- Recommended limits of radial clearance for bearings in dismounted condition are as follows :

Table 10.5

New bearings	0.145 to 0.190 mm
Maximum permissible clearance for bearing in service	
SKF make	0.33 mm
FAG/NORMA makes	0.270 mm
NBC makes	0.295mm

1006b Mounting of spherical roller bearings and axle box components

- Before mounting the bearings, it is checked that journal and shoulder diameters are within permissible limits as per respective drawing.
- End holes are checked for elongation with the help of thread plug gauge. If found beyond permissible limits, these should be attended by using stainless steel helical thread inserts of the same size to use the same size of bolt.
- Mounting and maintenance work must be done by qualified personnel as per laid down procedures. When all necessary preparation have beentaken, proceed for bearing mounting in the manner described below -

Mounting of Labyrinth Ring (Collar) (see figure 10.13)

The labyrinth ring has an interference fit on the journal, and therefore requires heating for shrink fitting. Heat the labyrinth ring upto a temperature of **100^0 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 course 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.

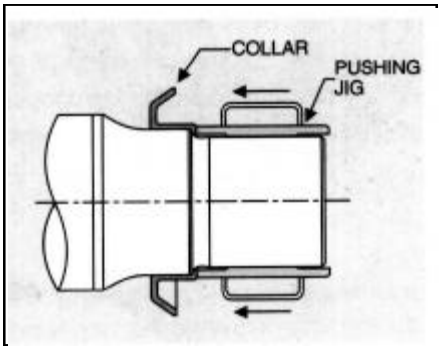

Figure 10.13

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, to avoid any possible gap. When tapping produces clear metallic sound, it shows that the part has seated correctly.

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

Mounting of Rear cover, Felt Seal & O-Ring (Collar)

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^o C to 50^o 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.

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. The spherical roller bearings are coated with rust preventive 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 fit with axle journal**,** therefore it 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 120^0 C** give sufficient expansion for easy sliding of bearing over journal. However, while heating by either of these methods, do ensure that temperature of bearing does not exceed **120^o C**.

Oil bath method (see figure 10.14)

The oil bath methods has advantage of gradual and unifirm heating of bearings. When several bearings are to be mounted, all can be put in oil bath simutaneously to save time.

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

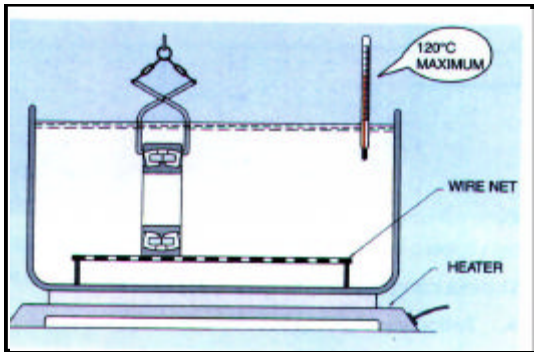

Figure 10.14

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

Recommended oils for this purpose are:

Oil	Supplier
Enklo 68	HPCL
Servosystem 68	IOC

Bearing shuold be suspended in heated oil by suitable hanger so that it caneasily be lifted out. Heat the bearing for approximately **30 minutes** to attain the temperature of **100^0 C to 120 ^{o} C**.

Induction heating is a quick, safe, energy saving and environment friendly process. In this system, bearing is short circuited to perform as a secondary winding whereas the 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 the desired temperature.

The Induction heater **(see figure 10.15)** should be equipped with:

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

Figure 10.15

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 takes 5 to 7 minutes to attain the temperature of **120^0 C** maximum of bearing. Overheating (**beyond 120^0 C**) or rapid heating may result in dimensional instability or change in material properties due to change in microstructure, which may initiate cracks in bearings 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 heated bearing on the axle. During mounting, installer must be careful to

keep the bearing bore aligned with the axle to avoid the scoring marks. Bearing position must be corrected by giving light taps with plastic hammer. Keep the bearing pressed by hand towards rear cover side for new minutes, till it has acquired sufficient grip on its seat.

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

The rest of the procedure is same as for Roller bearing maintenance in mounted condition (para 1005e).

1007 **PRECAUTIONS FOR MAINTENANCE OF ROLLER BEARING**

During maintenance of Roller Bearing Axle Boxes, following precautions should be observed

- Only specified tools should be used for attention of roller bearings.
- Tools should be kept as clean as the bearing themselves
- Tools and bearings should be kept on dry surfaces
- Bearings should be handled carefully avoiding bruises to the bearings
- Bearings should not be dropped
- Only cotton cloth free from fluff should be used for cleaning of bearings.
- Cotton waste should never be used while cleaning and handling of bearings.

Spare bearings should be stored in a dry place. They should be opened only at the time of mounting so as to protect them from dust and moisture.

1008 **ROLLER BEARING DEFECTS AND REMEDIAL MEASURES**

Table 10.6

Defect	**Effect on Bearing**	**Remedial Measures**
1. Felt ring perished	1. Grease may ooze out from rear cover 2. Dust and water may enter the axle box	Renew the felt ring every time the bearing is dismounted in workshop. Felt ring should be as per schedule of requirement laid down by RDSO.
2. Rubber 'O' rings of cover perished	Dust and water may enter the axle box	Renew the rubber 'O' ring every time the bearing is attended in workshop. The material of the ring should conform to the specifications laid down by RDSO.
3. 'V' grooves on rear cover , front cover and axle box faces not filled with grease.	Dust and water may enter the axle box.	At the time of maintenance clean out the old grease and apply fresh grease.
4. Improper and/or excessive / inadequate grease.	Excessive temperature , seizing or complete failure of Roller Bearing.	1. Use only approved brands of grease. 2. Use specified quantity of grease.
5. Bearing clearance not within prescribed limits.	Excessive wear of rollers and races leading to bearing failure.	Check bearing clearance during attention to roller bearing axle boxes in workshops and scrap bearings with clearances outside prescribed limits.

Defect	Effect on Bearing	Remedial Measures
6. Fitment of substandard/ improper size end locking bolts/ screws.	Bolt may fail in service cause damage to front cover and bearings	Check the end locking bolts /screws and if worn/sub standard, replace
7. Improper locking of end locking screws.	Screw may get loose in service and cause damage to front cover and bearings	Follow correct procedure.
8. End locking screws not tightened properly.	End locking arrangement may fail.	Tighten screws with torque wrench at specified torque value.
9. Journal finish and Diameter not as prescribed in the drawing.	Bearing may become loose/inner ring cracks causing serious damage to the bearing leading to bearing failure.	Journal should be to the size , tolerance and finish shown on the relevant drawings.
10. Excessive or inadequate lateral clearance between axle box covers and bearings.	1. Excessive clearance may damage roller bearings or covers. 2. Inadequate clearance may result in gap between axle box housing and bearings.	Maintain correct lateral clearance as indicated in the drawings.

1009 **EXAMINATION AND REPAIR PRACTICE IN CARRIAGE MAINTENANCE DEPOT**

Depot maintenance staff should ensure the following things in respect of proper functioning and safety of Rolling gear:

1009a **Wheel and axle**

i) Wheel profile should be checked with Tyre defect gauge to ensure the profile dimensions are within the permissible limits. Coaches with wheels having thickness and profile worn below condemning limit should not be allowed to continue in service and the coach should be marked sick for change of wheels in the sick lines.

ii) Limits for flat tyres

The limits for permissible maximum flat surfaces on tread for BG ICF coaches is **50 mm** (reference Rly. Bd.'s Letter no. 83/M (N)/960/1/Vol I dated 15/18.3.99)

iii) Guidelines for wheel inspection in open line depots (Ref RDSO CMI-K003)

In addition to normal checks exercised on wheel condition during primary/secondary maintenance of coaches, a detailed inspection of wheels should be done when the coaches are received in sickline for attention for either schedules or out of course attention. The wheels sets shall be inspected for the following conditions and action taken as indicated for each condition:

1. **Shattered Rim –** a wheel with a fracture on the tread or flange must be withdrawn from service. This does not include wheels with localized pitting or flaking without presence of any rejectable condition.

2. **Spread Rim-** If the rim widens out for a short distance on the front face, an internal defect may be present. Spreading of the rim is usually accompanied by a flattening of the tread, which may or may not have cracks or shelling on the tread. Such wheels must be withdrawn from service.

This condition should not be confused with a uniform curling over of the outer edge of the rim around the entire wheel, which is called rim flow. Rim flow is not a defect.

3. **Shelled Tread -** Shelling can be identified by pieces of metal breaking out of the tread surface in several places more or less continuously around the rim. Shelling takes place when small pieces of metal break out between the fine thermal checks. These are generally associated with small skid marks or "chain sliding.". Such wheels should be withdrawn from service and sent to workshops for reprofiling.

4. **Thermal Cracks –** Thermal cracks appear on a wheel tread due to intense heating of the wheel arising out of severe brake binding. Such cracks occur on the tread and generally progress across the tread in a transverse & radial direction. Whenever such a crack becomes visible on the outer face of the rim or tread crack has reached the outer edge (non-gauge face) of the rim, the wheel should be withdrawn from service. If a crack becomes visible on the outer flange face, the wheel should be withdrawn from service. Such wheels should be sent to workshop for examination and subsequent rejection.

Wheels involved in service brake binding should be examined carefully during the maintenance to rule out the possibility of rejectable thermal cracks. Such wheels may be identified by presence of flats (even within acceptable limits) and severe discoloration or blue black heating marks on the tread.

5. **Heat checks** – Thermal cracks are deeper and need to be distinguished from fine superficial cracks visible on the tread on or adjacent to the braking surface. These are called heat checks, which are usually denser than the thermal cracks. Heat checks are caused on the tread due to heating and cooling cycles undergone by the wheel during normal braking. Such wheels do not need to be withdrawn but should be carefully distinguished from the rejectable thermal cracks.

Note: All wheel sets withdrawn from service for any of the conditions mentioned above must be sent to the associated workshops for detailed investigations and further disposal.

iv) The date and station code of the maintenance depot where the wheels are changed should be stenciled on the end panels. An entry should also be made in the maintenance card of the coach.

v) The defective wheel should be sent to workshop for repairs after entering in the maintenance card details of the work order and date of dispatch to workshop.
vi) No repairs, except wheel profiling of wheel sets is permitted to be done in the maintenance depot.

1009b **Roller Bearing Axle Boxes**

A coach should invariably be detached from service for the following defects

i) Hot axle box
ii) Damaged axle box
iii) Damaged front or rear cover
iv) Seized roller bearing
v) Coach involved in accident, derailment, fire, flood etc.

Care should be taken not to keep a coach fitted with roller bearing stationary for a long time. Coaches grounded for a long time should be shunted up and down at regular intervals.

Coaches fitted with roller bearing should be checked to ensure that :-

i) No wash basin drain hole / discharge pipe is directly above the axle box
ii) The front and rear covers of the axle boxes are not damaged, cracked or loose
iii) Clearance between axle box and wheel is such that the axle box does not bind against the wheel.
iv) Brake gear is properly adjusted to avoid possibility of brake binding

Annexure - 10.1

ULTRASONIC TESTING OF AXLES

All incoming wheel sets are tested for flaw detection test of axles in the shop before sending them to service. Following techniques are adopted to test the axles.

i. Far end scanning
ii. Trace delay
iii. Near end low angle scanning
iv. High angle scanning

i. Far end scanning technique:

This technique is used to detect fatigue crack, manufacturing defects, blow holes etc. In this technique, normal probe of 1 MHz to 2.5 MHz having 10 mm. and 20 mm. in size are generally used. By this technique, full length of the axle specimen is covered for test.

ii Trace delay technique:

In this technique, the specimen is tested part by part with normal probe.

iii Near and low angle scanning:

In this technique, the area which cannot be tested by far end scanning i.e. raised portion or shadow zone (wheel seat) is tested by low angle. In this technique, angular probe of 2.5 MHz having angle of 10", 12.5", 15", & 17.5" are generally used.

iv High angle scanning:

This technique is a confirmation test of low angle scanning. This test is carried out on the body of the specimen. In this technique, high angular probe of 37,60, & 70 are generally used.

All tested axles are stamped on the inner face of the hub with following details:

UT.O 1.201. MM/YY/XXXX

Legend:

UT: Ultrasonic test
01: Code for Railway (This code changes from RLY to RLY)
02: Code for type of work shop
(this code also changes for type of work shop)
01: Code for place of workshop
(this code also changes for place of workshop)
MM/YY: Month and year of testing
XXXX :Initial of person testing the axle.

A. GENERAL REQUIREMENT FOR ULTRASONIC TESTING OF AXLES

(as per RDSOs Compendium on Ultra Sonic Testing)

The general requirement prior to ultrasonic testing of axle are surface preparation, selection of couplant, care and checking of probe.

1. SURFACE PREPARATION

Surface preparation of the areas where the probe is to be applied is necessary for maximum transmission of ultrasonic energy in the test specimen. It is essential that the surface should be clear of loose paint, dirt and loose scale. Ultrasonic testing of an axle is carried out from axle ends journals and from body.

1.1 Axle end

Ultrasonic testing of an axle by far-end and near end low angle scanning is carried out from the axle ends.

The end faces are usually stamped with cast Nos. and other identification numbers and this process displaces the surface material into raised areas thereby resulting in an inadequate acoustic coupling. The raised areas must, therefore, be removing by filling, or by using energy cloth, while cleaning of the end faces, care must be taken not to allow filling debris, dirt and grit to enter the axle box or roller bearings. The end faces should be cleaned by cotton cloth soaked in kerosene oil. All the precautions as mentioned in maintenance schedule for disassembly of the axle box covers and end face fitment should be strictly observed.

1.2 Axle Journals

When using the high angle scanning techniques on axle journals the surface must be made free of dirt, girt using cotton cloth soaked in kerosene oil.

1.3 Axle Body

When using the high angle scanning techniques on axle body, loose paint, rust and scale must be removed and the surface must be free from dirt and grit. Some axle body surfaces may have machining marks and these may cause some loss of ultrasonic energy but there should not be any difficulty from this source unless the machining is rough. In such cases or in case where axle body is in forged condition it is advisable to use adequate quantity of grease as coupling media.

Where it has been necessary to remove protective paint, the surface should be repainted as per relevant specimen or as recommended in maintenance schedule before the axle is put into service.

2. CHOICE OF COUPLANT

The choice of couplant depends on the condition of probing surface. The following couplant may be used for ultrasonic testing of axles.

1.	Lubricant grease as recommended for particular type of bearings in order to avoid any chances of contamination.	For far-end scanning near end low angle scanning for all types of axles fitted with roller bearing.
2.	Lubricant grease grade 2 or 3 to IS 507-1967.	For high angle scanning of all types of axles.

3. CARE AND CHECKING OF PROBES

3.1 Inspection and checking of probes

The inspection and checking of the probes must be carried out periodically.

3.2 Low angle wedges

All the low angle perspex wedges should be regularly checked at 6 months interval for the correctness of angle of refraction in steel. Any charges in the angle of perspex wedges will seriously impair the test results.

3.3 High angle wedges

All high angle perspex wedges should be regularly checked at 6 months interval. The operator must ensure that the angle of refraction in steel not been affected by wear. Any change in the angle of wedges will seriously impair the test results.

4. CARE AND CLEANING OF PROBES

4.1 Probes should be handled very carefully. The probes should be carefully packed in cotton. U-foam etc, in order to avoid any damage during transportation from one place to another.

In any circumstances no attempt should be made to open the probes by the operator as the crystal used inside the probe is very brittle. If any probe shows loss of sensitivity, it should be sent for repair to maintenance cell or to the suppliers.

4.2 The probes and probe cable should be cleaned daily after completion of the work and characteristics of probe should be checked at regular interval. The probes should never dismantled in any way for cleaning but it should be thoroughly wiped over with clean cloth. At no time the probes should be immersed in the liquid paraffin.

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