pre-loading or Minimum Load

  Operating Temperature

    Case Hardened Material lose its Hardness

  Misalignment

    For CTRB

  Max Speed of Bearing governed by

    Heat Generation

    Centrifugal Force

# Types of Bearings used in C&W

| Coach Type | Bearing Type | Nomenclature | Axle journal Dia | Mounting Procedure |
|---|---|---|---|---|
| ICF | Spherical Roller Bearings | 22326/C3 | 130 mm | Induction Heating |
| LHB (FIAT) | Cartridge Taper Bearing Unit (CTBU) | UIC-130 | 130 mm | Hydraulic Pressure |
| Wagons (CASNUB) | Cartridge Taper Roller Bearings (CTRB) | Class-E CTRB | 144.539 mm 144.564 mm | Hydraulic Pressure |

# Types of Bearings used in C&W

| Coach Type | Bearing Type | $L_{10}$ Life | Interference |
|---|---|---|---|
| ICF | Spherical Roller Bearings | 22.5 Lakh KM | |
| LHB (FIAT) | Cartridge Taper Bearing Unit (CTBU) | 30 Lakh KM | |
| Wagons (CASNUB) | Cartridge Taper Roller Bearings (CTRB) | 12 Lakh KM | |

# performance of Bearings used in C&W

| Coach Type | Hot Axle 2017-18 | Hot Axle 2018-19 |
|---|---|---|
| ICF | | |
| LHB (FIAT) | | |
| Wagons (CASNUB) | 453 | 572 |

## 1. Different Makes of Cartridge Tapered Roller Bearings& Related Details

Indian Railways have procured these bearings from four manufacturers viz: M/s NEI/Brenco, M/s Timken, M/s FAG and M/s SKF.

### a. M/s National Engineering Industries Ltd./ BRENCO Bearings

M/s NEI, Jaipur have indigenized all the components of CTRB Class ‘E’ except Grease Seal.

### b. M/s Timken India Ltd. Bearings

M/s Timken India Ltd .has indigenized all the components of CTRB Class ‘E’.

### c. M/s FAG Bearings India Ltd.

Initially complete unit of CTRB Class ‘E’ was imported from FAG, Germany. Now the company is in the process of indigenization.

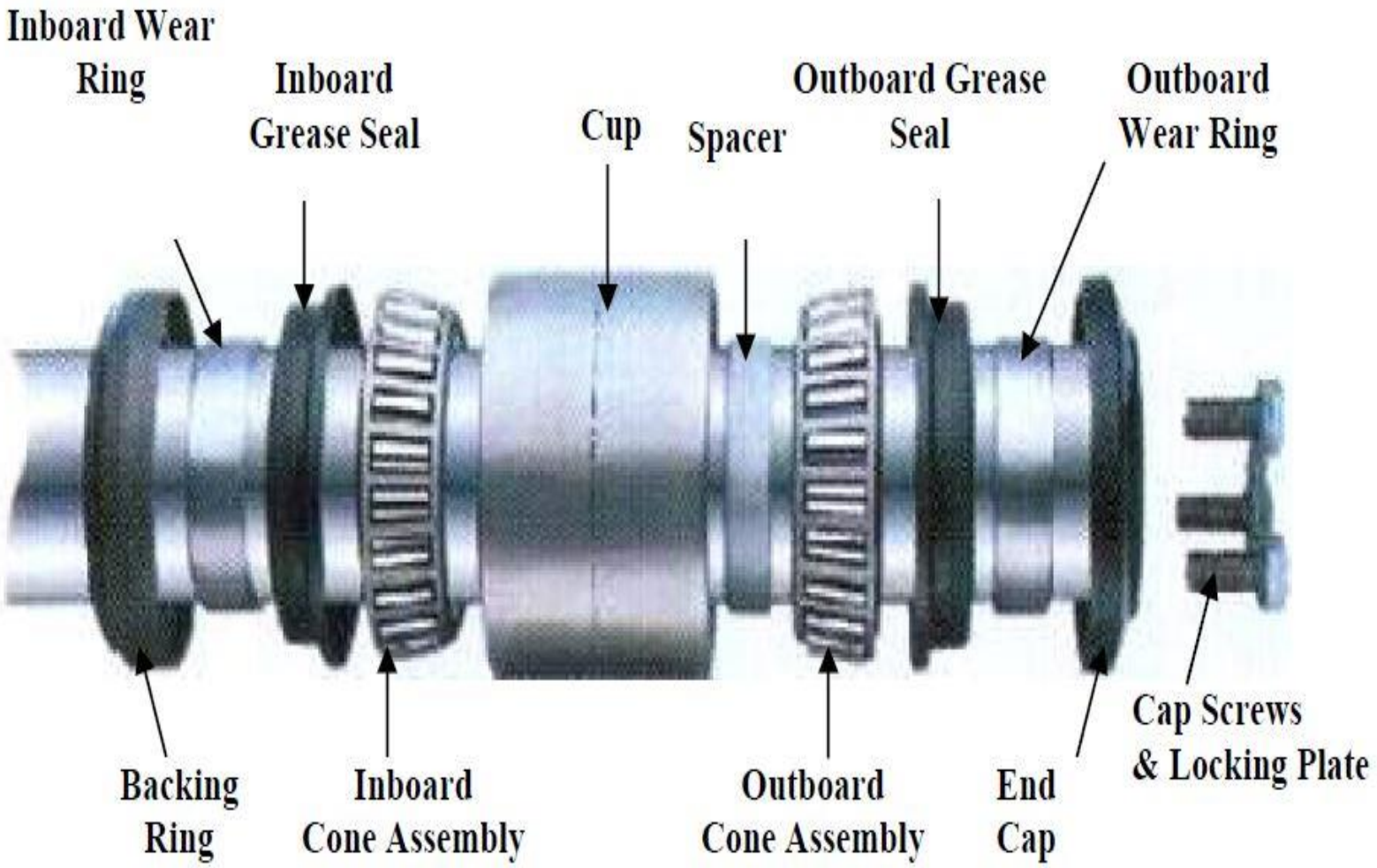
### M/s SKF Bearings.

Initially complete Unit was imported from SKF/Italy. Now the company is in the process of indigenisation.

## APPLICATION

The Cartridge Bearings used on Indian Railways freight stock are of type Class **'E'** (6”x11”). This bearing is suitable for RDSO’s Axle to drawing no. **WD-89025-S-02**.These bearings are being used on all BG wagons/Container fitted with bogies like CASNUB 22NL/22NLB/22NLC/22HS/LCCF-20(C) like BOXN, BOXNHL,BOXNEL, BCN, BCNAHS, BOY, BOYEL, BTPN, BOBSN, BOBRNHS, BLCA/BLCB etc.

# Components of CTRB - casnub



| SN | Terminology | Description of Cartridge Bearing Parts |
|---|---|---|
| 1. | Backing ring | Collar between bearing and journal fillet; Axle collar; Dust guard ring; Enclosure collar |
| 2. | Cage | Retainer; Separator. |
| 3. | Cap screws | End cap fasteners. |
| 4. | End cap | Cap at end of journal; Axle end cap; Locking cup; End cover. |
| 5. | Fitted backing ring | Backing ring with extension to provide press fit with suitable diameter axle dust guard seat. |
| 6. | Inner ring | Cone or inner race. |
| 7. | Locking plate | Cap screw locking device. |
| 8. | No Field Lubricating (NFL) bearing | Bearings which are not designed to be lubricated in the field and do not have a lubricant fitting, or pipe plug. |
| 9. | Outer ring | Cup or outer ring. |
| 10. | Raceways | Surfaces of outer and inner ring on which rollers operate. |
| 11. | Roller assembly | Rollers with inner ring and cage, inseparable |
| 12. | Rollers | Tapered rollers |
| 13. | Seal | Seal proper, including inner case, if used. |
| 14. | Seal wear ring | Ring on which seal rides or makes contact |
| 15. | Spacer | Spacer, spacer ring; Cone spacer |
| 16. | **Adapter**(Roller Bearing Adapter) | A casting that fits between a freight car roller bearing and the bogie side frame to transfer the load from the side frame to the bearing. |

## Description of Cartridge Bearing Parts

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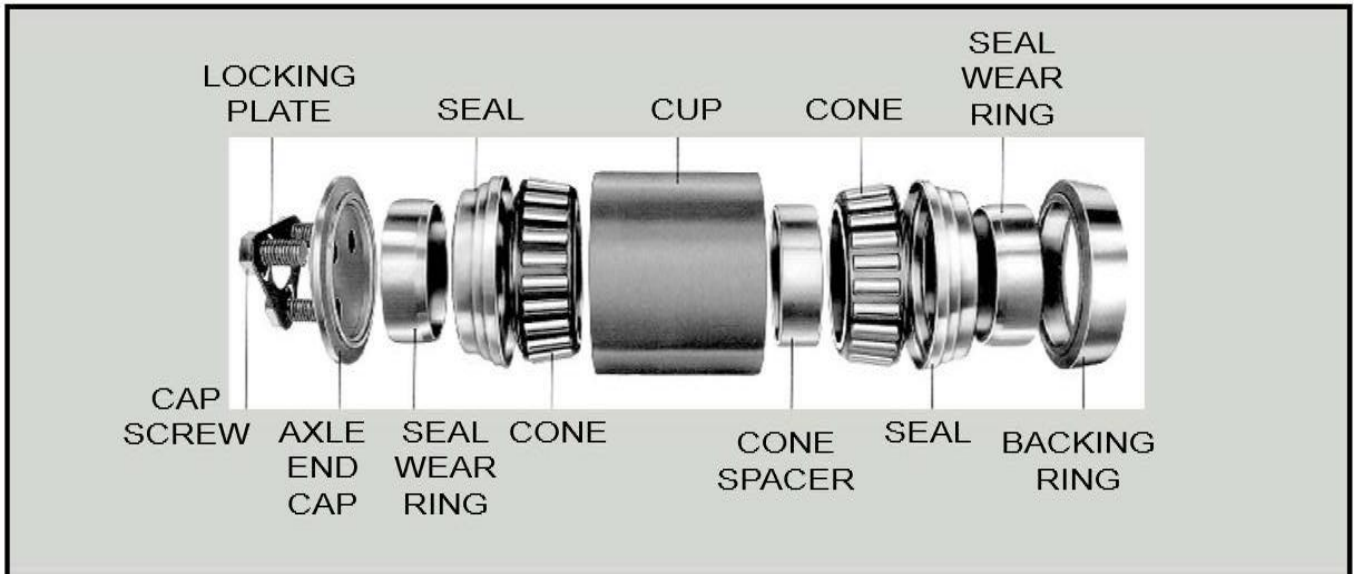



The Cartridge Tapered Roller Bearing is a self-contained, pre-assembled, pre-adjusted, pre-lubricated, completely sealed unit and applied to or removed from the axle without exposing the bearing elements, seals or lubricants to contamination or damage.

The **Cartridge Tapered Roller Bearing(CTRB)** has two inner races (Cones) along with rollers and Cage, separated by a Spacer, a single case-hardened outer race (Cup), a grease seal and a seal-wear ring at each end, a backing ring at the rear, axle end cap, **3** cap-screws and locking plate . The cup also acts as the bearing housing and is fitted in the bogie side frame with a suitable adapter

The weight of **Class 'E'**(6”X11”) CTRB is around 34.3 kg, weight of Narrow Jaw Adapter is around 12.0 kg and weight of wide jaw Adapter is around 23 kg.

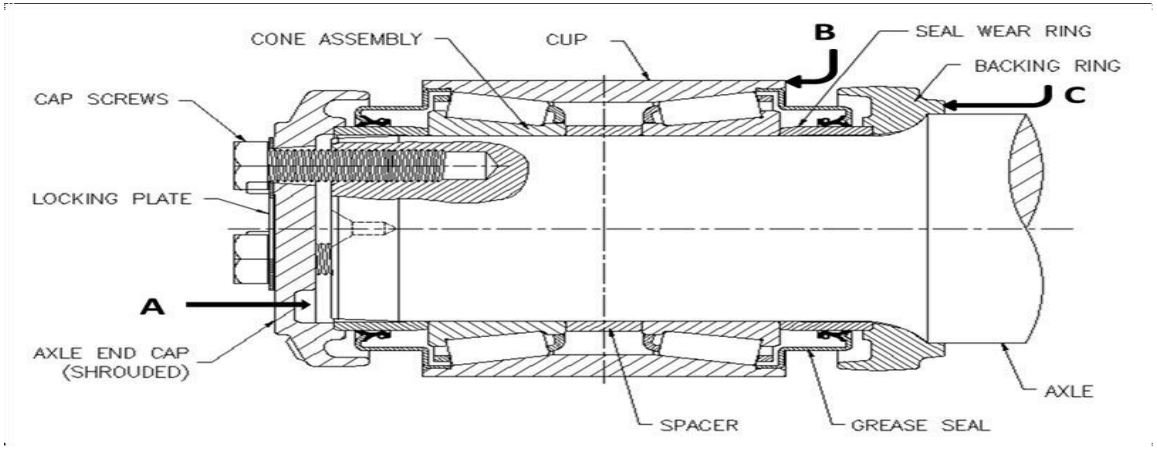



**Fig.2: Cartridge Tapered Roller Bearing Section view**

## GREASE SEAL

The grease seal is made of special synthetic rubber of superior oil resistance quality. Double lip seal element is bonded to the steel plate seal cover which is retained in the outer ring by a press-fit. The seal lips are moulded to provide bi-directional grease retention employing the elasto hydro-dynamic principle .

- **Seals perform two important functions:-**

(a)Retain a quantity of grease inside the bearing to provide adequate lubrication through the bearing service period.

(a)Prevent the ingress of water and other contaminants in to the bearing.

## . PERIODICITY OF MAINTENANCE

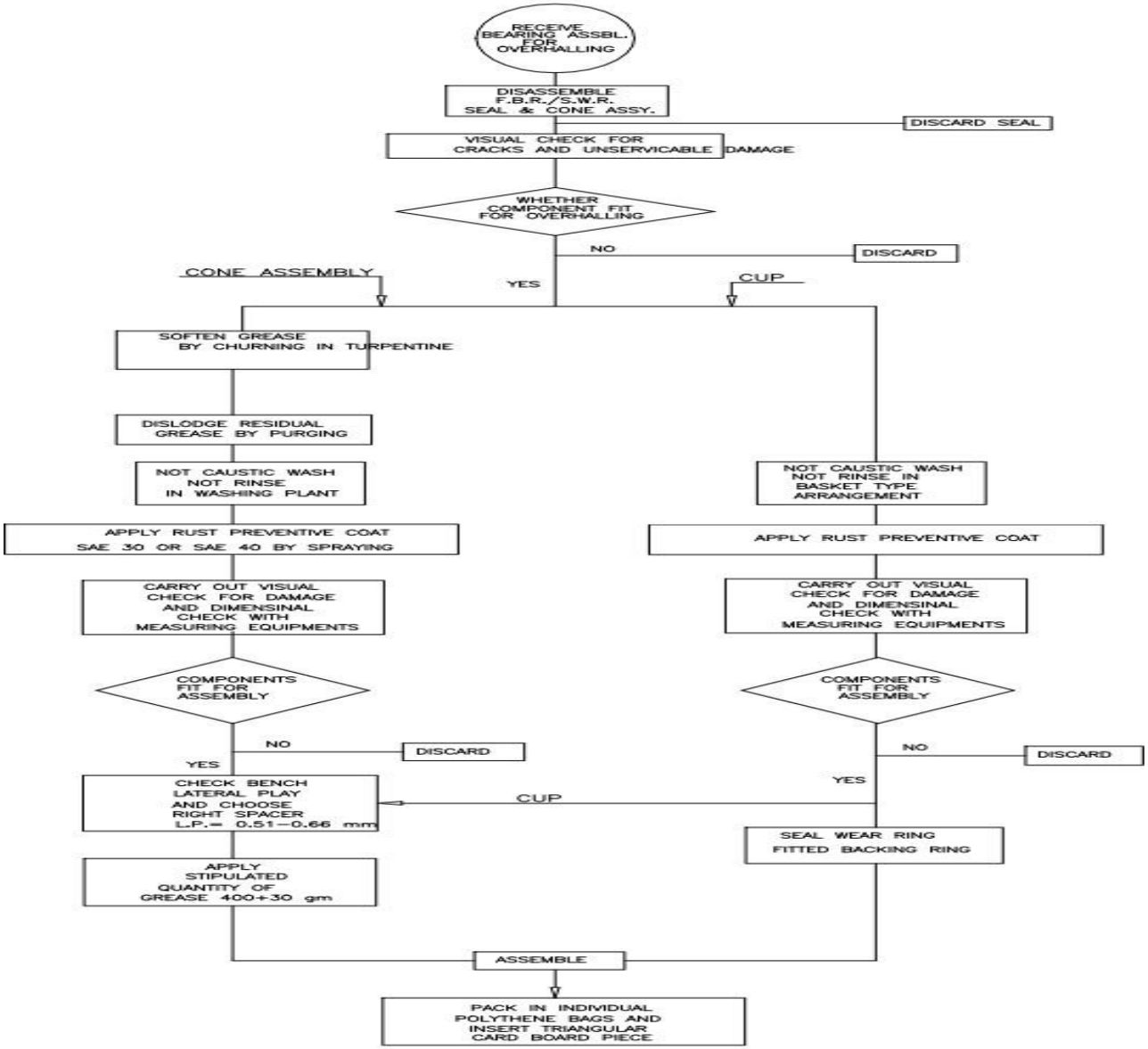
The Cartridge Taper Roller Bearings used on Indian Railways are of **'No Field Lubrication' (**NFL) Type. These bearings require no maintenance between POH to POH. The periodicity of first POH of BOXN Wagons has been laid down as six years by Railway Board vide letter No. 85/M (W)/814/53 dated 19-3-86. The periodicity of subsequent POH has been fixed as **4 1/2** years by Board vide their letter No.85/M (W)/814/53 dated 3-7-90.

POH interval of various Wagons of air brake has been mentioned below: -

**POH INTERVAL OFAIR BRAKE STOCK.**

| **S . No** | **Stock/Wagons** | ***POH** (Years) | |
|---|---|---|---|
| | | **First** | **Subsequent** |
| 1. | BOXN, BLC | 6 | 4.5 |
| 2. | BCN/BCNA, BOXN CR | 6 | 6 |
| 3. | BRN | 6 | 4.5 |
| 4. | BOY | 3 | 3 |
| 5. | BTPH | 6 | 4.5 |
| 6. | BTPN | 6 | 6 |
| 7. | BOBR & BOBRN | 6 | 6 |
| 8. | BTPGLN | 4 | 4 |
| 9. | BTALN | 4.5 | 4.5 |

# PROCEDURE FLOW DIAGRAM FOR MAINTAINCE OF 'AP' CLASS 'E' (6X11) AT RAILWAY WORKSHOP




SWR–SEAL WEAR RING
FBR–FITTED BACKING RING
L.P.–LATERAL PLAY IN mm

* HOT CAUSTIC SOLUTION SHOULD BE PREPARED FROM GRANULAR CAUSTIC SODA MIXED WITH WATER IN THE RATIO 0.6 OUNCE PER GALLON & HEATED TO .....

# Axle Box Bearing Used - CASNUB

- Cartridge Taper Roller Bearing

- Periodicity – Every POH

- Steps of Attention in POH
- Removal of Tabs of Locking Plate
- Removal of End Capscrew Locking Plate
- and End Cover
- Removal of CTBU
- Insertion of Pilot Sleeve
- By Hydraulic Puller as prescribed by OEM

# Axle Box Bearing Used - CASNUB

- CTRB
- Steps of Attention in POH (Contd…)
- Through Cleaning of Bearing
- Items to be checked
- Flaked/Spalling
- Brinelling
- Peeling
- Rust/Corrosion
- Heat Discoloration
- Crack on rollers
- Electric Burn

# Axle Box Bearing Used - CASNUB

- CTRB

- Steps of Attention in POH (Contd…)
- Items checked other than Bearing
- Axle end holes 
- Cleaning by Air Blowing
- by Go-No Go Thread Plug
- End locking plates 
- To be replaced
- End locking bolts 
- by Go-No Go Thread Ring

- **The workshops does the following works during POH of Cartridge Bearings:-**

  i. **Disassembly**
  ii. **Cleaning**
  iii. **Inspection**
  iv. **Reassembly**

  **Major repairs like remachining/remanufacturing of the track raceway of cone/cup, cage changing etc. is to be done only by the bearing manufacturer.**

For rectification of defective bearings in Railway workshop refer to **clause 13.0**.

## 8. PROCEDURE FOR OVERHAUL

### 1. Removal of wheel set from the side frame.

1. Remove side frame key bolt and the key. Lift side frame and take out wheelset. Remove adapter retaining bolt and nut (only for wide jaw bogies) and take out adapter from the side frame.

### 2. Removal of Bearing from Axle

1. Clean the outside surface of bearing. Unscrew the axle cap screws from the end cap and remove locking plate and end cap.

2

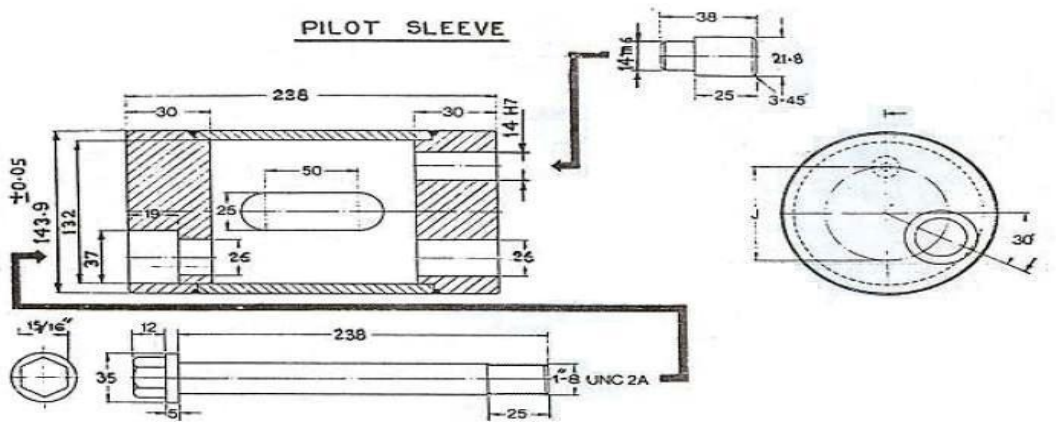



**Fig. 18**

8.2.3 Apply pulling shoe behind the backing ring. Hold it in position until the pressure has been applied. Go on increasing the pressure to pull the bearing off the axle end. **The pressure may exceed 5 tons**. A general arrangement for removal of bearing is shown in **Fig. 19.**

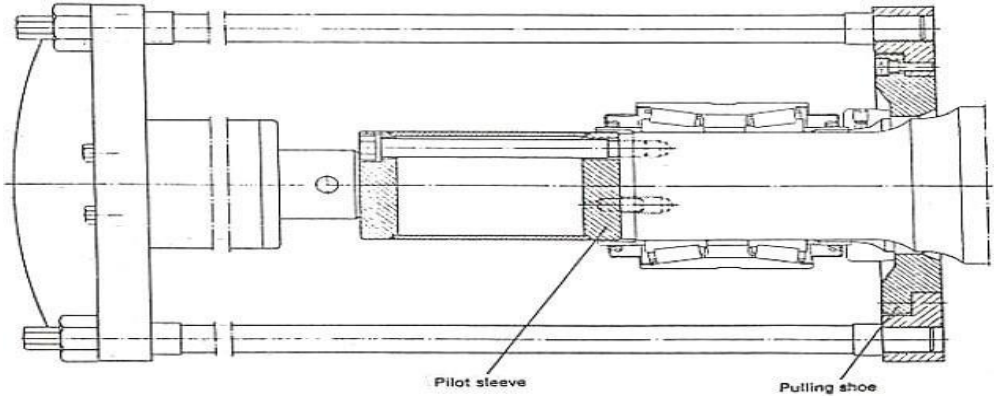



**Fig. 19**

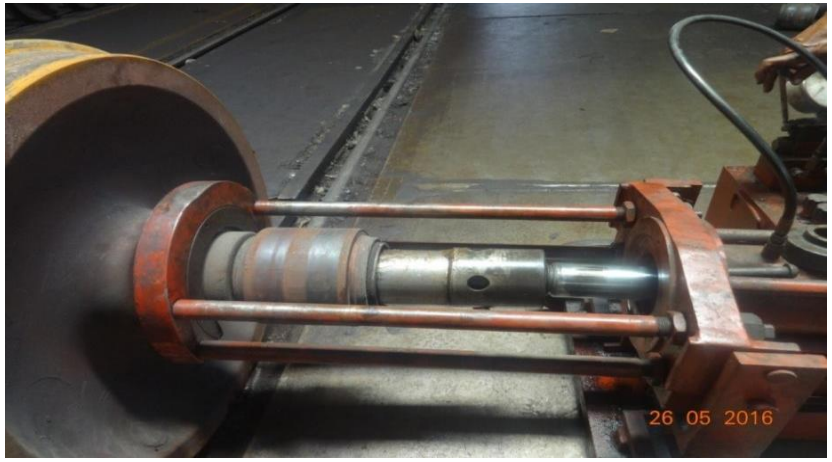



**Fig.20: Position the bearing removal fixture on the bearing assembly to be removed by tilting the pulling frame.**

4. Removed bearings should immediately be kept in a clean and dry place in a covered room. **Under no circumstances a bearing should be left in open** to avoid ingress of moisture/water causing severe rusting of the bearing.

5. The bearings should be very carefully handled. While loading/unloading the bearings for transportation from one place to another or otherwise, **care should be taken to ensure that the bearings are not thrown one over the other**. The bearings should be carefully stacked one over the other as even a small impact is enough to damage the bearing. Every bearing is precious **– SO HANDLE IT CAREFULLY.**

8.3 **Dismantling of Bearing**

After the assembly is taken out from the puller, remove backing ring, seal wear rings and excess grease. The bearing is now ready for dismantling on the workbench. Remove seals from both sides with the help of seal dismounting jig. The application of seal dismounting jig is shown in **F**i

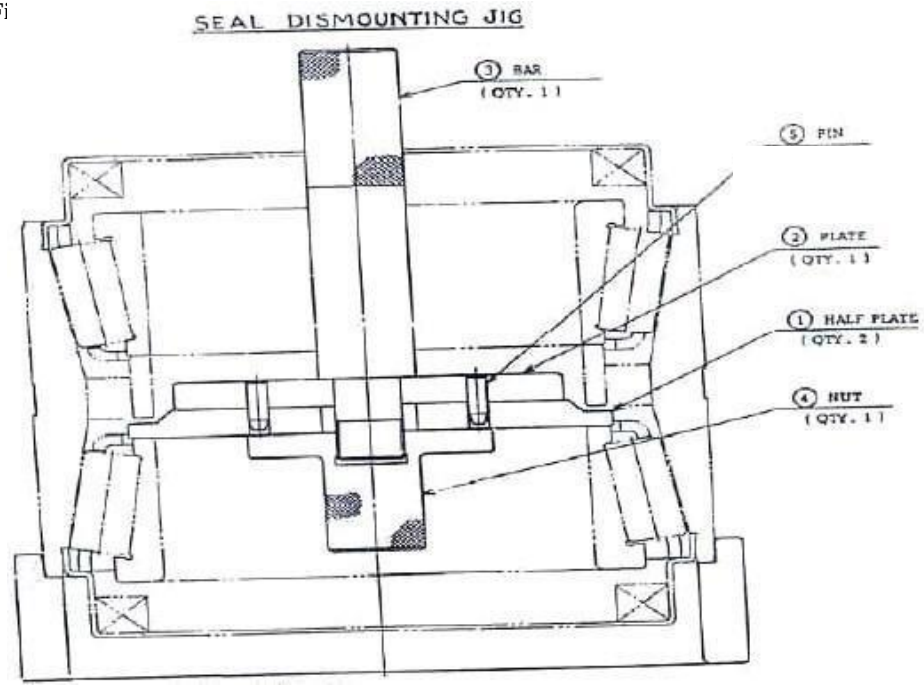



**Fig. 21: Seal Dismounting Jig**

. A feeler gauge probe or surface roughness tester is inserted between the roller and cage at the large and small ends of roller in turn. The inner ring is rotated on the inspection stand. Surface defects can be noted visually or by any roughness felt through the feeler gauge probe as shown in **Fig.25 and 26**.

Place the inner ring with the roller and cage assembly with back face (large diameter face) down on a horizontal support. Measure the bore diameter at both ends **9 to 13 mm from each face**. The average bore dia shall not be **more than 144.488 mm**(5.6885") at three locations **(see 'd' in Fig. 24, 27)** out of roundness should not exceed 0.076 mm (0.003") as per **Annexure VI**.

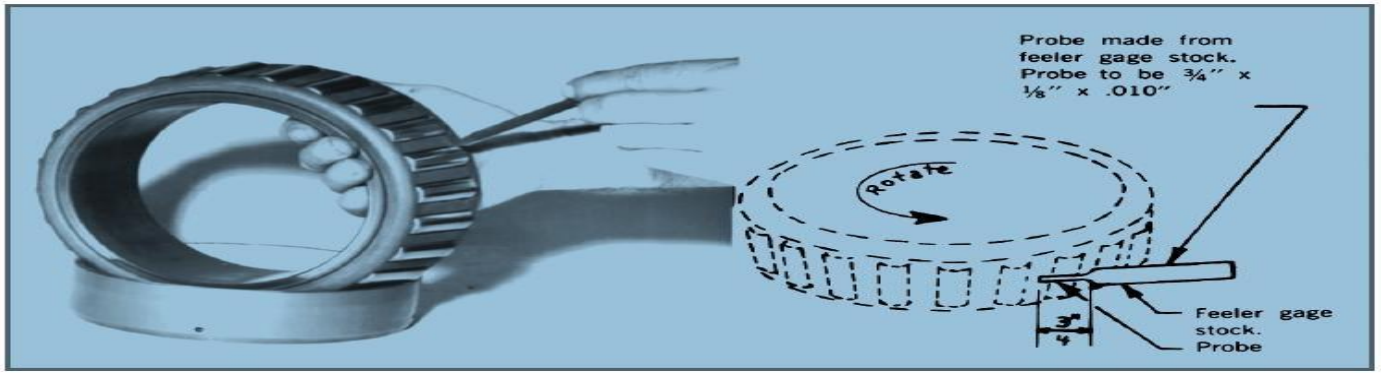
**Average out of roundness = ($D_{Max}$ - $D_{Min}$)/2 ≤ 0.076 mm** (0.003")

Cone face wear depth shall not exceed 0.127 mm (0.005") as shown in Fig. 28.

Measure the gap between the small flange of the inner ring and bore of cage flange in two diametrically opposite location. If the total of the two sets of **feeler gauges is 2.3 mm** (0.090") **or more,** the roller assembly should not be returned to service. **(See dim. $B_1$ & $B_2$ in Fig. 24) i.e. $B_1 + B_2 < 2.3$ mm (0.090")**.This is to be measured only for Timken, Brenco/NEI& SKF make bearings.

Measure the gap **'A' in Fig. 24** between the roller and the cage.The assembly should be rejected in case feeler gauge to the condemning dimensions given below can be inserted:-

| Make | Condemning Dimension 'A' |
|---|---|
| TIMKEN, NEI/BRENCO, FAG, SKF | 1.5 mm (0.06") |




Place feeler of surface roughness tester between the roller and cage adjacent to both the large and small ribs, rotate inner ring. Any surface defects can be noted by roughness felt through the feeler gauge.

**Inspection inner ring for defects**

By rotating the inner ring and observing the light area between roolers, the inner race can be visually inspected. Additionally while rotating the inner ring, the feeler gauge (as shown in Fig.25) can be used to inspect the raceway adjacent to both the large and small thrust shoulders.

**Inspection stand (typical)**


**Checking inner ring bore with dial bore gauge (Recommended method)**

**Fig.: Checking seal fit counter bore with dial bore gauge (recommended method)**

**Fig.: Master setting ring to set dial bore gauge**

8.5.4.2 **Cup Outer Diameter**

Measure the outside diameter using a micrometer at the points where the **adapter has been in contact** (See location '**A; in Fig. 31, 32**) with the cup. The diameter should not be less than that specified in the manufacturer's specification (**Annexure VI**). The make wise limits of outside cup diameter are reproduced below:

| **Make** | **Condemning Cup Outside diameter mm** (in.) |
|---|---|
| TIMKEN,BRENCO/NEI,SKF, FAG | **220.345** (8.675) |

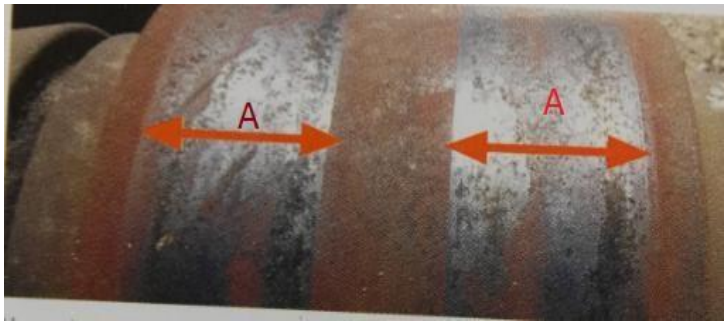



**Fig: Normal wear bands**


**Fig: Normal wear bands**

## Wear Pattern

The maximum out of roundness should not exceed 0.127 mm (0.005") (**See Annexure-VI**).

The wear pattern on the outer side of the cup should be studied because it reveals excessive wear of adapter. Inspect cup for wear band due to an excessively worn adapter at the ends. If wear bands extend upto the ends of the cup it reveals excessive wear on the adapter (**See location B in fig. 33**). The adapter in such case should be rejected.

Inspect rolling surface for any damage or type of defects like brinelling, spalling, smearing or peeling, fragment indentation or el

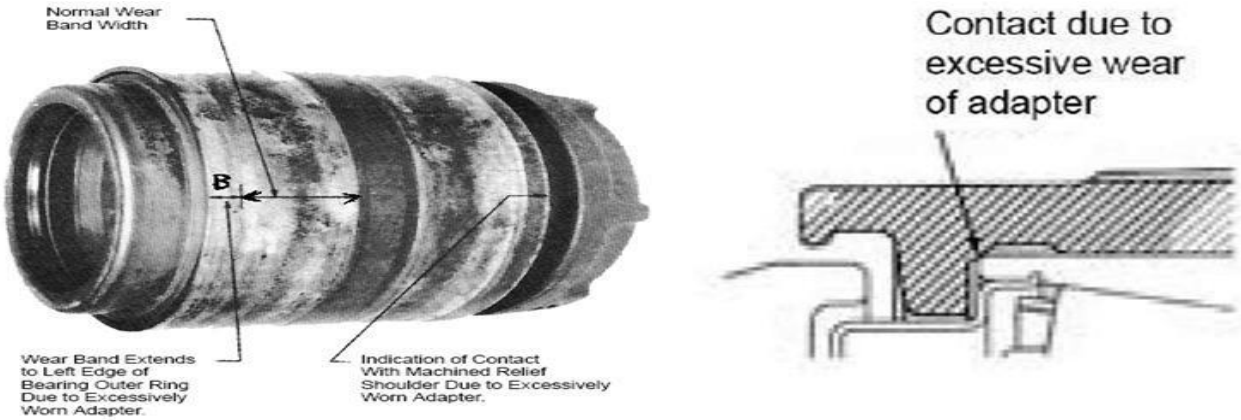



**Fig: Abnormal wear of outer ring/Cup due to excessively worn adapter**

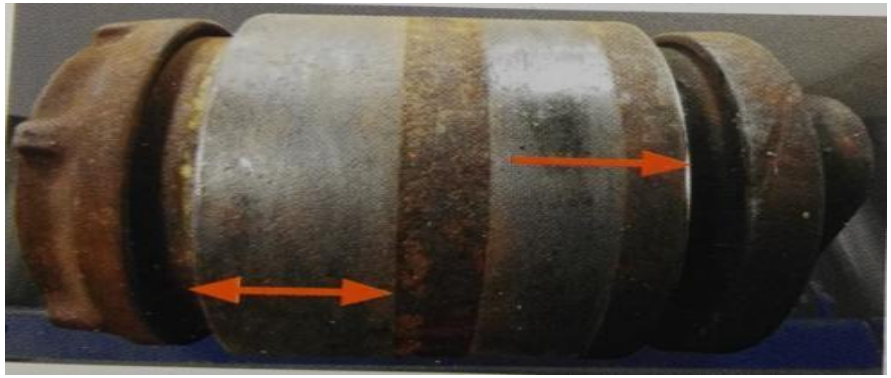


**Fig: Abnormal wear of outer ring/Cup due to excessively worn adapter**


**Fig: Rolling track of Cup**

# Cage

Check cage pocket clearance as given in the last two paragraphs of clause 8.5.2. Cracks of any size on the cage especially at the corners of the roller pockets are cause for scrapping roller assembly.

**Cage once taken out cannot be re-used. Cage changing can be done by the bearing manufacturer only and not by the workshops.**

## 6. Seals

**Seals must never be reused.** All used seals must be replaced with new seals.

## 7. Spacers

Spacers must be visually inspected for cracks, nicks and burrs. Cracked spacer must be scrapped. Nicks and burrs on the end faces should be ground smooth. The end faces of the spacer should be parallel within **0.025 mm (0.001") (See spacer in Fig. 24 & 36).** Width selection must provide for proper lateral clearance.

**Fig: Spacer width gauging**

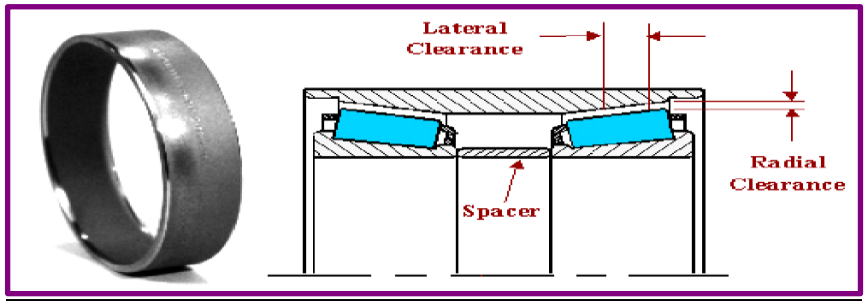



**Fig. 37: Radial and Lateral Clearance indication**

**Note: Widths of Spacer decides bearing Lateral Play**

**Seal Wear Rings**

Seal wear rings must be visually inspected for nicks, cracks, or scratches on the outside surface. The seal lip contact path must be smooth and free from any defects that might damage the seal lip. Check seal wear ring for wear. If seal lip contact path worn to a depth of more than **0.13 mm** (0.005") they should be replaced (See seal wear ring in **Fig. 24 & 38). The wear ring and backing ring must fit tightly together.** If worn to the extent that there is no longer a tight fit, they must be scrapped (see 'F' in **Annexure- VI** also). Seal wear rings with vent holes should be discarded if found during maintenance /reconditioning.

**Fig: Checking Seal wear ring groove depth**

**Backing Ring**

Check backing ring break out diameter **d1** in **Fig. 39,** which shall not exceed **178.511 mm (7.028") for Timken, Brenco/NEI, FAG & 178.562 mm (7.03") for SKF.** Check backing ring for excessive corrosion. Scrap backing ring with break-out dia. which exceeds the specified limits. Scrap distorted, cracked or heavily pitted rings also. Check seal wear ring counter bore diameter **d2 in Fig. 39.** The counter bore must provide a tight fit for seal wear ring. See **G, H, I** in **Annexure-VI** also. Backing rings with vent holes should be discarded if found during maintenance/overhauling.

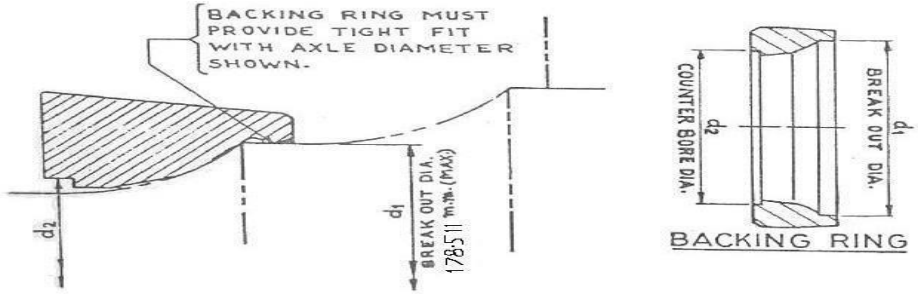



**Fig: Backing ring break-out (counter-bore) diameter limits**

| S. No | Description | Specified Dimensions/ parameter in mm unless otherwise stated | Relevant Clause. |
|---|---|---|---|
| | | | |
| 1. | Cone Bore/ID (max) | 144.488 | 8.5.2 |
| 2. | Cone Bore out of roundness (max) | 0.076 | 8.5.2 |
| 3. | Inspection of Cone Racewaysby feeler gauge probe. | - | 8.5.2 |
| 4. | Gap between Inner ring & Cage Flange i.e. B1 + B2 (max) (Only for TIMKEN, BRENCO/NEI& SKF Bearing) | 2.3 | 8.5.2 |
| 5. | **Gap (A) between Cage Pocket & Roller** | 1.5 | 8.5.2. |
| | TIMKEN, BRENCO/NEI, FAG, SKF | | |
| 6. | **Cup Counter Bore $D_1$** | 209.677 | 8.5.4.1 |
| | (a) Maximum | | |
| | (b) Minimum | 209.423 | |
| 7. | Cup Counter Bore out of roundness (max) | 0.127 | 8.5.4.1 |
| 8. | **Cup Outside Diameter** (min) | 220.345 | 8.5.4.2 |
| | TIMKEN, BRENCO/NEI, FAG & SKF | | |
| 9. | Cup Outer Dia out of roundness (max) | 0.127 | 8.5.4.3 |
| 10. | Inspect Cup for extended wear band. | B in Fig.33 | 8.5.4.3 |
| 11. | Parallelity of end faces of Spacer | 0.025 (max) | 8.5.7 |
| 12. | Wear limit for Seal Wear Ring outer dia. (max) | Seal Lip contact path has worn to a depth less than **0.13** mm (0.005") | 8.5.8 |
| 13. | **Bench Lateral:** With Hand Operated Device With Power Operated Device | 0.51-0.66<br>0.58-0.74 | 8.7.1 |
| 14. | Amount of Grease to be Applied | 400 $\pm^{30}$ gram | 8.7.2 |

| | | | |
|---|---|---|---|
| 15. | Verification of Quantity of Grease | Minimum two samples per day. | 8.7.2 |
| 16. | Greasing of Seal Lips | 10 gram (approx.) to be applied, if not prelubricated by supplier | 8.7.2 |
| 17. | Seal wear ring fitting into Backing Ring Counter Bore. | Tight fit | 8.5.8 |
| 18. | Backing Ring Breakout Diameter | Average I.D not to exceed 178.511 (7.028") for Timken, Brenco/NEI, FAG& 178.562 (7.03") for SKF | 8.5.9 |
| 19. | Backing Ring with vent holes | Backing rings with vent holes should be discarded | 8.5.9 |
| 20. | Machined Surface 'C' of End Cap in Fig. 24. | - | 8.5.1 |
| 21. | Wear on threads of Cap Screws | No wear | 8.5.10 |
| 22. | Wear on threads of Axle End Holes | No wear | 8.5.10 |
| 23. | Cleaning & Lubricating of Cap Screws & Axle End Holes | To be done | 8.5.10 |
| 24. | Packing | Polythene bags etc. | 9 |

| | | | |
|---|---|---|---|
| **Axle** | | | |
| 25. | Journal size | Journal of axle to DrgNo. WD-89025/S-02 | 5 |
| 26. | Journal Diameter of Axle | 144.564 to 144.539 | 10.1 &10.2 |
| 27. | Groove depth on Axle Journal | 0.05 (max) | 10.2.1 |
| 28. | Upset End of Axles | 0.075 (max) | 10.2.2 |
| 29. | Axle Fillet Radius with Feeler Gauge (Max. depth of insertion). | 10 (max) | 10.3 |
| 30. | Axle Fillet Radius | 38.1 | 10.3 |
| 31. | Axle end Tapped hole Thread Size | 1" – 8 UNC – 2B | 5 |
| **Mounting** | | | |
| 32. | **Journal Coating** | Anti-rust lead free compound to IS: 9862 | 10.4 |
| | (a.) Fillet & Collar Dia. | | |
| | (b.) Bearing Seats | Heavy mineral oil (SAE 30/SAE 40) or Castor oil | |

8.5.10 **Cap Screw**

Check cap screws wear on threads, and for stretching or elongation. Reject and replace if any defect is found. Cap screws which cannot be tightened to the recommended torque must be scrapped. The new cap screws shall conform the size **1** " Dia-8 UNC-2A X 2- 1/4" Long having Hexagonal head and material shall be IS: 1367 (Part-3): 2002 Class **P**
**8.8** (See Fig. 40)**. The cap screw threads should be properly cleaned and lubricated before fitment.** Cap screws having rusted threads should be used only after proper cleaning and lubricating. **Mating threads on axle end holes should also be checked,**
**cleaned and lubricated.**

With clean and lubricated threads the major portion of the applied torque is used for tension of the cap screw. Higher the amount of tension developed in the cap screw, higher is the end cap deflection and better is the clamping of the bearing on the axle i.e. **better retention.** A deflected end cap acts like a lock washer. In dry threads or rusted threads a major portion of the torque is used up to overcome the friction. **SO DO NOT FORGET TO CLEAN & LUBRICATE CAP SCREW THREADS AND AXLE END HOLES'**
If bearing attended on ROH/POH Depot for investigation and the End Cap is removed then tighten the cap screws for the recommended torque of 40 Kg-m. Repeat the torque wrench pass until no further screw movement is detected. Ensure to use the properly calibrated torque wrench. **Apply minimum 2 passes & maximum 5 passes** and bend the tab of locking plate against the sides of bolt using adjustable rib joint pliers. **It is advisable to use new locking plate, whenever re-torquing is done.**

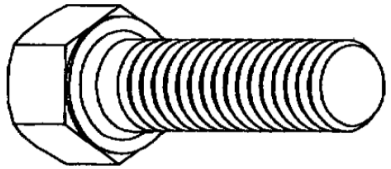


**Fig. 40: Hexagonal head Cap screw 1" dia-8UNC-2A x2 ¼" long**

8.5.11 **Locking Plate**

**Locking plate should never be reused.** Whenever locking plates are removed they should be replaced with new locking plates. Locking plate shall be as per RDSO Drg. No. WD-87019/S-1 (**Annexure-VII).**

8.6 **Accident Involved Bearings**

Extra precaution should be taken during inspection of accident involved bearings in the shop for brinelling, denting, cracks etc. on rollers and raceways.

## 7. Assembly of Bearing

After proper inspection of all the components they can be assembled. Care should be taken that these parts do not get contaminated during assembly. So assembly should be done in a proper place. Make sure that all components, tools and work benches are thoroughly cleaned. Cover the parts with waxed paper, polythene sheet or similar material whenever reassembly work is discontinued or delayed due to some reasons. **Never use cotton waste.**

### 1. Bench Lateral

Improved rolling contact fatigue is the 'BENEFIT' of proper 'Bench Lateral'. Check the unmounted play of the bearing assembly to make sure that the **spacer has the correct width.** Use radial indicator mounted to a cam actuated hand operated device (**Fig.41)** for checking the bench lateral. The bench lateral must be within as specified below:

| **Bench Lateral** | |
|---|---|
| **With Hand Operated Device** | **With Power Operated Device** |
| **0.51 - 0.66 mm** (0.020 to 0.026 in.) | **0.58 - 0.74 mm** (0.023 to 0.029 in.) |

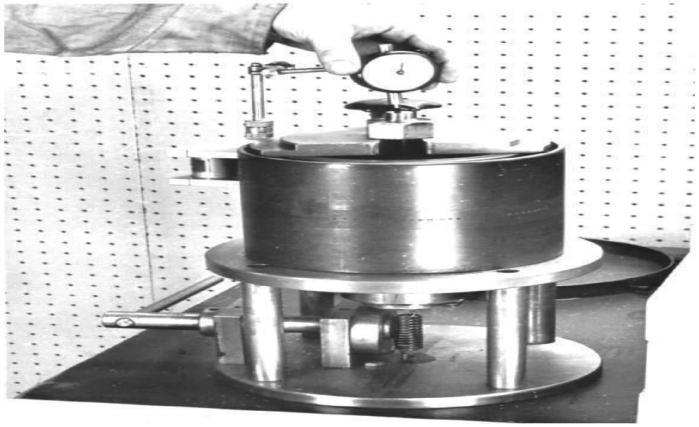


**Fig.: Fixture for checking Bench lateral (recommended method)**

**Fig**

**Lubrication**

Grease to be used should be clean and free from all kind of contamination. **The grease container should always remain closed**. The grease recommended for use on CTRB of freight stock shall be AAR approved in accordance with M-942-2004 or latest of AAR MSRP Section H or Grease Approved by RDSO, in accordance with their **specification No. WD-24-MISC-2003** or latest.

Before applying the grease, clean all the equipment to be used for lubrication. Apply grease to each single assembly and between the roller and cage assemblies in the quantity as given below:-

**Amount of grease& distribution of grease to be applied for Class 'E' bearing**

| **Each Roller Assembly** (Each Cone assembly) | **Between Roller Assembly** (Around spacer) | **Total** $^{\pm 30}$ (Quantity per Bearing) |
|---|---|---|
| **115** gram | **170** gram | **400**$^{\pm 30}$ gram |

Accurate lubrication system/device must be used to apply correct amount by weight of lubricant and **must be verified by measuring two samples per day.** Quantity of grease excess than the specified should not be applied, as excess quantity of grease causes higher operating temperatures and also results in purging at the seal, **thus giving false indication of seal wear or seal damage. The lips of the seal should also be lubricated with same grease, if not pre-lubricated by supplier.** The recommended cone greasing fixture and its details are shown in the **Annexure-VIII, IX & X.**

### 3. Mounting of Roller &Cage Assembly & Fitment of Seals.

Use seal mounting jig for assembly of cone and seals. The three parts of Jig are:-

**(i) Support Ring -** in which the outer ring stands to keep it in an upright position.

**(ii) Adapter Ring -** transfers pressures directly to the seal base shoulder.

**(iii) Installing Plate -** may be required depending upon the type of press used.

Recommended dimensions of these parts are given in**(Fig. 42).**

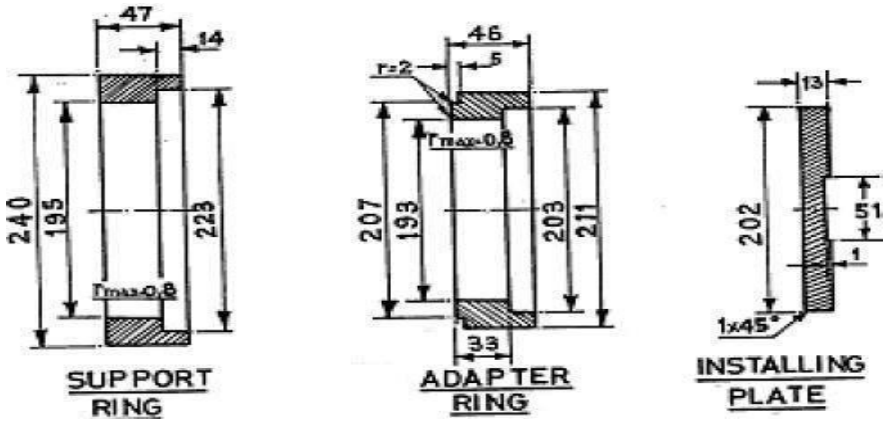



**Fig.:42**

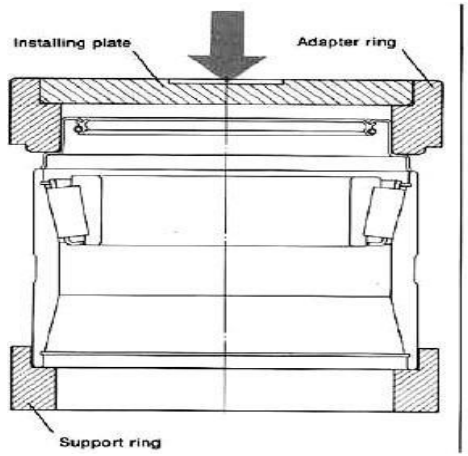



**Fig. 43**

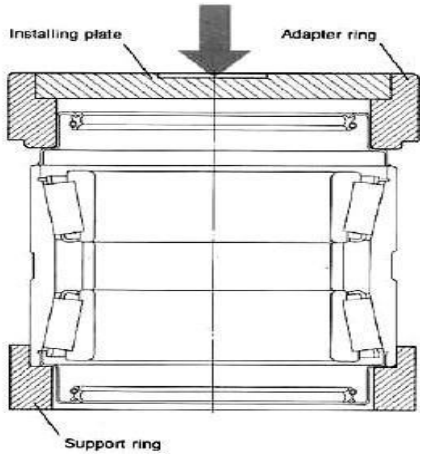



**Fig. 44**

Keep the support ring on the work bench and place the outer ring (cup) in its recess. Keep the first cone assembly in the outer ring. Then keep seal in position and press into the outer ring with the use of seal adapter ring as shown in **Fig. 43 & 44).** The shoulder of the seal must be flush with or below the bearing outer ring face. Turn the unit upside down and keep it on the support ring again. Insert spacer in position. Fill the space between spacer and outer ring with grease as prescribed in **Para 8.7.2.** The procedure for fitment of other outer ring is repeated as described above.

8.7.4 **Fitment of Seal Wear Rings & Backing Ring**

Slowly force the seal wear ring in position so that lips of seal expand and do not get turned under. While mounting the seal wear ring, make sure that they are assembled with the tapered end towards the bearings. Put the backing ring and other seal wear ring in their respective places (See para**8.5.8 & 'F' in Annexure- VI**).

## 9. STORAGE & PACKING OF BEARINGS.

Special attention must be given to proper packing and storage of CTRB. All outer surfaces should be coated with rust preventive. After servicing/ overhauling **a triangular card board as shown in Annexure-XI should be inserted in the bore to avoid displacement of the spacer & to prevent lubrication loss.** The complete bearing should then be wrapped in polythene bags of minimum 400 mm width and 600 mm length. The thickness of polythene should be 0.127 mm minimum. The packed bearings should be kept in a container as shown in **Annexure- XII.**

Complete bearing unit and components should be stored in a clean area with good protection from moisture. Periodic inspection of the storage area should be made. As the self-life of grease is limited, the bearing unit should be used in the order in which they were stored, **i.e., first in, first out (FIFO).** The packages of new bearing should be opened only before mounting. If they are opened for inspection etc. ensure that they are carefully sealed again.

**The bearings should leave the servicing room only in properly packed condition even if they are to be used within the same premises/workshop.**

## 10. INSPECTION OF AXLES BEFORE MOUNTING OF TAPERED BEARING ON AXLE& MOUNTING OF TAPERED BEARING ON AXLE

Before mounting, the journal should be inspected in a clean and well-lit area. Check the axles to make sure that they are fit for service. Axle bearing seat diameters, shoulders and radii should be within tolerance and free from defects like sharp corners, burrs, nicks, tool marks, scratches, corrosion, upset end/bulging etc. Axle bearing seat diameters should be concentric with the wheel seat diameters. The cap screw holes in the ends of the axle should be checked with a bolt circle checking gauge (See figure 46).

**Fig. 45: Checking backing Ring Seat on Axle**

**Fig. 46: Axle end thread checking Gauge**

Method of measuring journal diameter for new and old axles is as under:-

10.1 **For New Axles**

Measure the journal diameter at three points A, B & C (**See Fig. 47**). Take three readings, equidistant (i.e.$120^0$ apart) around diameter at each point A, B & C. The three circumferential readings taken at 'A' must be averaged and the average must be within the tolerance shown below, or axle must be rejected. The same applies for points B & C. Total nine readings have to be taken.

**DO NOT AVERAGE ALL NINE READINGS:-**

**AXLE ALLOWABLE DIA - 144.564 mm to 144.539 mm**

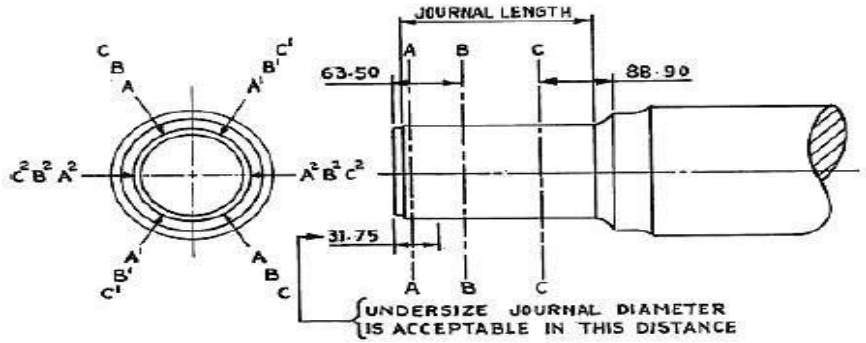



**Fig. 47**

10.2 **For Old Axles**

Measure the journal diameter at the two bearing seat locations at three equidistant points (i.e. $120^0$ apart) around the journal shown in cross hatched area (**Fig. 48**). The three measurements at each individual bearing seat may be averaged to obtain the average size, which must be within the tolerance given in Clause 10.1 above. **DO NOT AVERAGE ALL THE SIX READINGS.**

**NOTE: -** There should be no abrupt changes or steps over the length of the journal for either **NEW** or **OLD axles.**

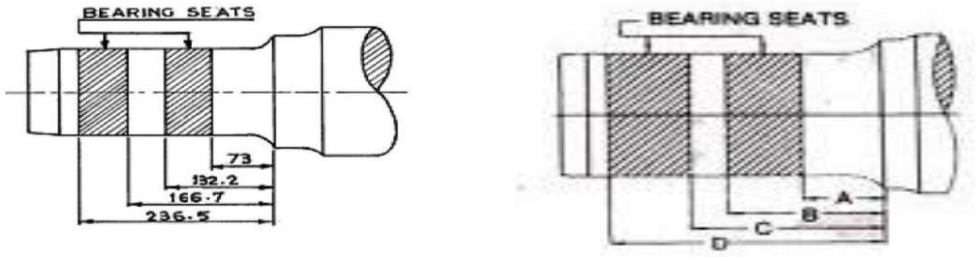



**Fig. 48**

| **Journal of axle to RDSO Drg. No.WD-89025-S-02** | **Dimensions** (mm) | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |
| | 73 | 132.2 | 166.7 | 236.5 |


**Fig. 49: Measuring journal diameter by snap gauge**

- Practice in Open Line

- Visual Check for
- Grease Oozing – Slight Oozing allowed
- Any Damage or Loose Parts
- Temperature
- Limit of Temperature of 90°C
- RDSO Letter No. MW.RB.Genl Dt 20/21.11.2012
- Abnormal Sound
- Accident Involved Bearing to be marked
- as Accident involved and
- not to be used

# Axle Box Bearing Used - CASNUB

- Practice in Workshop received for ROH

- Visual Check for
- Grease Leaking
- Roughness in revolving
- Overheating
- Any Damage
- Check of End Play
- Removal of End Cap for Turning
- Fixing of End Cap and tightening of End Capscrew
- Renewal of Locking Plate

# Axle Box Bearing Used - CASNUB

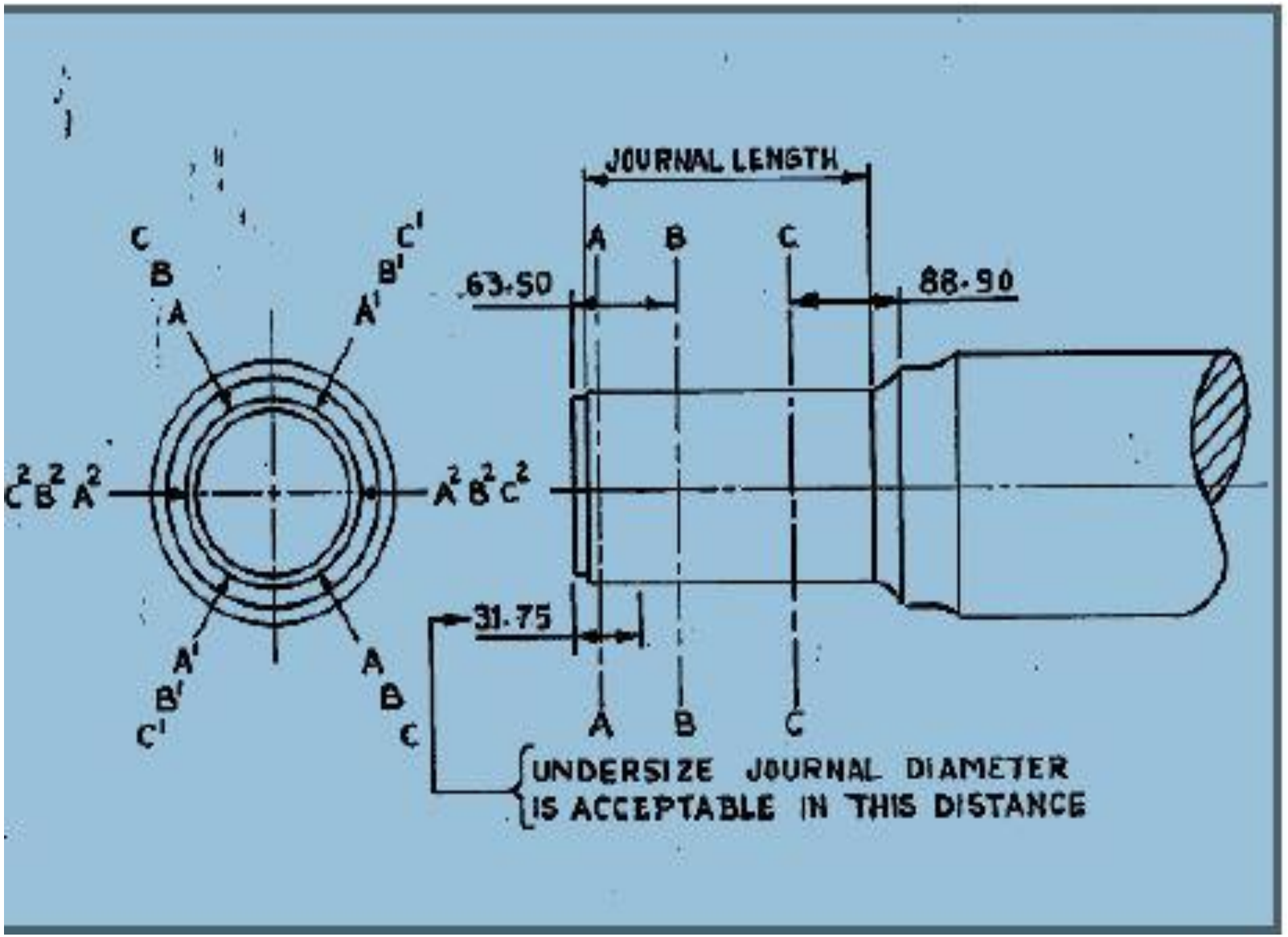
- Steps of Attention in POH (Contd…)
- Mounting
- Pressing of CTRB
- Check of Inner Dia of CTRB
- Check of End Play
- At Bench
- Pressure by Hydraulic Pusher 50T
- Check of End Play
- After Mounting (0.03 to 0.38 mm)

# Axle Box Bearing Used - CASNUB

- Steps of Attention in POH (Contd…)
- Mounting
- End Cap
- Renewal of Locking Plate
- End Capscrew by Torque Wrench 40 KgM

- Precaution during Fitment into Bogie
- CTRB not able to take Misalignment
- Alignment of Adaptor
- affects performance severally

# CTRB Journal Dimensions



# CTRB Journal Values

| JOURNAL CLASS ( Size) | ACCEPTABLE TOLERANCES FOR JOURNAL DIAMETER | | BEARING SEAT LOCATIONS | | | |
|---|---|---|---|---|---|---|
| | MAXIMUM | MINIMUM | A | B | C | D |
| E (6"x11") | 144.564 mm (5.6915") | 144.539 mm (5.6905") | 73.0 mm (2.88") | 132.2 mm (5.20") | 166.7 mm (6.56") | 236.5 mm (9.31") |

# CTRB Journal Values

| JOURNAL CLASS ( Size) | ACCEPTABLE TOLERANCES FOR JOURNAL DIAMETER | |
|---|---|---|
| | MAXIMUM | MINIMUM |
| E (6”x11”) | 144.564 mm (5.6915”) | 144.539 mm (5.6905”) |

# Axle Box Bearing Used - CASNUB

- Steps of Attention in POH (Contd…)
- Mounting
- Pressing of CTRB
- Application of Rust Preventive Coating
- On exposed surface of Axle
- Between Hub and Bearing
- Application of Thin Coat of
- Anti Slip Oil (SAE 40 or 50)

# CTRB Mounting Parameters

- Final Seating Pressure - 50±5 Tonnes
- Cap Screw Torque – 40 kg-m
- Lateral Play – 0.03 to 0.38 mm
- If a bearing rotates freely by hand but indicates less than 0.03 mm Lateral on Dial indicator, the application is satisfactory for service
- Grease – RDSO Spec No. WD-24-MISC-2003
- Qty – At each Cone 115 g
- Between Roller Assembly 170 g
- Total 400 g

## SCHEDULE OF INSPECTION & MAINTENANCE

The following are the recommended practices for long life and trouble-free operation of Cartridge tapered Roller bearings

### 1. Recommended Practice during incoming examination in yards

1. The bearings should be examined for

**i. Abnormal Noise**

Check for any abnormal sound and/or grinding noise.

**ii. Running Temperature**

Detection of warm bearings on arrival of the train .Check operating temperature of the bearing by touching the adapter or underside of the bearing cup with bare hands immediately after wagon/vehicle is halted. If it is found impossible to hold the hand for a few seconds on the adapter or the Cup it means that the bearing is running hot. Cross check the bearing temperature with temperature sensing hand held pyrometers/sensors giving direct reading of the bearing.If bearing temperature is **more than 90 degree** centigrade the wagon/vehicle should be removed from service. Running temperature up to $38^0$C above ambient may be expected under normal operating conditions.

**iii. Visible Damage**

Inspect adapter, axle cap screws, locking plate, outside of the cup and seal. If any of these are found cracked, broken or distorted the wheel set must be removed from service. If one cap screw is found loose or missing examine the bearing by rotating it. If it is OK remove all the cap screws. Apply a new locking plate and, torque tighten all the cap screws. If two or more cap screws are found loose or missing, the bearing should be removed from service for complete inspection and servicing before reuse.

If locking plate tab are broken, remove locking plate and fit a new one. Tighten the axle cap screw with torque wrench to a specified torque of**40 kg-m**. Lock the cap screws by bending the tabs of locking plate.

**iv. Displaced Adapter**.

Check for displaced adapter from its correct location on **the bearing outer cup which can result from lack of care at the time of bogie assembly or from vehicle abuse during tippling**. **A displaced adapter can cause mechanical damage, off centre loading, accelerated fatigue damage and pre-mature bearing failure**. **Any wear of damage to the end cap or backing ring is an indicator that the adapter has been out of position**. Sometimes a displaced adapter can get automatically reseated in its correct position due to bogie action. If an adapter is found displaced, the bogie should be lifted. Outer cup, backing ring and end cap should be thoroughly examined and then the adapter should be properly seated.

2.1 Overheating, such as discoloration or parts fused together.

**Fig. 8: Phenomenon of discoloration due to overheating**

2.2 Check for loose and/or missing cap screws.


**Fig. 9: Missing Cap Screw**

2.3 Check that all tabs of the locking plate are properly bent up against the flats of the cap screw in the loosening direction


**Fig.10: Position of End Cap Srew**

2.4 Inspect for damage or wear to the End cap from a displaced adapter

**Fig.11: Damaged End Cap**

2.5 Examine the bearing for welding damage or exposure to extreme heat, such as from a cutting torch. Remove the bearing from service if you find any damage.

2.8 Check the backing ring for damage or wear from a displaced adapter

.

**Fig.14: Damaged Backing Ring**

2.9 Check whether the grease seal is displaced or cocked or has external damage

**Fig.15: Cocked Grease Seal**

3. While carrying out wheel turning, the prescribed dummy/protective covers (as mentioned in clause 7.2 (2) & shown in Drawing No. WDIIA-8514/S-1) on bearing shall be used.

4. Proper tightening of End cap Screws with periodically (monthly) calibrated torque wrench at specified torque may be ensured on wheel sets. The specified torque should be maintained to 40 Kg-m (290 foot-pounds). The torque wrench must be maintained with an accuracy of ± 4% (Maximum). Minimum 2 passes and maximum 5 passes to be applied to ensure proper clamping. If any screw movement persists after 5 passes check for any irregularity.

5. Handling of wheel sets to be done by using the prescribed lifting tackle and not by wire ropes which can damage the grease seals.

6. In case bogie(s) are dismantled for any purpose, the Adapter must be thoroughly inspected for soundness and wear. Gauging must be done as specified in clause 19.

7. Ensure the Adapter is properly placed on CTRB. Most bearings will **"creep** "in service, creating two wear bands as pictured below. This is a normal condition that also causes wear to the adapter's seat pads

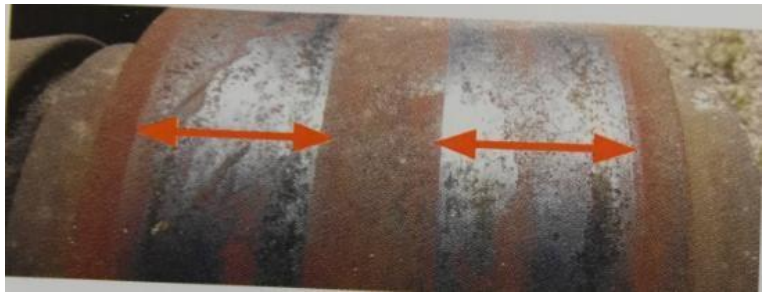


**Fig.16: Normal wear bands**

Wear bands that extend to the end of the outer ring (cup), as shown on the left side of the image below, indicate an excessively worn adapter seat. A shiny edge at the extreme end of the outer ring, as shown on the right side of the image below, is an indication that the thrust shoulder is worn. Replace the adapter if either of these conditions exists.

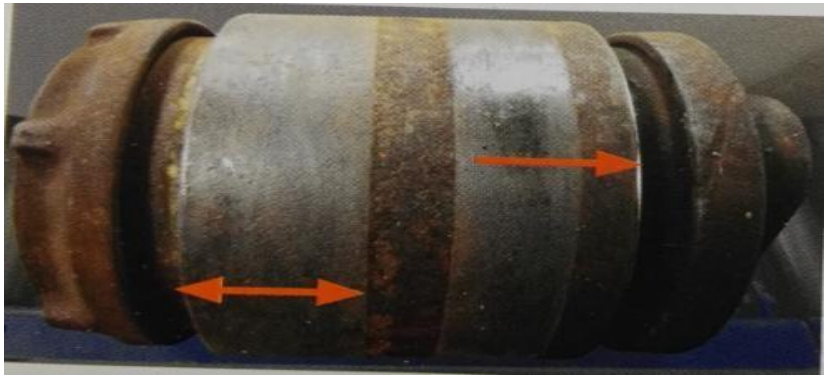


**Fig.17: Excessive wear bands**

8. Whenever wagons or bogies fitted with CTRBs require welding in ROH Depots/Sick lines, special attention should be paid so that electric current does not pass through the bearings. The earthing should be done very close to welding area and the earthing wire should be tightly secured at both ends. Alternatively the earthing can be done with an earthing wire/strip running parallel to the track instead of earthing with the rails. If wagon is not properly earthed the current passing through the bearings will cause arcing in between the rollers and the raceways leading to failure.

## 4. Overhauling of Taper Bearing

1. The overhaul includes the removal, cleaning, inspection, repair or replacement, assembly of all parts and installation. **Overhauling should be carried out at the time of POH of wagon and also at the following occasions:-**

**a) Re-discing**

b) When wagon has been **submerged in flood, etc**.

c) When Hot Box or Bearing failure has been reported on account of **broken cup, unusual sound etc.**

**d) Derailment:** All the bearings of wagons involved in accident should be removed and sent for servicing/overhauling in the workshop. The word **'Accident Involved'** should be painted on the outside of the cup of such bearings before sending to workshop for detailed examination (Refer **Para 8.6**).

# Machines and Tools

- Machines Required
  - Axle Box Cleaning Plant
  - Automatic Bearing Cleaning Plant
    - 3 Stage Washing
  - Induction Heater with Demagnetizer for
    - Heating of Labyrinth Ring and Bearing
  - Oil Bath for Heating
  - Hydraulic Bearing Extractor for
    - Spherical Roller Bearing
  - Hydraulic Bearing Mounting and Dismounting for CTRB

# Machines and Tools

- Machines Required
  - Hydraulic Bearing Mounting and Dismounting for CTBU
  - Hydraulic Measuring Container
  - Zyglo Testing Machine
  - Engraving Machine

# Machines and Tools

- Tools Required
  - Cleaning Oil Vessel
  - Snap Gauge
  - Feeler Gauge to check Radial Clearance
  - Bore Gauge to check Bore
  - Torque Wrench for Tightening of Bolts
  - Pusher Jig
  - Measuring Container
  - Thread Ring Gauge
  - Thread Plug Gauge

# Thank You