

BEARING

Defination:

Bearing are Mechanical assemblies that consists of rolling elements & assist object rotation. Bearing support, the rotating shafts of the Wheels & allow them to rotate more smoothly. The main function of bearing of a rotating shaft is to transmit power from one end to the other i.e. it plays a vital role between two rotary moving parts.

Introduction:

- Bearing work as an anti-frictional element and reduce frictional losses, make rotation more smooth and improves service life.
- Protect the part that supports the rotation & maintain the correct position of the Rotating shaft. smoother.
- Bearing transfer motion, i.e. they support & guide components which turn relative to one another & transmit forces.
- 'DOUBLE ROW SELF ALIGNED SPHERICAL ROLLETR BEARING' is used in ICF coach.
- Self-Aligned spherical Roller Bearing arrangement is used for higher load carrying capacity.
- CARTRIDGE TAPER ROLLER BEARING (CTRB) is used in LHB Coach.
- Cartridge taper Roller Bearing is self-contained-assembled, pre-adjusted lubricated completely sealed unit and is applied to or removed from the axle without exposing the bearing elements.
- 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 bearing parts are made of nickel - chromium alloy steels.
- Bearing components are manufactured to very close tolerance.

Roller Bearing:

There are three types of roller bearing used in Indian Railway.

- i) Cylindrical or parallel roller bearing used in BOX, BCX, BRH Wagon.
- ii) Cartridge taper roller bearing used in LHB coaches & air brake wagons fitted with casnub bogie.
- iii) **Double Row Self-Aligned Spherical Roller bearing used in ICF coach.**

No bearing gives an unlimited length of service. If a roller bearing is exposed to moisture or dirt, it will be rendered unserviceable due to rust or wear after a period of service, which obviously cannot be predicted. However, if it is effectively protected, well lubricated and otherwise properly handled, all causes of damage are eliminated except one, the fatigue of material due to repeated stresses under rotation.

The Roller Bearing consists of the following parts-Two rings or Discs with race ways made from high purity chrome alloy steel for high load rating & long service life. The raceways are hardened, ground & honed. Inner Ring or Race which fits on the shaft. Outer Ring or Race whit fits inside the housing. 28 nos. (14 nos. in each row) roller arranged between the surfaces of two

races. These provide rolling action between the races. The Cage is responsible for keeping the rolling elements apart and guiding them. The materials used include steel, Brass & Plastic.

General Guide line: If conditions of the roller bearing are kept close to the ideal by proper care in use & maintenance, long service life can be expected from them. Some important factors involved are –

- ❖ Bearing should not be unpacked until it is ready for mounting.
- ❖ Do not drop the bearing.
- ❖ All plastic wedges inserted between rollers to protect from any damage during transportation, must be removed prior to fitment on axle journal.
- ❖ Spherical Roller bearings are designed, manufactured, and assembled to provide a specific amount of radial clearance. Therefore, components of any spherical roller bearings should never be interchanged with other bearing.
- ❖ Mounting, dismounting, inspection and maintenance work of bearings must be done by trained/ qualified persons.
- ❖ Electrical current must never be allowed to pass through roller bearings as it may cause arcing within the roller bearing causing damages. All welding should be done with ground cable attached so that circuit formed shall not allow electrical current to flow through roller bearing.
- ❖ When cleaning passenger coaches or any part of it, care should be exercised not to direct steam jet or water jet spray toward sealing area of axle box. This may cause damage to the bearings.
- ❖ Heating or cutting torch when used around roller bearing must never have heat directed on any portion of the roller bearing assembly.
- ❖ Never use heating torch for removal of bearings from journal. Use only specified tools and equipment.
- ❖ Use of abrasive cleaning material such as sand blasting, grit blasting etc. for cleaning any part of roller bearing is strictly prohibited.
- ❖ Cotton waste must never be used to clean roller bearing. Use only clean towels
- ❖ Use only recommended tools for mounting / dismounting and maintenance work.
- ❖ Use only those parts, which are new or otherwise satisfactory to reach the next reconditioning interval after service.
- ❖ Bearing parts of different roller bearing units or different manufacturers must never be mixed or interchanged. This can disturb the radial and axial clearances, which can lead to poor performance of the bearing during service.
- ❖ Never mix two different brands of grease or used grease with fresh grease.
- ❖ Lubricate both new and used cap screws prior to installation.
- ❖ Be extremely careful about the conditions, such as under size journal diameter, oversize housing bore, absence of cap screw load etc.
- ❖ Any wear or damage on axle box component should be cause for renewal.

Bearing Defects & its Causes:

a) Flaking: -

- Flaking appears when fragments of bearing material split off from the smooth surface of the race way or rolling elements track. The flaking generally spreads in the direction of rolling.

Causes of Flaking-

- Normal fatigue
- Excessive Load
- In correct mounting.
- In adequate lubrication.
- Dirt ingress.
- Entry of Foreign Particles
- Unsuitable bearing clearance
- Shaft Bending or Improper precision for shaft or housing

b) Smearing: -

- Smearing is a kind of seizing, caused by two surfaces sliding against each other under load.
- It damages surface which occurs from a collection of small seizers between Bearing components.

Causes of Smearing -

- Excessive grease or Improper lubrication
- Grease being too stiff or too fibrous.
- Dirt or Dust ingress
- Deformed cage.
- Sudden Acceleration or Deceleration.

c) Wearing: -

- It is the surface deterioration of a Bearing.
- Wear normally occurs as a result of sliding friction between rolling elements and the cage and effect on rolling element, rib face & cage pockets etc.

Causes of Wearing-

- Foreign particles like dust, which may cause wear, may enter the bearing either together with lubricant or via defective seals or inadequate care during mounting.
- Poor Lubrication
- Sliding due to irregular motion of rolling elements.

d) Peeling-

- Dull or Cloudy spots appear on surface along with light wear. From such dull spots tiny cracks are generated downwards to a depth of 5 to 10mm.
- **Causes of Peeling-**
- Unsuitable Lubricant.
- Entry of Debris into Lubricant
- Rough surface due to poor lubrication.
- Surface Roughness of mating rolling parts.

e) **Cracks** – Due to continuous use with Cracks in the raceway ring & Rolling elements it leads to larger cracks.

Causes of Cracks-

- Excessive Interference
- Excessive Load
- Errors of the journal shape or axle box.
- In correct fitment.
- Lack of care during mounting.

f)Fracture:

- It refers to small pieces of metal which are broken off due to excessive load or shock load acting locally on a part of the roller corner or rib of the raceway ring.

Causes of Fracture-

- Impact during mounting
- Excessive load.
- Poor handling such as dropping.

g)Electric corrugations : - When an electric current passes through the point of contact between the race & rolling element & the point of contact are melted locally to form fluting or groove like corrugations which are seen by the naked eye.

Causes of Electric corrugations-

- Electric Potential difference between inner & outer Ring
- Due to voltage drop.

h)Cage Damage: -

- Under normal condition roller cages are not subjected to get any great stresses, but usually affected by poor lubrication.
- Beginning with wear at the point where they make contact with the rolling elements & gradually damage the cage and jam the bearing.

Causes of Cage Damage-

- | | |
|---|-------------------------------|
| i) Poor mounting | v) Excessive speed |
| ii) Certain acceleration & deceleration | vi) Poor lubrication |
| iii) Rise in temperature. | vii) Poor handling |
| iv) Excessive load | viii) Shock & large vibration |

Measures to prevent HOT BOX in roller bearing axle box assembly.

External Inspection of Roller Bearing during train examination.

It is important to ensure proper examination of all roller bearing axle boxes during train examination for detection any defect at an early stage, otherwise the defect may lead to a severe form of failure of roller bearing and likely to consequent damage to wheel sets to

affect the safety of passenger. External examination is sought for –

Hot Box: - A roller bearing axle box, which is abnormally warmer than other axle boxes of the same bogie / vehicle may be deemed as defective.

- ❖ Grease leaking out of axle box
- ❖ Visible sign of damage on axle box body or front cover or other components.
- ❖ Seized roller bearing.

Rolling- in- examination and Hot Box feeling is to be ensured at every originating / terminating depot for avoiding accident relates with Roller Bearing failure

Inspection of Roller Bearings in Mounted Position

Following procedure should be adopted for carrying out inspection of roller bearings in mounted position.

- Clean the exterior of axle box, front cover, and axle box housing.
- Remove axle box with the help of mechanical screw type puller, by taking care to protect axle centre with the use of pad not allowing the screw to rest on the axle centre. The end locking plate should be removed.
- Examine the grease for consistency, colour, contamination with water, foreign particles, etc.
- If the grease is in good condition, the bearing should not be dismantled, provided its felt sealing ring and rear cover does not require renewal.
- Remove old grease. Roller bearing and its components should be thoroughly washed and cleaned with kerosene and then petrol/white spirit.
- All components viz., rollers, cage, outer and inner rings (races), roller track of outer ring should be examined after swiveling the outer ring.
- Bearing should be rejected for the following defects:
 - Pitted or flaked roller tracks and rollers.
 - Cracked or deformed or badly worn out cage
 - Cracked inner or outer ring
 - Scored or damaged outer surface of the outer ring
 - Indentation or rings or rollers
 - Scoring of roller tracks or rollers

- Rust/corrosion, damage, or excessive fretting corrosion
- Brinelling or false brinelling
- Rings exhibiting deep straw or blue or purple colour indicating heat effect
- Excessive or less radial clearance.

Radial clearance should be measured in a mounted position with a long feeler gauge Simultaneously over both the rows of roller. The blades of the feeler gauge should be inserted between the outer ring and the unloaded rollers. While measuring the radial clearance, the rollers should not be allowed to roll over the blade. The acceptable range of radial clearance for bearing in mounted position on journal for different makes of roller bearings is given.

<i>Bearing make</i>	<i>Radial clearance in mm</i>
<i>SKF</i>	<i>0.105 to 0.296 mm</i>
<i>FAG/NORMA</i>	<i>0.080 to 0.185 mm</i>
<i>NEI/NBC</i>	<i>0.080 to 0.190 mm</i>

- After inspection, if bearing is found satisfactory for further service, the bearing may be cleaned further for re-assembly and greasing. Care should be taken that outer ring is aligned or turned back to its original position slowly. Jerky movement of outer ring can cause damage to rollers.

- Carry out detailed inspection of all other parts for wear, mechanical damage and any other defect, the locking plate should be fitted in position, the end locking bolts tightened with a

Torque wrench to a correct torque value as given below:

15 o 12 m kg. For M16 bolts.

15 o 16 m kg. For M20 bolts.

- Torque wrenches should be periodically checked for accuracy with torque wrench tester.
- Bend all tabs of locking plate against the sides of the bolt using adjustable rib joint pliers.
- The date, the month, and the year of attention and workshop code should be punched on the locking plate in case of retaining ring and on the annular nut in case of annular nut type arrangement

- Fresh grease should be packed between the rollers and the space between rear cover and the roller bearing. Correct quantity of grease is filled in each axle box for which volumetric containers having unique shape and size are used to eliminate mistake by staff.
- A truncated cone of grease should be formed to in from of the bearing. The „V“ grooves in the rear cover should also be filled with fresh grease after thorough cleaning.
- The axle box housing, front cover and „V“ grooves on their faces should be thoroughly cleaned and checked for damages, distortion and trueness of dimensions. After filling the fresh grease in the grooves, the axle box housing should be carefully pushed on the bearing and the front cover tightened in position. The nuts of the axle box should be secured with the split pin.

Month, year, and workshop code should be stenciled on the front cover and the axle box Sealed. The free rotation of the axle box should be checked by hand.

Lubrication

- The quantity of grease filled per axle box

SKF make bearing needs --2.00 kg

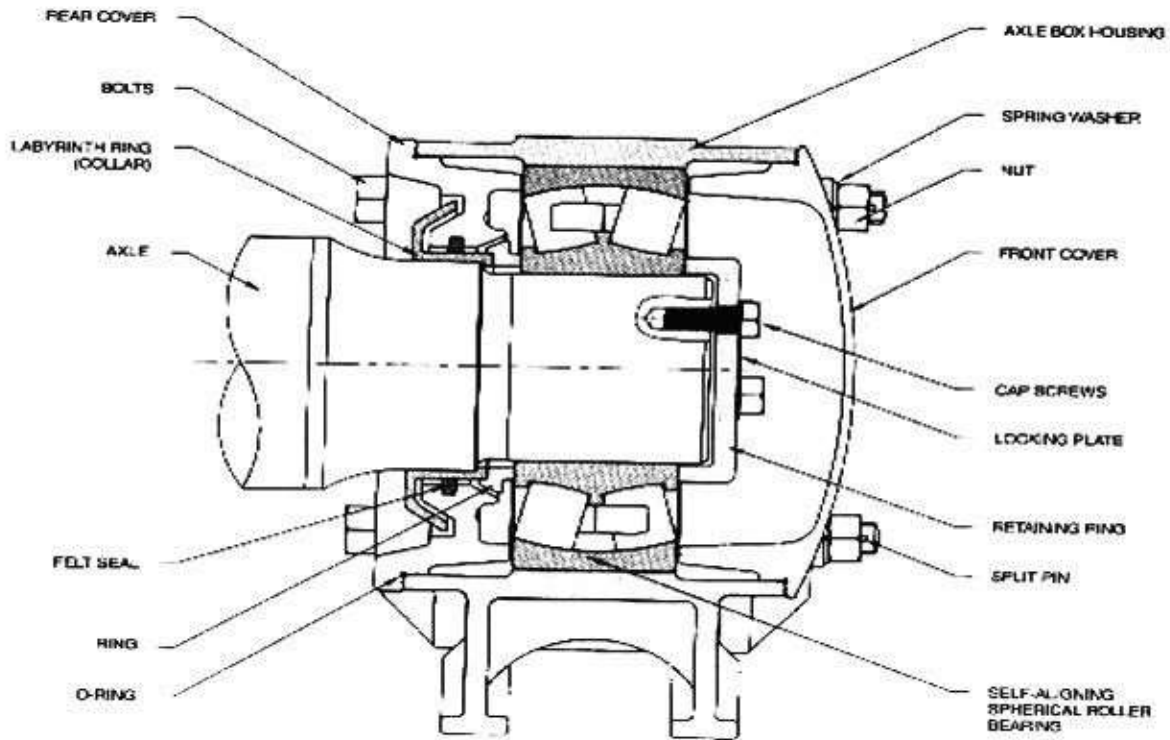
Other makes bearing needs-- 1.75 kg

- Only lithium base grease of approved brands should be used

Guidelines for storage of Grease

- 1) Grease drums should be stored in vertical position in a covered room.
- 2) Take all precautions to prevent contamination of grease due to dirt, moisture, dust foreign Particles etc.
- 3) Always store grease in container with cover.
- 4) Never mix different types of grease.
- 5) Use only clean tools and container when handling the grease.

DOUBLE ROW SELF ALIGNED SPHERICAL ROLLER BEARING



DIRECT MOUNDED ROLLER BEARING ARRANGEMENT

INSPECTION OF OTHER ROLLER BEARING COMPONENTS

The following components other than roller bearing should be inspected during roller bearing maintenance in the workshop.

<ul style="list-style-type: none">▪ Axle end holes▪ End locking plates▪ End locking bolts▪ Retaining Ring	<ul style="list-style-type: none">▪ Collar▪ Felt ring▪ Rear and Front Cover▪ Axle box housing
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External Inspection of Cartridge taper Roller Bearing

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

The cartridge Type Taper 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, e 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 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 bearings, therefore, should not be opened in the sickliness/ ROH Depots.

CTRB stands for Cartridge Tapered Roller Bearing. The main function of Cartridge Tapered Roller

Bearing is to support Axial as well as Radial forces.

The main components of CTRB are-

- a) CUP b) Roller
- c) Cone d) Spacer Ring
- e) Cage f) Wear Ring
- g) End Cup h) Cap Screw

Taper Roller Bearing Components



The bearings should be examined for

a) Abnormal Noise

b) Running Temperature

Running temperatures up to 38°C above atmosphere may be expected under normal operating conditions. If bare hand cannot be held on the adapter or the underside of the bearing cup for a few seconds, and the bearing is noticeably WARMER than other bearings on the wagon, the bearing should be checked with a temperature –

indicating crayon suitable for temperature of around 90°C on the front face of the adapter. Direct reading pyrometers can also be used for measuring the temperatures. If the bearing temperature is in excess of 90 C then the bearing should be removed from service for further examination.

c) 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 tabs are broken, remove locking plate and fit a new one. Tighten the axle cap screw with torque wrench to a specified torque of 40 kgm. Lock the cap screws by bending the tabs of locking plate.

d) 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 above during tipping. A displaced adapter can cause mechanical damage, off Centre loading, accelerated fatigue damage and premature bearing failure. Any wear or damage to the end cap or backing ring is an indicator that the adapter has been out of position. Some times a displaced adapter can get automatically resealed 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.

e) Grease Leakage

In case of grease purging or leaking out of the bearing, check for visible damage to seals. Grease leaking between the cup counter bore and the seal cage major diameter (Location B in Fig. 1) may be an indication of a loose seal. Seal is loose if it can be moved by hand or is cocked out of position. Grease leaking between backing ring on the axle dust guard is an indicator of a loose backing ring and a loose bearing. If a backing ring can be moved by hand on application of pressure it is considered to be loose. Bearing with loose backing ring should be removed from service.

EXAMINATION IN SICKLINES

When wagons pass through sicklines for some repair or tyre turning, the bearing should be subjected to external examination as listed above. In case if the bogie is lifted for any reason the **bearing should be rotated by hand and checked for any unusual sound due to raceway damage or any jamming which restrict the rotation. Bearings giving unusual sound/ found jamming should be removed from service.**

Before tyre turning, open out the axle end cap and replace it with a dummy cover. The dummy cover can be made as per RDSO Drg. No. WDIIA – 8514/S – 1. After tyre

turning, clean the axle end thoroughly, taking special care to see that no grit or swarf is left. Also check axle end cap screw holes for any frit / swarf.

Mount the axle end cap and locking plate. Tighten the axle cap screws with torque wrench. The torque specified is 40 kgm. Bend the tabs of locking plate and finally rotate the bearing, and check the condition of bearing seals and adapter.

Wheel condition

Wheel conditions, which can generate high impact forces into the bearing, are indicators of possible internal damage. Built up tread and several slid flats are two such condition, which can be detrimental to the bearings. Hence brake gear is to be properly adjusted to avoid any brake binding effect enroute.

All wheel sets of wagons involved in accident must be withdrawn from service and inspected for condemnable defects.

A guide line for causes of CTRB Failure & Remedial action.

Investigation was conducted by RDSO to find out reasons of CTRB failure over Indian Railway. The finding reveals that spelling in the major course of failure. The other main reasons of failure are pitting, flaking, and Electric current damage.

The failure can be caused by internal factors (of the bearing) and external factors (operating environment).

1. Non Replacement of worn wide jaw Adaptor (WJA).

The excessive clearance between side frame and adaptors were noticed mostly in case of wide jaw adapters becomes of non-replacement of worn WJA. Excessive clearances cause adapter shifting or tilting resulting in change of loading pattern. The change of loading pattern can be a reason of initiation of spalls.

Remedial Action:-

Liner of specified thickness should be welded on bogie pedestal jaw as indicated in G- 95 and worn wide jaw Adaptor should be replaced.

2. Elastomeric pad Failure :-

Numbers of perished Elastomeric pads were noticed during inspection, which also cause in proper loading pattern on CTRB outer cup.

Remedial action: -

The perished Elastomeric pads should be replaced immediately when noticed.

3. Hitting / Rubbing of Adapter Retaining Bolt :-

Rubbing / hitting marks of retaining bolts on other outer cups are noticed causing point loading. The rubbing marks on outer cup are caused due to improper

