NBC Spherical Roller Bearing

NBC Spherical Roller Bearing
Mounting, Dismounting and Maintenance Manual

This booklet is intended as a guide to Spherical Roller Bearing Maintenance used in Indian Railway coaches, with the main consideration of proper mounting, dismounting and preventive maintenance of bearing.

We will be pleased if this guide book assists the user in enhancing bearing performance and in trouble shooting the causes of bearing failure.

CONTENTS

COMPANY PROFILE

NATIONAL ENGINEERING INDUSTRIES LTD. JAIPUR was founded in the year 1946 as a pioneer industry in the field of bearing manufacturing by the renowned industrialist, late Shri B.M.Birla, under the name of "National Bearing Company Ltd." The first bearing was manufactured in 1950 with a modest start of 30 thousand bearings in 19 sizes. The company is now producing nearly 2.2 million bearings per month in over 500 different sizes ranging from 6 mm diameter to 1300 mm diameter and has the capacity to produce bearings upto 2000 mm diameter. At NEI, the development of bearings is a never ending job. With ever increasing activities and grant of industrial licenses for other vital industries and manufacturing of Roller Bearing Axle Boxes for Railway Rolling Stock, Steel Balls, Tapered Roller Bearings, Spindle inserts etc., the name of the company was changed in 1958 to "National Engineering Industries Ltd." retaining its original trade mark NBC.

The industry is spread over 118 acres of land in jaipur and 56 acres in Gunsi (Newai). This is the only unit in the country manufacturing wide variety & range of bearings such as Ball Bearings, Steel Balls, Tapered Roller Bearings, Cylindrical Roller Bearings & Axle Boxes for Railway Rolling Stock including Spherical Roller Bearings, Cartridge Tapered Roller Bearings and Large Dia Special Bearings in separate fully equipped divisions. The development of National Engineering Industries Ltd., was pioneered with a theme "Indigenisation & Self-reliance".

NBC Bearings are widely used by Automobiles, Electric motors, Trucks and Tractors, Railway wagon, coach and locomotive manufacturers as original equipments and Steel mills, Heavy engineering plants, Bulldozers, Showels Tiliers and Thermal Power Plants all across the country.

TECHNICAL COLLABORATION

a) Hoffmann Manufacturing Co. Ltd., U.K. From 1946-1970- For Ball Bearings & Cylindrical Roller Bearings for Railway Stock.
b) SRO- FAG 1975 – For Spherical Roller Bearings for Railway Coaches.
c) Federal Mogul Corporation U.S.A. from 1963 –1984- For Tapered Roller Bearing.
d) BRENCO incorporated of U.S.A. since 1982 – For Cartridge Tapered Roller Bearings for Railway.
e) NTN Corporation of Japan Since 1985 – For Ball Bearings, Cylindrical & Spherical Roller Bearings. Since 1996-For Tapered Roller Bearings.
b) Izumi Kinzoku 1996 – For remanufacturing, retrofitting and overhauling of Grinding and Supper finishing machines for Bearing races.

BALL BEARING PLANT AT JAIPUR

Precision Ball Bearings From 6mm Bore to 75mm Bore diameter are manufactured on state of art manufacturing facilities with in- process and post process gauging in grinding and centrally Air Conditioned Assembly Lines with auto gauging and testing equipments. The latest advanced techniques for manufacturing and Quality Assurances are implemented to meet the rapid increase in demand for quality, diversity of specifications and new types of bearings. The plant is spread over a covered area of 14,694 sq. meters.

BALL BEARING PLANT AT GUNSI (NEWAI)

Established in the year 1980-81 as an expansion project of NEI Ltd. The factory is equipped with fully automated Grinding Lines with electronic in- process & post - process gauging and centrally air- conditioned Assembly Lines with auto gauging and test equipments for quality & reliability of the products.

The plant is spread over a covered area of 7,200sq. mtr.

PRECISION BALL PLANT AT JAIPUR

Precision Steel balls up to 25 mm diameter for NEI bearings are being manufactured in a separate well equipped factory. Precision quality balls are manufactured on precision Grinding & Lapping machines to acheive superfinished surface , accuracy and roundness as per ISO standards. The plant is spread over a covered area of 4,700 sq.mtr.

TAPERED ROLLER BEARING PLANT AT JAIPUR

This plant with the most modern equipment was set up in the year 1968. Presently under modernisation and expansion plan the new latest state of the art technology lines are installed.

The plant is spread over a cover area of 11,652 sq mtr.

RAILWAY BEARING PLANT AT JAIPUR

a) ROLLER BEARING & AXLE BOXES

With the production of Roller Bearings and Axle Boxes, since 1952 the company has fully met the requirements of the Indian Railways (one of the largest systems of the world) by designing and developing axle boxes and bearings for fitment to Locomotives manufactured by Diesel Locomotive Works & Chittaranjan Locomotive Works, various Wagon Builders, the ICF Broad and Meter Gauge Coaches. Over a million NBC Bearings and Boxes are in service with the Indian Railway The development of completely indigenise axle boxes and bearings for the high speed Rajdhani Locomotive and the Yogoslavia and Egyptian Railway Wagons are the highlights of the design capabilities at NEI. On date more than 100 types of axle boxes and bearings have been manufactured.

B) SPHERICAL ROLLER BEARINGS

The manufacture of Spherical Roller Bearings was started in the year 1975-76 for fitment to broad gauge and meter gauge passenger coaches with designs, technology, machines and equipment procured from the collaborators.

C) CARTRIDGE TAPERED ROLLER BEARINGS

For fitment to the new BOX-N Uprated Wagons designed by the RDSO, NEI is the only manufacturer in the country who are the first to indigenise these bearings to a high percentage under collaboration with the largest manufacturer of these bearings in the world. Production of these bearings are grease packed and require no field lubrication for a period of 7 year

The Railway Bearing Division is spread over a covered area of 4,855 sq.meters.

Large diameter bearings plant at Jaipur

Self-sufficiency in steel is the call of the day so is the importance of bearings in steel Mills Equipment NEI has the distinction of being one of the ten manufacturers of these bearings up to 2000 mm diameter.

The largest bearing produced by NEI for fitment to plate will of Rourkela Steel Plant was released by Mr. G.P. Birla in September 1985. This 4-row tapered roller bearing measures 1300 mm dia and weighs 4.39 tonnes.

The large diameter bearings are mainly produced out of case carburiding steels, heat treated on special equipment and furnaces developed by NEI. The precision grinding is done to close tolerances on CNC Twin Spindle Programmable Berthiez Machine for bearings ranging from 500 to 2000 mm diameter with electronic sizing and numerical display.

Production of these bearings started in 1975 and to date over 100 different types of special large diameter bearings have been manufactured and successfully used. considerable foreign exchange for the country.

The Large Dia Division is spread over a covered area of 2,500 sq. meters.

RESEARCH & DEVELOPMENT AT JAIPUR

A)DESIGN & DEVELOPMENT

Complete in-house facility for design & development of all types of bearings and toolings is available . The design is done on CAD. The large dia bearings and toolings have Been entirely designed and developed by NEI's R&D at its computer centre.

Complete engineering and research facility is available to solve problem of design development, manufacturing, installation and maintenance of bearings. With the signing of the technical collaboration agreement with NTN CORPORATION JAPAN & BRENCO IN CORPORATED OF USA, the capability to offer the finest engineering services in the bearing industry has enhanced.

B) MACHINE BUILDING

The NEI has the capability of Machine Building to design, develop and manufacture special purpose CNC grinding lines, HT lines, material handling equipments and other special purpose machines, which have been made for its captive use to keep pace with latest technology

A Well equipped electronic design, development laboratory with all testing facilities supports the M/c Building division.

Machine Building has the capability and supports the Manufacturing divisions by overhauling and retrofitting of the existing equipments so that these are upgraded to help produce quality and improve productivity.

R&D is spread over a covered area of 2,007 sq.metres

QS 9000/ISO 14001

NEI extensively embarked upon system improvement and implemented modern concepts of Total Quality Management and has been awarded QS 9000 certificate in addtion to –the ISO-9001 Certificate "THE MARK OF EXCELLENCE IN QUALITY MANAGEMENT SYSTEM" by the renowned Certification BVQI of the U.K. for Design, Development, Manufacture and Supply of NEI's complete range of products. NEI was awarded ISO 14001 Certificate by BVQI in the month of April '2001/for Environrnent.

SAP-ERP

In order to re-engineer and integrate the Business processes for Sales, Production, Materials and Finance, NEI has success- fully implemented SAP ERP. By use of this Package, our processes now conform to World Class best practices.

MILESTONES

1946 Company Established as National Bearing Company (NBC) under Technical Collaboration with Hoffman, U.K.

1950 Ball Bearing Production Started

1951 Railway Bearing Production

1957 Company name changed to National Engineering Industries Ltd. (Retaining NBC as Trade Mark)

1967 Tapered Roller Bearing under Technical Collaboration with Federal Mogul Corporation, U.S.A.

1971 Established Research & Development Division

1971 Established Machine Building Division

1975 Large Diameter Special Bearings

1976 Spherical Roller Bearings with Technical Know how from FAG-SRO

1981 Separate Factory for Ball Bearings at Gunsi (Newai)

1982 Cartridge Tapered Roller Bearing in Technical Collaboration with BRENCO Incorporated U.S.A.

1985 Largest Bearing with O/D 1.3 Meter & Weight 4.39 Tons produced

1985 Technical Collaboration with NTN Corporation of Japan for Ball, Cylindrical & Spherical Roller Bearings

1990 to 95 Modernization in Three Phases

1995 ISO-9001 Certificate

1996 Technical Collaboration with Izumi Kinzoku Ltd., Japan for Machine Retrofitting

1997 Technical Collaboration with NTN Corporation of Japan for Tapered Roller Bearings and Hub Bearings

1998 IV Phase-Modernisation Started

1999 Implemented 1st Phase of E.R.P. - SAP Solutions.

2000 QS-9000 & ISO-14001 Certification.

Basic Bearing Construction

Rolling stock employs a large variety of bearings. Spherical roller bearings for passenger coach applications are specially important and require extremely high levels of performance, durability and reliability. In order to achieve these high levels, NEI (NBC) performs strict inspection and quality control at every stage of design,and production, from selection of material to the processing technology used for manufacturing the bearings. First spherical roller bearing was manufactured in year 1976 and since then NEI has made continuous efforts to improve the quality of products supplied to Indian Railways.

Spherical roller bearing consist of an outer ring having a continuous spherical raceway within which it operates, two rows of barrel shaped rollers, which in turn are guided by an inner ring with two raceways separated by center rib (Refer to Fig. 1).The spherical roller bearings have self-aligning properties and therefore can automatically adjust to any deviation in the centerline of the axle.

Spherical roller bearings have a large capacity for radial loads, axial loads in either direction, and complex loads. They are suited for the applications such as railways rolling. stocks where vibrations and shock loads are encountered.

Spherical roller bearings for railways passenger coaches are manufactured and supplied for a controlled amount if radial clearance. Therefore, races and rollers are not interchangeable.

All NBC spherical roller bearing are fitted with machined brass cages. Brass is the most preferred cage material for bearing used in railways all over the world. NBC spherical roller bearings for Meter Gauge and Broad gauge passenger coaches have symmetrical roller design. Where as in case of bearing used in Broad Gauge EMU, rollers are of asymmetric design.

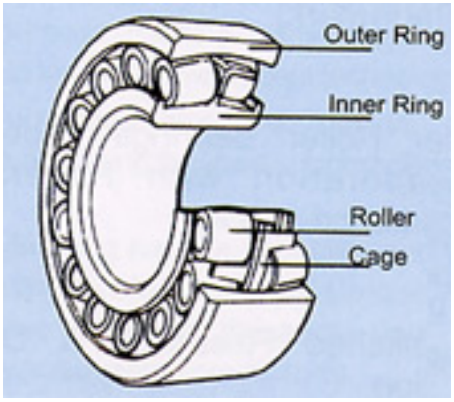


Fig. 1 Spherical Roller Bearing

NBC Spherical Roller Bearing	Application in Indian Railways	Axle Load
22320 C/C3	M.G. Passenger Coach	10.25t
22326 C/C3	B.G. Passenger Coach	16.25t
22328 BL1C3	B.G. EMU	20.0t

Table 1

Meanings of suffix/prefix

C = Type C Roller (Symmetrical)
C3 = Radial internal clearance C3
B = Type B Roller (Asymmetrical)
L1= High Strength machined brass cage

BEARING COMPONENTS

Outer ring

Outer ring for NBC spherical roller bearings are manufactured from forged and rolled rings from bearing quality steel. It is through hardened and precision ground all over. The track or roller surface of bearing outer ring is spherical in shape for self-aligning.

Inner Ring

Inner ring for NBC spherical roller bearing are also made from bearing quality steel which is forged and rolled. Inner rings are also precision machined heat-treated and precision ground. Inner ring have two rolling surface which are ground together with high accuracy.

Roller

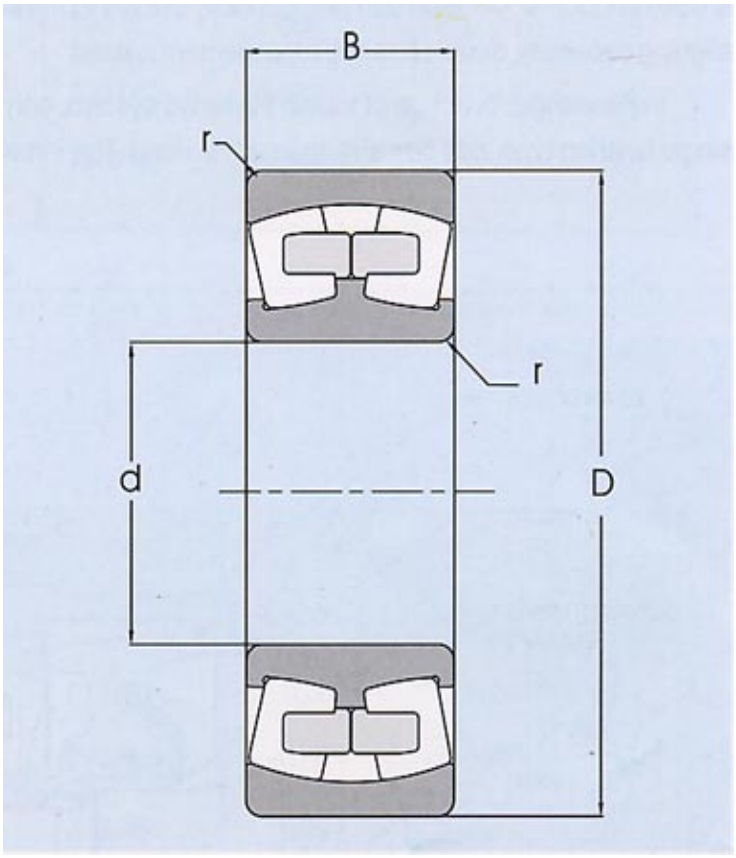
Roller are either forged or machined from bearing quality steel bars & then through hardened and ground to high degree of accuracies. In bearing 22320 and 22326, symmetrical design rollers are used and for bearing 22328, asymmetrical design rollers are used.

Cage

NBC spherical roller bearings are fitted with machined brass cages. These cages are made from brass centrifugal castings and then precision machined. Brass cages have advantage of assuring positive lubrication and cooler running of the bearing therefore are best recommended for railway applications.

Materials used by NEI are as per recommendation of our collaborator and also approved by RDSO.

Bearing Dimensions



Bearing Table

Bearing No.	Bore Diameter **d** (nominal) mm	Outside Diameter **D** (nominal) mm	Width **B** (nominal) mm	Radius **r** (nominal) mm	Basic Load Rating		Bearing Mass (Approx)
					Dynamic **Cr** K.N.	Static **Cor** K.N.	
22320 C/C3	100	215	78	4	599.1	727.2	12.4KG.
22326 C/C3	130	280	93	5	1043	1343.6	26.8KG.
22328 BL1C3	140	300	102	5	1110	1430	33.8KG.

AXLE BOX ASSEMBLY

For spherical roller bearings two types of axle box arrangements are commonly used. To take advantage of bearing's self aligning property, single bearing arrangement is used for higher load carrying capacity but without self aligning capability, double bearing arrangement is used.

In passenger coaches of Indian Railways system, only single bearing type axle box arrangement is used. The inner ring of the bearing is provided with either a cylindrical bore (Direct Mounted type) or with a tapered bore and withdrawal sleeve (Sleeve Mounted type). All new passenger coaches built by Indian Railway, use only direct mounted type spherical roller bearings. Therefore, practices related to the sleeve mounted bearings, have not been covered in this manual.

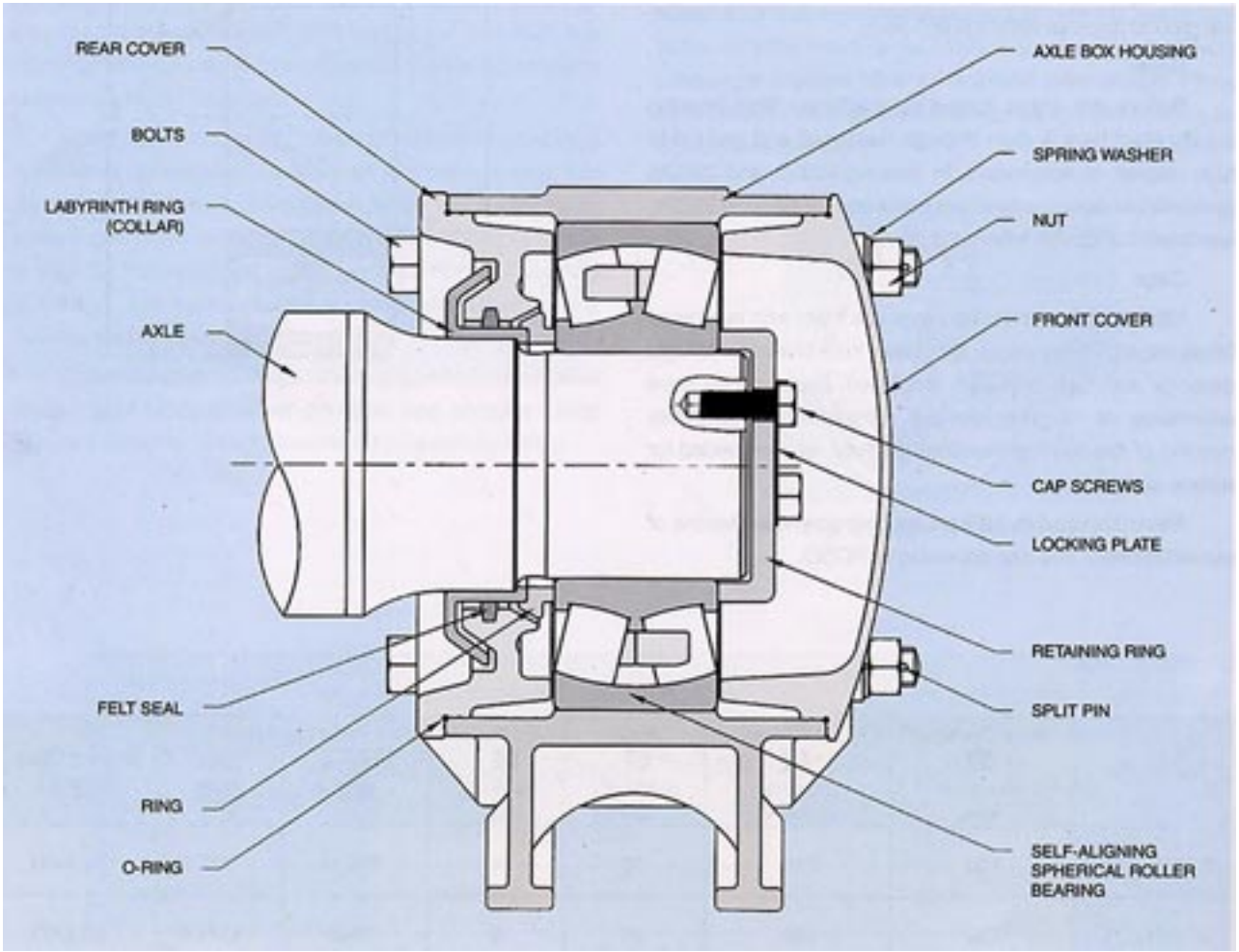


Fig. 3 Spherical Roller Bearing and Axle Box Assembly

Fitting Against Axle Journal

Bearing No.	Bearing Bore Diameter (mm)		Journal Diameter (mm)		Amount of Interfernce (mm)		Class
	Max.	Min.	Max.	Min.	Max.	Min.	
22320 C/C3	100.000	99.980	100.045	100.23	0.065	0.023	n6
22326 C/C3	130.000	129.975	130.068	130.043	0.093	0.043	p6
22328 BL1C3	140.000	139.975	140.068	140.043	0.093	0.043	p6

Table 3

Fitting Against Axle Box Housing

Bearing No.	Bearing Outside Diameter (mm)		Housing Bore Diameter (mm)		Fit With housing (mm)		Class
	Max.	Min.	Max.	Min.	Loose	Tight	
22320 C/C3	215.000	214.970	215.030	214.984	0.060	0.016	J7
22326 C/C3	280.000	279.965	280.036	279.984	0.071	0.016	J7
22328 BL1C3	300.000	299.965	300.036	299.984	0.071	0.016	J7

Table 4

General Instructions and Precautions

NBC spherical roller bearings are manufactured with high degree of precision and therefore require utmost care during storage, handling, mounting and dismounting work. Without care bearings may fail to fulfill its desired performance. Following are some of the important instructions to be followed

1. Do no drop the bearing.

2. Bearing should not be unpacked until it is ready for mounting.

3. All plastic wedges inserted between rollers to protect from any damage during transportation, must be removed prior to fitment on axle journal.

4. 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. This can lead to poor performance or failure of the bearing.

5. Mounting, dismounting, inspection and maintenance work of bearings must be done by trained/ qualified persons as per laid down procedures/specifications.

6. Use only recommended tools for mounting / dismounting and maintenance work.

7. Use only those parts, which are new of otherwise satisfactory to reach the next reconditioning interval after service.

8. 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.

9. Never mix two different brands of grease or used grease with fresh grease.

10. Lubricate both new and used cap screws prior to instllation.

11 Be extremely careful about the conditions, such as under size journal diameter, oversize housing bore, absence of cap screw clamp load etc..

12. Any wear or damage on axle box component should be cause for renewal.

13. 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.

14. 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.

15. Heating or cutting torch when used around roller bearing must never have heat directed on any portion of the roller bearing assembly.

16. Never use heating torch for removal of bearings from journal. Use only specified tools and equipments.

17. Use of abrasive cleaning material such as sand blasting, grit blasting etc. for cleaning any part of roller bearing is strictly prohibited.

18. Waste must never be used to clean roller bearing. Use only clean towels free from lint.

Storage and Handling of Bearings

NBC spherical roller bearings are coated with rust preventive oil prior to packing. Therefore, bearings must be stored in original packing. Following are some of instructions to be exercised during storage and handling of the bearing

BEARING STORAGE

- The bearing should be stored in a clean and dry place and should be protected from heat, dust, moisture, direct sunlight, vibrations etc. Even microscopically small dirt may start bearing damage and premature failure.
- Store bearing in original packing on clean and dry racks away from wall and floor.
- Do not store any chemical / solvent in the bearing storage area, which that can cause corrosion due to chemical attack.
- Use older stock first.

HANDLING AND TRANSPORTATION

NBC spherical Roller Bearings are properly packed in pallets before supply to customers. Each pallet contains 27 Bearings. During transportation following precautions are necessary.

- Do not throw or drop the packed boxes while loading & unloading in the lorry/truck or any transportation vehicles.

Fig 4 Pallet packing of NBC berings

- Use fork lift truck or crane for loading & unloading purpose.
- When using cranes, use proper slings to avoid any damage to the packing.
- As far as possible same size of the packed boxes should be stacked one over other.
- Do not transport any boxes containing oil, liquid, chemicals etc. in same transportation vehicle.
- Do not keep heavy iron articles on the pallets to avoid any damage to packing.
- Cover packed boxes with tarpaulin to protect from dust, rain, water etc.
- There should not be any transshipment. Material should be delivered at the consignee's work or godown.

STORAGE AND HANDLING OF MOUNTDED WHEEL SETS

Wheel sets with mounted bearings must be handled carefully. Use appropriate lifting tackles to avoid any damage due to hitting of wheel flange on bearing, axle box or any other component.

Bearings fitted on wheelsets , must be wrapped in a clean plastic or polythene sheet, sealed with tape on wheel side. Renew the wrapping sheet regularly.

Wheel sets fitted with bearing and axle boxes should be stored in a dry and covered space. If wheel sets are to be stored for a long time, rotate axle boxes around the journals periodically.

ASSEMBLY AREA

Installation of bearings on axle must be done in a clean and dust proof area. The assembly area must be spacious, clean and free from dust. No welding, metal cutting spray painting or compressed air cleaning should be permitted in the assembly area.

Tools, gauges & equipment being used must be clean and conveniently located. Use only specified tools. Gauges must be calibrated regularly. To accomplish this operation satisfactorily and adequately, following are required.

- Cleaning oil vessel with kerosene or light oil(two sets)
- Heating oil tank with wire mesh, mineral oil, thermometer (200° C) and heater or induction heater with temperature controller and timer
- Heavy machine oil
- Recommended grease for lubrication
- Pusher jig for labyrinth ring fitting
- Dial or digital snap gauge with master
- Cylindrical bore gauge with dial indicater for checking housing bore.
- Vernier caliper, scale, micrometer & precision surface
- plate / straight edge
- Feeler gauge
- Torque wrench (duly calibrated)

Big and small hammer, vinyl hammer, spanner, monkey

- wrench, pincher, chisels,adjustable rib joint pliers
- Clean wiping waste and oil papers
- Crane or chain block

Bearing Mounting

AXLE PREPARATION

Before mounting any part on the axle, it is very important to examine each axle journal thoroughly and to qualify for its correctness. Following procedure must be adopted for inspection and to ensure maximum reliability

1. Ensure that the axle journal is free from sharp edge, rust, burr, scratch or high spot. Clean the bearing seat area, fillet and shoulder thoroughly to remove dirt, swarf and rust if any prominence are observed, use only fine grade emery paper (180 grit or finer) to clean and polish. Use of file is strictly prohibited.

2. Check the axle journal for waviness along it's length with the help of a high precision straight edge smeared with blue. Move the surface place forward and backward in axial direction several times to obtain the impression of blue. Repeat this procedure at a plane 90° apart on the same journal. (Fig 5). If impression observed is continuous unbroken line, journal is even and suitable for use.

In case the impressions shows waviness (broken line), Check the journal diameter with a dial snap gauge at any unblued area (if found) and it must be within the specified tolerance limits.

3. Check the journal diameter on bearing seat at three different locations. Use dial or digital snap gauge for accurate measurement. Set the dial digital snap gauge correctly over master. Apply the snap gauge on the journal at bearing seat area and rotate it around by 180 in same location to obtain the maximum and minimum diameter readings.The average of maximum and minimum reading will indicate journal diameter at that location.

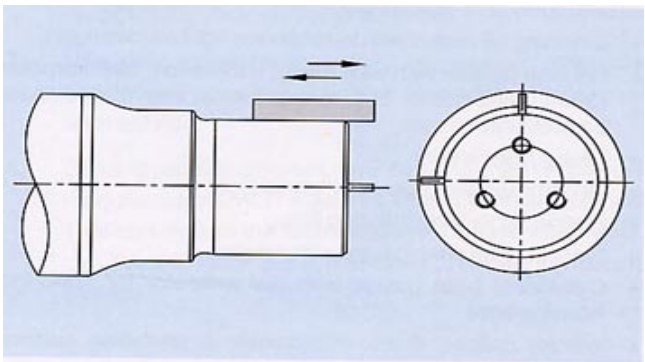


Fig 5 Use of straight edge for checking journal

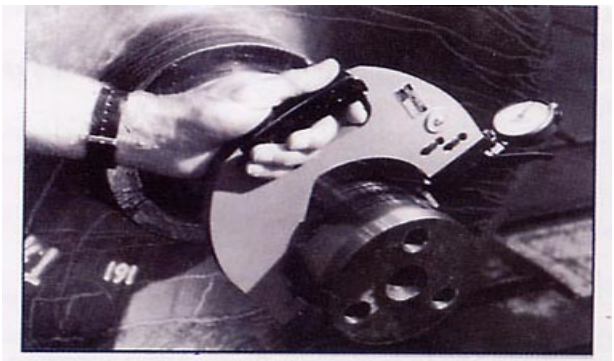


Fig 6 Use of dial snap gauge for checking journal diameter

The average journal diameter at each location must be within limits as specified in table 5. Roundness and taper must also be within limits specified limit.

4. Before mounting of the bearing, ensure that axle does not have any residual magnetism.

5. Examine condition of tapped holes in axle. Holes must be clean and free from dirt, rust, debris,burr, metal chip etc. Tap run through, if necessary. This is important to ensure maximum clamping of the bearing. The thread size of tapped holes can also be checked with suitable plug gauge. Lubricate tapped holes with oil before bearing installation.

6. The labyrinth ring has an interference fit with the axle therefore it is necessary to check shoulder diameter of each axle. The shoulder diameter must bewithin limits. Fillet area of journal should also be free from any defect.

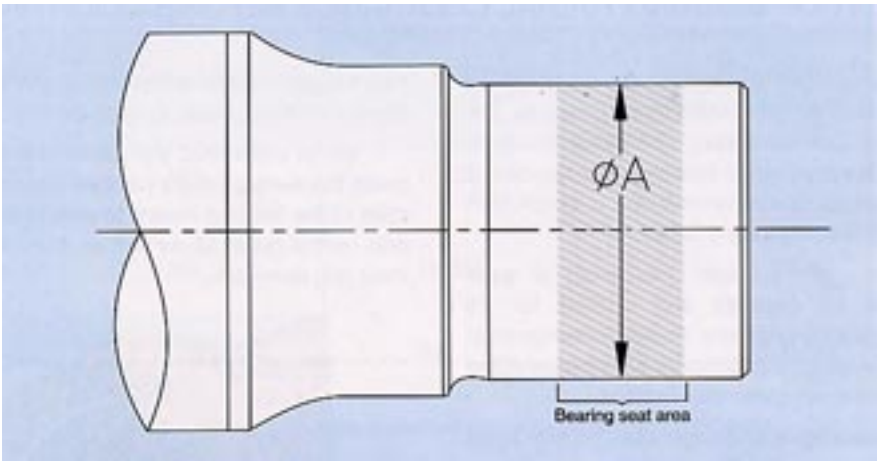


Fig 7 Axle Journal

Bearing No.	Journsl Diameter A(Max/Min) mm	Maximum permissible out of roundness mm	Maximum permissible taper mm
22320C/C3	100.045 / 100.023	0.015	0.015
22326C/C3	130.068 /130.043	0.015	0.015
22328BL1C3	140.068 /140.043	0.015	0.015

Table 5

Notes

- Master, dial snap guage and axle journal should be at same temperature.
- Be extremely careful about the conditions, such as over size or under size journal diameter. Such conditions could be potential cause for bearing failure during service.
- Be specially careful about the diameter of the axle journal where upsets (swelling) occur due to pressing of wheel disc on axle.
- All gauges and masters must be calibrated periodically
- Care must be taken when using a temperature compensating snap gauges that speed of rotation does not create sufficient heat, due to friction to effect the readings.
- If bearing is not to be mounted immediately, coat the axle journal with rust preventive oil and wrap kraft paper.
- Use of heli-coils or thread inserts in tapped holes is strictly prohibited.

MEASUREMENT OF BEARING RADIAL CLEARANCE BEFORE MOUNTING

During manufacturing of NBC spherical roller bearings, highest quality standards are maintained. Bearings are checked thoroughly before supply, therefore no prior inspection is necessary, provided bearings are handled & stored properly. However, it is recommended to check both used & new bearings, visually for any defect.

Radial clearance (or diametric clearance) of each bearing must also be checked and verified for it's correctness, before mounting on axle. Radial clearance must be within specified limits for satisfactory performance of the bearing. Following is the recommended method.

(a) place the bearing in an upright position with inner ring and outer ring faces parallel. Place both thumbs on inner ring bore and oscillate inner ring two or three times, pressing down firmly (Fig8). This action will seat the inner ring and rolling elements in a central position, and the individual roller assemblies will be positioned so that the roller at the top of the inner ring on both sides of the bearing has the maximum gap or clearing between the curved surface of the outer ring and top of the roller.

Fig 8

(b) In the above position, rollers on upper side will be hanging loose and will obviously have a tendency to slide down towards the outer flange of the bearing inner ring and thus the gap created on the top will give the incorrect reading when a feeler is passed through the bearing.

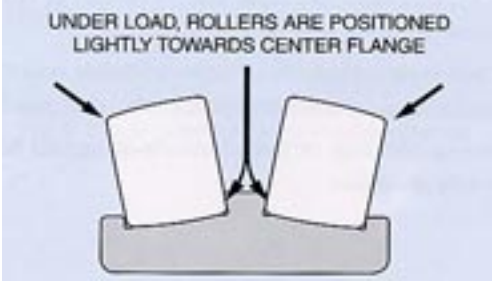


Fig 9

(c) In order that rollers are properly positioned, press the two top rollers (at apex positions) on the opposite rows of the bearing inward to ensure their being in contact with central guide rib as well as make contact with bearing inner ring raceways.

Fig 10

(d) With the rollers in correct position, insert a thin blade of feeler gauge between the rollers. Move it carefully over the top rollers between the rollers and outer ring raceways. Repeat this process using progressively thicker feeler gauge blades until one is found that will not go through. The blade thickness that preceded the "not-go" blade is a measure of radial clearance of the bearing (Fig 10).

Fig 11

(e) It will be preferred to let the feeler pass over both the roller of the two rows bearing simultaneously (Fig 11).

Radial clearance for NBC direct mounted spherical roller bearings must be as specified below

Bearing Nos.	Coach Type	Axle Load	Radial Clearance of Free Bearing (Un-mounted Condition) mm
22320C/C3	MG	10.25 t	0.100 0.135
22326C/C3	BG	16.25 t	0.145 0.190
22328BL1C3	BG EMU	20 t	0.145 0.190

Table 6 Bearing Radial Clearance in unmounted condition

INSPECTION OF AXLE BOX HOUSING

Before mounting check axle box housing thoroughly. Check visually for any mechanical damage or distortion. Housing must befree from score marks, corrosion and any wear. Use cylindrical gauge fitted with dial indicator to check housing bore diameter at bearing seat. Check the bore at several places and it must be within specified tolerances (Table 7). Housings not conforming to the above limits or otherwise found unsatisfactory must be rejected.

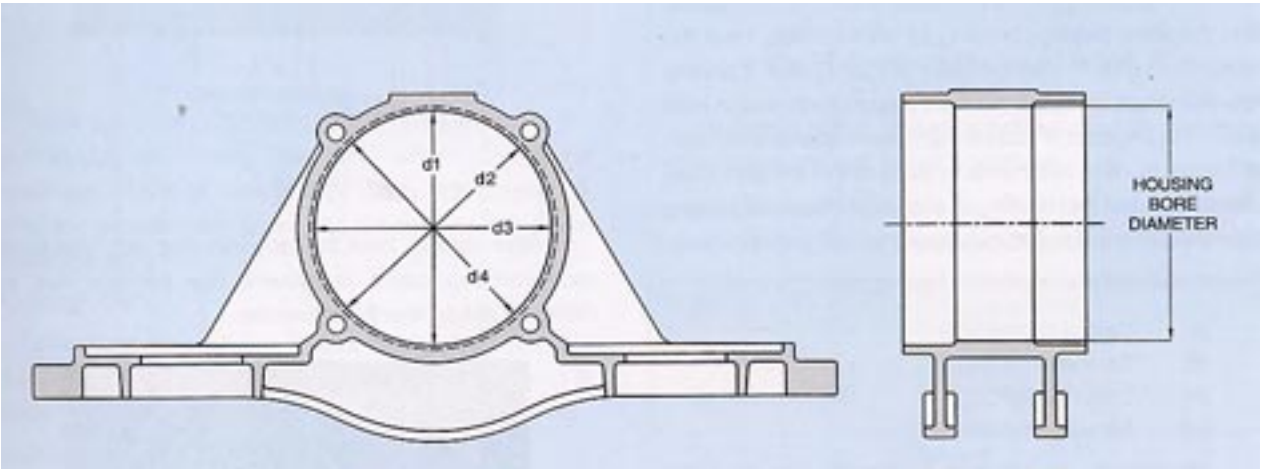


Fig 12

Bearing No.	Coach Type	Axle Load	Housing Bore Diameter (mm) Max/Min
22320C/C3	MG	10.25 t	215.030 214.984
22326C/C3	BG	16.25 t	280.036 279.984
22328BL1C3	BG EMU	20 t	300.036 299.984

Table 7

Fig 13

INSPECTION OF OTHER COMPONENTS

All components of axle box must be cleaned and checked thoroughly prior to mounting. Inspect all parts visually and dimensionally. Mating surfaces must be free from burr, sharp edge, rust and other type of defect which may prevent proper seating of mating parts. Any crack, mechanical damage wear or distortion should be cause for renewal of the component.

Check cap screw visually for any mechanical damage, distortion, wear or rust and ensure that condition of bolt head is OK. Threads must be on good condition. Use thread gauge, if necessary. Use new cap screws as far as possible. Lubricate both new and used cap before installation.

MOUNTING OF SPHERICAL ROLLER BEARING AND AXLE BOX COMPONENTS

Mounting and maintenance work must be done by qualified personnel as per laid down procedures.When all necessary preparation has been made, proceed for bearing mounting in the manner described below -

Mounting of Labyrinth Ring (Collar)

The labyrinth bring has an interference fit on the journal, and therefore requires heating for shrink fitting. Heat the labyrinth ring up to a temperature of 100° C max. If several labyrinth rings are to be mounted a good method is to heat them in an oil bath. Oil bath should have a coarse wire mesh at bottom to allow sediments to settle below the part. Care should be taken that heating oil should be clean and heating time should be around 30 minutes.

Recommended grades of oil for heating are

(i) Yantrol 150 (HPCL)
(ii) Servoline 150 (IOC)
(iii) Enklo 68 (HPCL)
(iv) Servosystem 68 (IOC)

Alternatively, an induction heater can also be used, Heating time should be between 5-7 minutes.

Clean the seating area of the axle, and push the heated labyrinth ring on the seating and hold it in position for few seconds When labyrinth ring has been cooled sufficiently to have a fairly firm fit on its seating, drive it home against the shoulder by tapping it with pushing jig (fig14), to avoid any possible gap. When tapping produces clear metallic sound, it shows that the part has seated correctly.

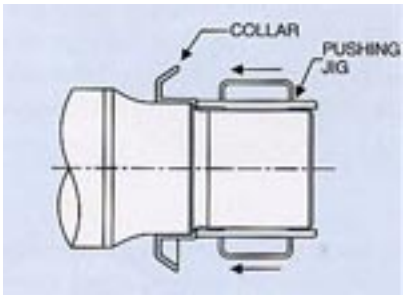


Fig 14

After cooling, coat the labyrinth ring with grease of recommended brand to prevent any damage due to moisture, dirt or other foreign matter.

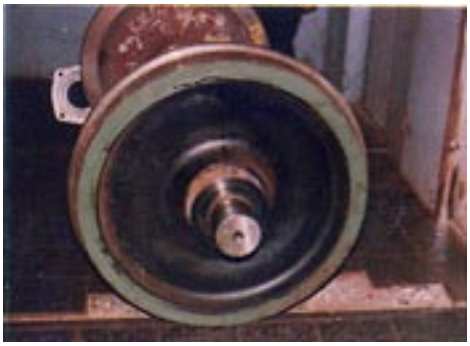


Fig 15

Mounting of Rear Cover, Felt Seal & O-Ring

Wipe and clean the rear cover and insert 4 nos. bolts. Fill "V" grooves of rear cover with grease and fit rubber O-Ring in it's position.

Now soak the felt seal in warm cylinder oil (IS:1589 type 1 Grade 3), heated to 40 C to 50 C for about 30 minutes. Smear the felt seal by hand with same grease as used in axle box and fit into the groove at rear cover. Always use new felt seal of specified quality. Used felt seals must be discarded.

Fig 16

Slide and push in the rear cover in position against the labyrinth ring along with bolts and rubber O-ring. Fill approximately 50% of sealing collar cavity with grease. Fill the space between rear cover and the neck of collar with grease and align.

Mounting of Ring

Clean and wipe the ring. Ensure that faces are parallel, flat and free from burr, rust etc. Insert the ring it is position. Fill grease in the cavity in the rear cover up to the face of the ring.

Mounting of Spherical Roller Bearing

New bearings should be taken out from original packing only just before mounting. NBC spherical roller bearings are coated with rust preventing oil prior to dispatch. There is no need to wash new bearings before installation.

All direct mounted spherical roller bearing for passenger coach have interference (tight) fit with axle journal, therefore requires heating and shrink fitting. Heating of bearings can be done either by using an oil bath or induction heater. Usually, temperature range of 100 to 120 degree centigrade give sufficient expansion for easy sliding of bearing over journal. However, while heating by either of these methods, To ensure that temperature of bearing does not exceed 120 degree centigrade.

Oil bath method

The oil bath method has advantage of gradual and uniform heating of bearings. When serveral bearings are to be mounted, all can be put in oil bath simultaneously to save time.

The oil bath should be equipped with suitable arrangement for electrical heating, temperature controlling system (Auto cut-off) and thermometer. A wirenet should be provided at bottom, under which impurity can settle.

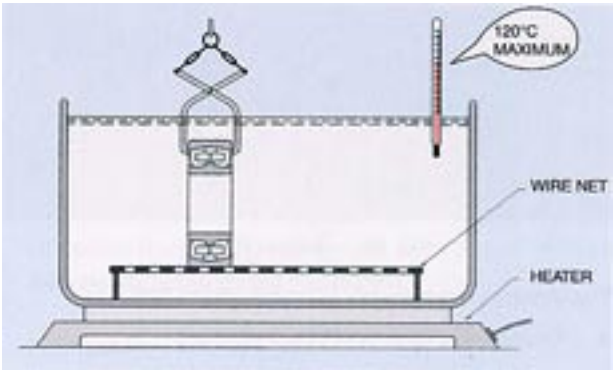


Fig 17 Heating of Bearing in Oil Bath

Oil used in oil bath should be fortified with anti-oxidation, anti corrosion and anti- foaming additives.

Recommended oils for this purpose are :

Oil	Supplier
Enklo 68	HPCL
Servosystem 68	IOC

Table 8

Bearing should be suspended in heated oil by suitable hanger so that it can easily lifted out. Heat the bearing for approximately 30 minutes to attain the temperature of 100°C to 120°C

Induction Heating System

Induction heating is quick, safe, energy saving and environment friendly process. In this system, bearing is short circuited to perform as a secondary winding whereas core winding is at primary side. Bearing is placed around a yoke. Due to principal of induction current, bearing is heated due to its electrical resistance and attains desired temperature.

Fig 18 Induction Heater

The induction heater should be equipped with :

- Temperature and cycle time controllers
- Auto demagnetizer
- Temperature and cycle time indicator
- Audio alarm to indicate completion of cycle

Heating time required in induction heating system largely depends upon the weight of the bearings. It is recommended to set the machine in such a way that it 5 to7 minutes to attained the temperature of 120C maximum of bearing. Overheating (beyond 120 C) or rapid heating may result in dimensional instability or change in material properties due change in microstructure, which may initiate cracks in bearing races in due course.

Heated bearing should be handled with the help of hook, tong or asbestos gloves and mounted on the Journal. Push the heating bearing on the axle. During mounting, installer must be careful to keep the bearing bore aligned with axle to avoid the scoring marks. Bearing position must be corrected by giving light taps with plastic hammer. Keep the bearing pressed by hand toward rear cover side for few minutes, till it has acquired sufficient grip on its seat.

The stamp face of bearing should be kept outwards., so that stamping can be seen during inspection.

Paint the exposed portion of the journal with synthetic enamel to IS:520

Checking Bearing Radial Clearance after Mounting

Due to interference fit between inner ring bore and journal diameter, the inner ring of the bearing expands after mounting. The clearance between the roller and outer ring track is reduced due to enlargement for inner ring track diameter. Therefore, to ensure satisfactory performance, it is necessary to check radial clearance of each bearing after mounting on axle. Checking should only be done when the bearing has completely cooled down prior to fitment of axle box housing.

Fig 19 Checking Brg. radial clearance in mounted condition

With the bearing in mounted in position, only the clearance of front row can be checked as the labyrinth ring at the back of the bearing prevents the approach of the fingers to position the back row roller against the inner ring flange. However it will be sufficient to measure the clearance of the front row of the bearing. Here again, the rollers have to be kept pressed by thumb firmly against the center flange and the procedure as described earlier has to be repeated. Be careful that feeler gauge is not buckled or rolled between rollers and raceways. Measurement data must be recorded.

Radial clearance of NBC spherical roller bearings in mounted condition must be as specified below.

Bearing Nos.	Readial Clearance After Mounting of New Bearing on Axle (mm)
22320C/C3	0.050 0.090
22326 C/C3	0.085 0.160
22328 BL1C3	0.085 0.160

Table 9

Mounting of Retaining Ring, Locking Plate and Cap Screws

Wipe clean and fit the retaining ring. Apply locking plate and cap screws. Always use new locking plate.

In order to ensure proper retention of the bearing and other parts mounted on the journal, it is of utmost importance that cap screws must be tightened with specified a mount of torque using torque wrench. Recommended torque values are as specified in the table below. Apply minimum 2 passes on each cap screw for proper tightening.

Bolt Size	Torque Value
M 16	12 kg - M
M 20	23 kg - M

Table 10

Fig 20

Bend all tabs of locking plate against the sides of the bolt using adjustable rib joint plier. Punch date, month and year and workshop code on the retaining ring.

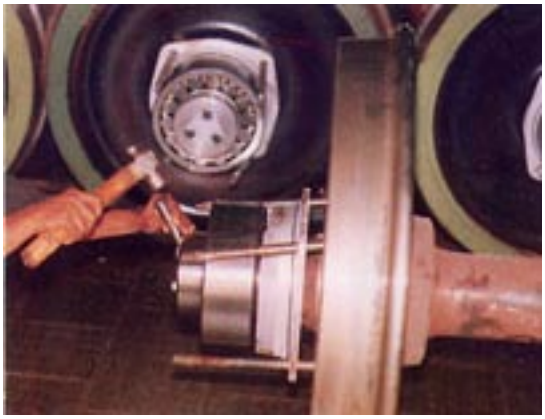


Fig 21

Notes

- Torque wrench must be accurate within±4%
- Cap screws must be of specified grade (Property class P8.8 or higher)
- Lubricate cap screws before mounting.
- Tapped holes must be clean and free from rust, burr chip or metal chip etc.
- Use of helicoils or threaded inserts in tapped holes is strictly prohibited.
- Always use new locking plates. Do not re-use.

Mounting of Axle Box Housing

Rotate and align the rear cover. Fill "V" grooves on face of the axle box housing with grease. Slide and carefully push the axle box housing over the bearing.

Lubrication

Grease plays very important role in safe and satisfactory performance of bearing. It is recommended that only specified quantity of grease of approved brand should be filled in the axle box. Over greasing or under greasing can lead to poor performance or failure.

Form a truncated cone of grease in front of the bearing.

After the has been mounted and lubricated, wipe thoroughly the bearing grease which has been leaked out through the back cover. This is necessary in order to enable early detection of grease leakage during service.

Recommended Brands of Grease

Brand Name Of Grease	Supplier
Servogem3	Indian Oil Corporations
Lithon 3	Hindustan Petroleum Corporations Limited

Table 11

Quantity of grease used for initial charging of axle boxes with NBC make bearings is as follows.

Bearing Nos.	Coach (Axle Load)	Quantity of Grease for Initial Charging per Axle Box Assembly
22320C/C3	MG (10.25 t)	1.65 Kg per Axle Box Assembly
223226 C/C3	BG (16.25 t)	1.75 Kg per Axle Box Assembly
22328 BL1C3	EMU (20 t)	2.250 Kg per Axle Box Assembly

Table 12

Fig 22

Guidelines for storage of Grease

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

Mounting of front cover

Fix the front cover. Place locking washers on bolts and tight nuts. Be careful for even tightening of all 4 nuts. Finally secure with split pin and seal the axle box.

Finally check the axle assembly for free rotation.

Fig 23

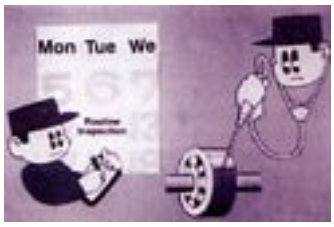
Some of common damages caused due to incorrect mounting are as below -

Damage during mounting	Possible Cause
Score marks on rings	Bearing inner ring not properly aligned with axle during mounting. Forcible entry on axle box during mounting
Surface cracks	Rapid or excessive heating of bearing (temperature more than 120 ^{O}C)
Discolorated surface	Excessive heating temperature (more than 120^{O}C)
Axial cramping of bearing	Faces of bearing and associated part not flush with one other.
Radial cramping of bearing	Oversize or undersize journal diameter
Excessive fretting of outer race	Improper fit between housing and outer ring
Grease oozing from rear cover	Used or poor quality of felt seal

Table 13

Maintenance

MAINTENANCE ON LINE



Visual

Inspect axle box for any indication of hot box. Any wheel set with axle box running hot, must immediately be removed from service and sent for replacement.

Visually inspect the axle box housing, front cover, rear cover and other part for any damage. Check for any missing or loose fastener. Watch for any other reason that could be detrimental to the performance of roller bearing and could lead to unsafe condition in service.

Roller bearings and axle boxes damaged due to fire, over heating, water submersion or welding , must be removed from service and sent for detailed internal examination.

Running Temperature

Check operating temperature of axle box by touching the housing with bare hand immediately after the train is halted. If it is found impossible to hold the hand for few second on the box housing, it means that the bearing is running hot. Cross check the temperature with temperature indicating crayons suitable for 90 degrees centigrade. Any alternative method can also be utilized to find out temperature. If temperature of axle box housing is more than 90 degree centigrade, wheel set must be removed from service and sent for internal examination.

Abnormal sound

When a bearing rotates, try to listen for any unusual / abnormal noise or grinding. Remove the wheel set / roller bearing axle box in case it produces abnormal sound and should be sent internal part examination.

Grease leakage

During service, a small amount of grease leakage could be normal and comes from initial purging of grease and relieving of internal pressures. However, if fresh grease continues to leak, wheel set must be removed from service.

Axle boxes involved in derailment / accidents / Flood

All wheel sets of the coaches, involved in accident, flood or submerged in water, must be removed from service. Bearing and parts must be identified separately by marking “ACCIDENT INVOLVED” and should not be reused. It recommended that inspection of roller bearing is made together with parts including wheel sets, bogie etc.

Standstill Coaches

Care should be taken that no coach is fitted with spherical roller bearings is kept stationary for a long time. In case coaches are to be grounded for long time, they should be kept shunted up and down and regular intervals.

PERIOD OF INSPECTION OF BEARINGS

All roller bearings must be cleaned, inspected and re-lubricated with fresh grease at every POH (Periodic Over Hauling) or 2 year or after 2,00,000 Kilometers of service which ever is earliest.

Dismount roller bearings at every alternative inspection in workshops for renewal of felt ring. If any defect on roller bearing or it’s components is suspected, bearing should be dismounted and sent for inspection.

INSPECTION OF ROLLER BEARING AXLE BOX ASSEMBLY WITHOUT DISMOUNTING OF BEARING

Thoroughly clean the exterior of the axle box with MTO/ petrol. Remove the front cover and send for cleaning and inspection.

Remove axle box housing using suitable mechanical screw type extractor and send for inspection. Care should be taken that the end of screw does not directly rest on the axle center. Use of plate is recommended to protect the axle center from any damage.

Examine the condition of grease for it’s consistency, color, contamination and for any ingress of foreign material, water, dirt, metal etc. if grease is found to be in good condition, bearing does not require dismounting from journal.

Unbend tabs of locking plate. Remove locking plate, axle cap screws and the clamping plate / retaining ring and send for cleaning and inspection. Discard all used locking plates.

Remove the grease and thoroughly wash the bearing and components first with MTO and then with petrol using syringe / brush and cotton cloth. Waste must never be used to clean roller bearing. Use of clean lint free towel is recommended. Rotate the bearing slowly and intermittently while cleaning so that grease is removed completely from bearing. Care should be taken while cleaning that cloth or hair from brush does not clog / stick to any surface of roller bearing.

Clean the rear cover and it's "V" grooves thoroughly.

Swivel the bearing outer ring and thoroughly examine cage, rollers and bearing outer ring for any damage. If necessary, few rollers can also be pulled out to the examine condition of inner ring raceway however rollers must be replaced at same positions after inspection. Roller bearings are to be rejected, in case any of the following defect is noticed.

- Pitted or flaked rollers.
- Spalled or flaked raceway.
- Cracked inner ring, outer ring or roller.
- Cracked, deformed or badly worn out cage.
- Scored or damaged outside surface of outer ring.
- Smearing of raceways and roller.
- Rust/ corrosion or excessive fretting damage of rings.
- Brinelling or false brinelling
- Heat discoloration.
- Any other type of damage which could be detrimental to the performance of roller bearing.
- Excessive or low radial clearance (use same method as described)
- Maximum permissible value of radial clearance for NBC spherical roller bearings in mounted position must be within the limits as specified in table 14.

Bearing Nos.	Condemning Limits of Radial Clearance (mm) (in Mounted Condition)
22320C/C3	0.225 max
22326 C/C3	0.295 max
22328 BL1C3	0.295 max

Table 14 Condemning limit of Redial clearance

Any bearing if found having radial clearance more than above specified values must be replaced.

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 it's original position slowly. Jerkey 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 as mentioned in.

Reapply retaining ring, locking plate and cap screws. Tighten cap screws with torque wrench to torque value as specified in table.

Punch date, month and year and workshop code on the retaining ring.

Pack fresh grease between rollers and the space between rear cover and roller bearing. Form a shape of truncated cone of grease in front of bearing. Fill "V" grooves or rear cover with fresh grease.

Thoroughly clean the axle box housing and front cover which have already been inspected. Fill fresh grease in "V" grooves on the front cover face. Carefully push the axle box housing on the bearing. Fully tighten front cover in position by applying minimum two passes of tightening torque to ensure uniform tightening. Use split pin to prevent any loss of clamp force due to rotation of nuts. Month, year and workshop code may be stenciled on the front cover and seal the axle box.

Check free rotation of the axle box assembly by hand.

DISMOUNTING OF BEARING FROM AXLE

Dismounting is reverse of bearing mounting. Unbent all tabs of locking plate and unscrew and remove cap screws and retaining ring.

As the bearing is shrink fitted on the axle, hydraulic technique is most convenient for dismounting of bearing from axle. Special purpose hydraulic bearing extractor or a mobile work station can also be used for removing the bearing . This technique employs forcing of high pressure oil between the bearing bore and it's seating, which create thin oil film between them. The bearing is pulled out from axle by cranking the specially designed puller.

Attach the adapter to the axle end face with screws. Fix the special hydraulic nut, and locate if on the face of the bearing. Place the holding drum over the bearing and hydraulic nut. Crank the jack over tie bar to pull out the bearing. Start pumping, to inject high pressure oil between mating surfaces of bearing and axle journal and crank out the bearing.

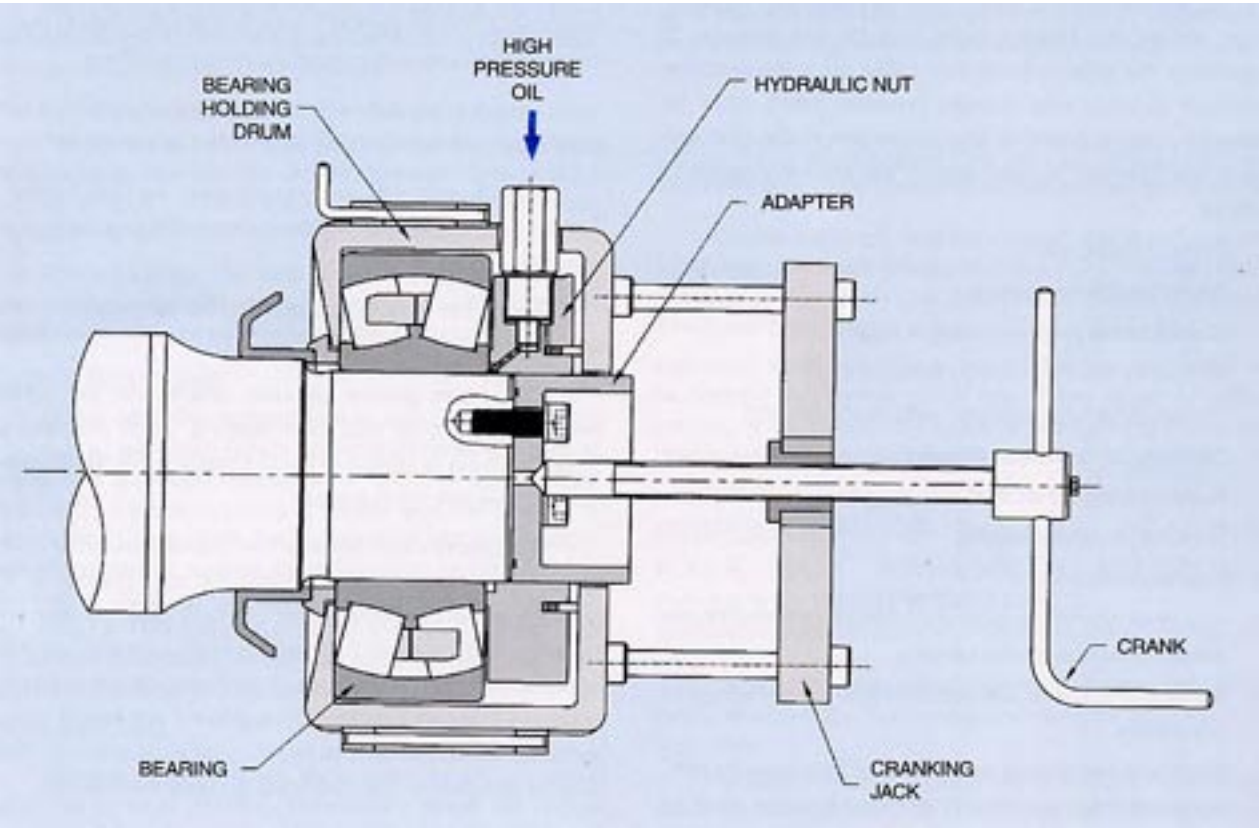


Fig 24

INSPECTION OF BEARING AND AXLE BOX COMPONENT

Inspection of dismounted bearing

Clean the bearing thoroughly in clean kerosene and petrol /white spirit. Wipe the bearing dry and examine under concentrated light. Use magnifying glass to see defects.

Check radial clearance of dismounted bearings and it must be within specified limits . Various common defects found in bearing are described in separate section.

Axle box housing

Whenever an axle box housing is removed from service, it should be cleaned thoroughly and inspected. Check the axle box housing visually for any mechanical damage or distortion. Housing must be free from score marks, corrosion and any wear. Check bore diameter of housing using gauge fitted with dial indicator and it must be within specified tolerances. Width should also be checked. Dimensions must be within limits.

Rear cover and Front cover

Covers are made from aluminium die castings. Clean thoroughly first with kerosene /MTO and then with petrol. Check parts for any crack, mechanical damage and wear. Cheack the height of shoulders using suitable gauges. If any non-conformity is found then end cover must be replaced.

Clamping plate and ring

Check retaining ring and ring visually and dimensionally. Mating surfaces must be free from burr, sharp edge, rust or any other type of defect that will prevent proper seating with mating part.

Labyrinth Ring

The labyrinth should not be dismounted unless it is damaged or lost interference with axle. In case it is dismounted then it should not be re-used.

Felt seal

Whenever a rear cover is dismounted felt ring must be replaced by new. Also, at every alternate attention of roller bearing axle box, felt ring must be replaced by new felt ring.

Felt ring must be soaked in warm cylinder oil to IS:1589 Type 1 Grade 3 heated to 40 to 50^{0} C for 30 minutes and smeared with grease before applying into rear cover.

Cap screws

Check cap screw visually for any mechanical damage, distortion,wear or rust and ensure that condition of bolt head is OK. Threads must be on good condition. Use thread gauge, if necessary.

Axle journal

Axle journal must be cleaned with kerosene oil and examined for all dimensions and accuracies. Axle should also be subjected to ultrasonic testing and dye penetration test for any interior crack.

Other checks required before remounting are described in earlier sections of this manual.

Reliability Recommendations

1 Mounting, dismounting, inspection and maintenance work must be done by qualified personnels and procedures / specifications must be followed.

2. Bearing parts of different roller bearings or different make must never be mixed or interchanged.

3. Never mix two different brands of grease or used grease with fresh grease.

4. Coaches fitted with roller bearings should not remain stationary for a long time. In case coaches are to be grounded for long time, then they should be kept shunted up and down at regular intervals.

5. Avoid interchanging of wheels, from one coach to another, so that all roller bearings of one coach are attended invariably at same time within prescribed intervals.

6. Make frequent field inspection of axle boxes.

7. At the time of weld repair of coaches, earthing cable should be attached at such a place that electrical current does not pass through the roller bearing .

8. Always use new locking plates.

9. It is recommended to use new cap screws to ensure maximum clamping of bearing. In case used cap screws, inspect for any mechanical damage or rust.

10. Lubricate both new and used cap screws prior to installation.

11 Only RDSO approved brands of greases must be used.

12. Be extremely careful about the conditions, such as over size inner ring bore, under size journal diameter, absence of cap screw clamp load etc.

13. All axle box housing becomes worn out in excess of the acceptable limits or damaged otherwise, must be replaced by new housing.

14. Any wear or damage on axle box component should be cause for renewal.

15. Inspect for any loose component.

16. Plating, metal spray, welding or any other method of ebuilding bearing parts is prohibited.

17. Heating or cutting torch when used for repair of the coach around axle box assembly, must never have heat directed on any portion on the axle box assembly. Care should be taken that cutting fragments are not directed towards axle box assembly.

Why Bearings Fail

In general, if rolling bearings are used correctly they will survive to their predicted fatigue life. However, they often fail prematurely due to avoidable mistakes. Failure of the rolling bearing can occur for a variety of reasons. Accurate determination of the cause of a bearing failure is must to make suitable recommendations for eliminating the cause.

The major factors that singly or in combination may lead to premature failure during service include incorrect mounting, excessive loading, inadequate & insufficient lubrication, impact loading, vibrations, contamination, entry of harmful liquids.

It is difficult to determine the root cause of some of the premature failures. If all the conditions at the time of failure, and prior to the time of failure are known, including the application, operating conditions and environment, then by studying the nature of failure and its probable causes, the possibility of similar future failures can be reduced.

Two or more failure pattern can occur simultaneously and can thus be in competition with one another to reduce the bearing life. Also a pattern of failure that is active for one period in the life of a bearing can lead to or can even be followed by another failure mechanism, which then cause premature failure. Thus in some instances, a single failure pattern will be visible and in other indications of several failure pattern will be evident, making exact determination of root cause difficult. So when more than one bearing failure pattern has been occurred, proper analysis depends on careful examination of failed components. In contrast to fatigue life, this premature failure could be caused by :

(1) IN CORRECT FIT
(2) IMPROPER MOUNTING
(3) IMPROPER HANDLING
(4) POOR LUBRICATION
(5) CONTAMINATION
(6) EXCESSIVE HEATING
(7) EXCESSIVE LOAD

Effect of improper practices on Performance of Spherical Roller Bearing axle boxes

Sr.No.	Type of Defect	Efect on Performance	Recommended corrective Action
1	Felt seal perished	Grease starts oozing	Renew felt seal dicard used felt seal. Do not reuse 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. Do not reuse.
3	"V" grooves of rear cover front cover and axle box ' face not filled with grease	Ingress of dirt of water inside the axle box	Clean out the old grease and apply fresh grease in grooves.
4	Improper lubrication (Excessive or indequate grease)	Excessive temperature resulting in condition such as hot box, seizure or complete failure	Fill only specified amount of grease Use only approved brands of grease. Do not use contaminated grease.
5	Bearing radial clearance not within specification	Excessive wear of rolling elements Temperature rise, bearing seizure	Follow maintenance instructions and maintain clearances as specified.

cont.

Sr. no.	Type of defect	Effect on Performance	Recommended Corrective Action
6	Journal diameter not correct and surface finish not as specified	Undersize axle can cause poor performance due to slippage of bearing inner Oversize axle will result in less radial clearance after amounting and can cause seizure or failure Inner ring will not have proper grip die to poor surface finish	Do not use axles having undersize or oversize diameter at bearing seats Journal surface finish must be as per specifications
7	Excessive or inadequate lateral clearance between axle box covers and bearing	Excessive clearance can cause damage to bearings or covers inadequate clearance may result in gap between axle box housing and front cover through which water may enter, ultimately leading to bearing failure	Maintenance correct lateral clearance as per RDSO/ICF specifications
8	Cap screws not tightened to specified torque	Loosening of bearing and components on axle, which can lead to unsafe condition and bearing failure	Always use torque wrench for tightening Apply torque as recommended Lubricate cap screw before installations Never re-use locking plate

NBC

Classification of Bearing damages and it's Corrective measures

Bearing Failure classified and illustrated in Photos in this section. Use this section as a Guide for trouble shooting.

● Rust and corrosion

Condition	Causes	Corrective
 Surface becomes partially or fully rusted Sometimes rusted at spacing equal to distances between rolling element	• Improper storage • Improper packaging • Insufficient rust preventative • Invasion of moisture,acid etc. • Handling with bare hands	• Take measure to prevent rusting while in storage • Improve sealing performance • Improve method of assembly and handling

● Fretting

Condition	Causes	Corrective
 Fretting Surfaces wear producing red coloured particles that form hollows.	• Insufficient interference • Insufficient lubrication • Fluctuating load • Vibration during transport or when not operating Conditions	• Improve fit • Check surface roughness of journal and housing • Check consistency of grease • Do not use worn out or damaged housings

• Flaking

Condition	Causes	Corrective
 Flakes form on the surfaces of the raceway and roller elements. When the flakes fall off, the surface becomes rough and uneven.	• Excessive loads,fatigue life, 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	• 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

• Seizure

Condition	Causes	Corrective
 Bearing heats up, becomes discolored and eventually seizes up.	• Insufficient clearance (including clearances made smallar by local deformation) • Insufficient Grease • Bad quality of grease • Excessive load • Roller Skewing • Softening due to abnormal temperature rise	• Check grease type and quantity • Check internal clearance regularly • Improve method of assembly and handling

• Cracking

Condition	Causes	Corrective
 Split and cracks in bearing rings and rollers	• Rapid heating during mounting • Excessive shock load • Improper handling, use of steel hammer and impact of large foreign particles • Surface deformation due to improper lubrication • Excessive interference • Large flaking • Overheating by creeping	• Avoid rapid heating of bearing during mounting • Reconsider operating condition • Improve method of assembly and handling • Prevention of creep • Do not use excessively wornout or deformed housing

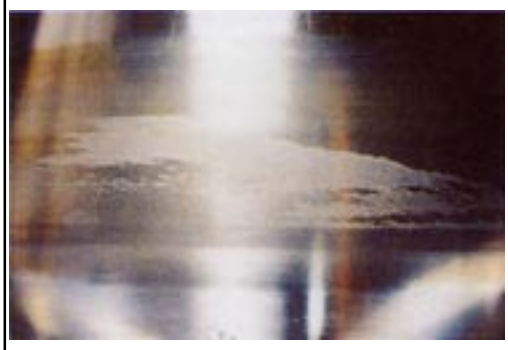
• Cage damage

Condition	Causes	Corrective
 Breaking or wear of cage.	• Excessive moment load • High-speed rotation or excessive fluctuation of speed • Trapping of foreign objects • Excessive vibration • Improper mounting (misalignment)	• Investigate rigidity of system • Reconsider operating conditions • Improve method of assembly and handlling

• Rolling Path Skewing

Condition	Causes	Corrective
 Roller contact path in raceway surface strays or skews	• Deformation or tilt of bearing due to insufficient precision of journal or housing • Improper mounting • Insufficient rigidity of journal and housing	• Re-check internal clearance • Re-check precision of journal and housing • Investigate rigidity of system

• Smearing and scuffing

Condition	Causes	Corrective
 Surface becomes rough with small deposits. "Scuffing" generally refers to roughness of the bearing ring ribs and roller end faces.	• Improrer lubrication • Invasion of foreign matter • Roller skew due to excessive misalignment • Excessive surface roughness • Excessive sliding of rolling elements	• Check the quality / quantity of grease • Improve sealing performance • Check operating conditions • Improve method of assembly and handling

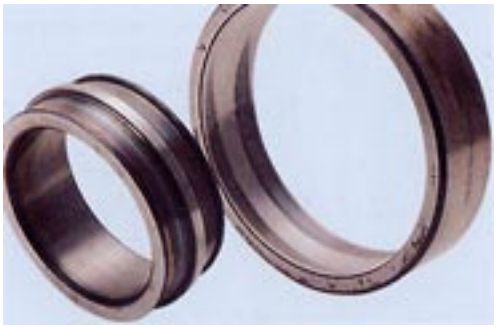
• Indentations

Condition	Causes	Corrective
 Hollows in raceway surface produced by solid foreign objects trapped or impacts (False) brinelling)	• Ingress of solid foreign objects • Trapping of flaked particles • Impacts due to careless handling	• Improve sealing performance • Improvement in handling and mounting practices • Check involved bearing for flaking if dents produced by metal practices • Always use clean grease

• Electrolytic corrosion

Condition	Causes	Corrective
 Pits from on raceway and develop into ripples. Further development leads to corrugated surface	• Electric current flowing through raceway	• Create a bypass for current • Insulate the bearing

• Discoloration

Condition	Causes	Corrective
 Change of raceways / roller colour	• Temper color by overheating • Deposition of deteriorated grease on surface • Improper lubrication	• Use good quality of grease • Replacement of grease after recommended interval

• Peeling

Condition	Causes	Corrective
 Peeling is a cluster of very small spalls. Peeling can also include very small cracks which develop in to spalls.	• Ingress of foreign matter • Improper lubrication	• Control of surface roughness and dust • Improve sealing performance • Use only clean grease

KEEP BEARINGS CLEAN ..... DIRT MEANS DAMAGE
THINGS TO REMEMBER

DONT'S	DO'S
Don't work in dirty surroundings.	Work with clean tools in clean surroundings.
Don't expose bearings to moisture or dirt at any time.	Keep bearings wrapped in polythene sheet when not in use.
Don't remove oil from new bearings.	Install new bearings as removed from packet without washing.
Don't use incorrect brand or amount of grease and also don't keep grease in open condition.	Apply clean grease and keep grease container closed when not in use. Use volumetric container for filling correct amount of grease.
Don't use cotton waste and dirty clothes to wipe bearings.	Use clean, lint free towles if bearings are wiped
Don't use dirty and rusty tools.	Tools should be clean in good condtion and dust free.
Don't store bearings vertically, in uncleaned and in humid environment.	Store bearing horizontally and room should be dry and clean.
Don't compromise with the journal and axle box housing dimensions.	Journal and axle box housing dimensions should be maintained within the specified limits.
Don't use faulty measuring instrument and gauges.	Calibration of measuring instruments and gauges should be done timely.
Don't unnecessarily unwrap the bearing from its original packing.	Bearing should be unwrap at the time of mounting only.
Don't use components like felt seal, locking plate.	Felt seal & locking plate should invariably be repalced at the time of POH
Don't raise the bearing temperature more than 120 degree centigrade and also rapid heating should be avioded.	it should be ensured that heating temperature is within 120 degree C and the minimum heating time should be between 5-7 minutes
Don't recycle the used grease. Never Mix up the greases of different grades or even different makes of same grade.	RDSO approved brand of grease should be used and grease must be changed at the time of POH
Don't use compressed air for cleaning the bearings.	Use clean solvents and flushing oil.

NOTES