सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

MAINTENANCE HANDBOOK FOR SUSPENSION BEARING TAO-659

CAMTECH/98/E/SB/7.0

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Centre for Advanced Maintenance Technology

उच्च अनुरक्षण प्रौद्योगिकी केन्द्र
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Excellence in Maintenance

FOREWORD

The maintenance instructions for various electric locomotive equipments are contained in various documents like ACTM, loco manuals, OEM manuals, RDSO's instructions etc. However so far equipment wise compiled authentic instructions have not been available for individual equipment in easy language with the target group as Artisan in mind.

I am glad that CAMTECH have brought out a maintenance hand-book for "Suspension Bearings of traction motor type TAO-659" . This hand-book will be of immense help to the supervisory and artisan staff of electric loco sheds and work-shops. I complement CAMTECH for bringing out this hand-book containing useful information.

I hope that CAMTECH will prepare similar handbook on other equipments of electric locomotives in future.

RDSO, Lucknow *Ramesh Chandra*
July 13, 1998. *Executive Director(Elect).*

PREFACE

On Indian Railways, deficiency of literature at field level leads to lack of knowledge and improper maintenance. CAMTECH has taken up the job of documentation and upgradation of information in maintenance practices. This maintenance handbook is prepared with the objective of improving the maintenance and to increase availability and reliability of Suspension Bearings on TAO-659 Traction Motors. It is however clarified here that this handbook does not supersede any existing provisions laid down in the "Maintenance Manual of Electric Locomotive" and "A.C. Traction Manual"

I acknowledge the sincere and dedicated efforts put in by Shri R.D.Bhargav, Sr.CTA of this centre who has collected and highlighted authentic and useful information and also acknowledge Shri Dhiraj Shrivastava, C.O. who has composed this hand book. I am also sincerely thankful to all field personnel who helped us in preparing this handbook.

Technological upgradation and learning is a continuous process. Hence if you find the need for any addition/modification in this handbook or have any new idea, please feel free to write to us. We shall be highly appreciating your contribution.

CAMTECH, Gwalior *Khushi Ram*
Date : 1st July'98 *Jt. Director*

ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows :

CAMTECH/98/E/SB/7.0/C.S. # XX date----------

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr. No. of C.Slip	Date of issue	Page no. and Item no. modified	Remarks

CHAPTER 1

INTRODUCTION

Axle suspension bearings are a vital part of the Traction System. They are mainly oil film sleeved bearings and are used to support axle hung & nose suspended traction motors TAO-659. Thus the suspension bearing carries the motor weight by allowing the free movement to the wheels. It is also subject to severe impact due to track irregularities, lateral thrust and sometimes, due to wheel skid. Bearings consist of a forged steel shell with an over layer of white metal. Bearing made of the right materials, having proper bond strength, dimensional accuracy and surface finish, properly installed and lubricated give trouble free service for years. Desirable life in Indian conditions should be three years. The suspension bearing of TAO-659 of electric locomotives fails due to various reasons, about 60% of the suspension bearings failures are only due to starvation of lubricating oil, which is to be filled up periodically during trip inspection.

The consequences of a suspension bearing failure on line are that the section is blocked for the traffic and if suspension bearing seizes, then the locomotive can not be moved until the axle of the locomotive is lifted. In about 5% cases of suspension bearing failure, axle is to

be replaced. The cost of changing axle, suspension bearing, rehabilitation of axle cap & traction motor head and manpower cost comes to approximately 2.5 lakhs.

1.1 RAW MATERIAL

Forged steel shell must conform to class-I of IS-1570, with a carbon content of maximum 0.18 %, sulphur & phosphorous impurities should be within 0.05 % Max. Forging should be properly heat treated. Stress relieving after rough machining is a must.

White metal conforming to IS-25 Grade 84 i.e. of following composition must be Virgin and Lead free :-

Copper	:	5 to 6%
Antimony	:	9 to 11%
Tin	:	86 to 84%
Lead	:	0.30% Max.
Other Impurities	:	0.15% Max.

Small percentage of lead is very injurious due to formation of Pb-Sn fact is eutectic, hence is to be restricted to 0.10% as against 0.30%. This now gaining greater importance in high speed and high load applications.

CHAPTER 2

MOUNTING AND DISMOUNTING OF SUSPENSION BEARING

2.1 CHECKS BEFORE DISMOUNTING

The following checks should be carried out before dismounting the suspension bearing in case of failure :

- Oil level in both sumps i.e. upper & lower.
- Cardium compound level in gear case.
- Gap between gear case & axle.
- Condition of axle cap gasket.
- Clearance between sandwich mounting block & bogie lugs.
- Condition of oil pump gasket & its fixing bolts.
- Condition of sandwich mounting block.
- Sealing condition of traction motor mounting bolts.
- Oil leakage from pump gasket, axle cap gasket, traction motor bolts, oil pump mounting bolts & mating surface of suspension bearing at CE, magnetic drain plug, wick pad covers, earthing shunt/dummy etc.

- Collect oil samples from upper as well as lower sumps.
- Now to drain the oil from bottom sump, unscrew the magnetic drain plug & check its condition.
- Collect drain oil in an empty drum, sweep out the metal pieces, dirt, foreign bodies etc., if any, from lower sump.
- Test the oil pump on test bench & measure the discharge.
- Condition of gear in two halve.
- Condition of oil pump.

2.1.1 **Procedure**

Whenever failed suspension bearing is required to change it, a lot of exercise is to be carried out. Loco body is lifted, then particular traction motor is dismounted from that axle. It is to be always keep in mind that during dismounting of traction motor it self, axle cap, suspension bearing (both half) at both end of traction motor, Gear case, oil pump, nose pad etc., should not be damaged. After dismounting of Gear case drain out the oil from axle cap. Unscrew all 08 nos. of bolts M 36x200/150 on axle cap. Now for dismounting, the axle cap from magnet frame, never hit directly the magnet frame or axle cap by hammer or badi. Don't try to pull the traction motor by overhead crane. The correct procedure is given on next page :

- As per the design of traction motor TAO-659 there are 4 nos. of threaded holes/eyes on axle cap.
- Hold the axle cap by overhead crane.
- Screw, bolt of size M 36x200 in these holes/eyes.
- Tighten diagonally till axle cap alongwith suspension bearing comes out from magnet frame.
- Unscrew these bolts.
- Keep down the axle cap on shop floor with the help of crane.
- Now remove the sandwich mounting block from bogie & traction motor lugs.
- Lift the traction motor alongwith suspension bearing, cautiously, so that any half of suspension bearing at pinion end & commutator end do not fell down.

Keep all bolt, washers, suspension bearing in a dismounting tray systematically.

2.2 CHECKS AFTER DISMOUNTING

The following checks should be carried out after dismounting the suspension bearing :

2.2.1 Oil Pump

- Oil pump (Priorily dismounted from axle cap) for any sort of damage on driving gear, its area of contact with gear in two halves. Play between gear shaft & brass block, condition of bucket (gear guard), condition of jally for blockage etc.
- Tightness of block on its foundation, which should not loose.
- Free movement - simply driving by hand.
- Condition of pump gasket.

2.2.2 Suspension Bearing

- Indicate/ note the worn out portion (condition of suspension bearing, both half at axle cap & magnet frame).
- Condition of felt.
- Condition of face dowel alongwith its housing.
- Condition of axle cap gasket.
- Condition of passage provided for returning of oil & Cardium compound.

- Now remove, both halve of suspension bearing from magnet frame & axle cap.
- Condition of back dowel & its housing on axle cap as well as half of suspension bearing on axle cap.
- Pitting mark etc. on both halve of suspension bearing at axle cap as well as magnet frame.

2.2.3 **Axle Cap**

- Condition of axle cap gasket & surface.
- Any sort of deformity/damage at the end of the axle cap.
- Condition of wick pad cover and its gasket.
- Oil level in the upper sump at both ends i.e. pinion end & Commutator end.
- Magnetic drain plug.
- Contamination of impurities, foreign bodies, metal pieces in oil at lower sump.
- Condition of wick pads assembly.

2.2.4 **Magnet Frame**

- Any deformity/damage appears at bearing housing & bore.
- Condition of threads for bolts M 36.

2.2.5 **Wheel Set**

- Condition of gear in two halve.
- Condition of stoppers i.e. height & sharpness of stopper collar.
- Distance between stoppers (collar to collar distance).
- Size of axle journal diameter (At three places) both at pinion end & commutator end.
- K-value of main gear & traction motor pinion.

2.2.6 **Bogie Lug & Traction Motor Lug**

- Distance between bogie lugs.
- Distance between traction motor lugs.
- Condition of sandwich mounting block.

2.2.7 **Gear Case**

- Condition of gear case.
- Condition of gear case felt (woollen).
- Condition of gear case rubber felt (sealing).
- Condition of Cardium compound.

2.3 RE-ASSEMBLY OF SUSPENSION BEARING

At the time of assembly of bearing, following checks should be made to ensure correct fitment.

2.3.1. Traction Motor

- **Measurement of housing bore :** The magnet frame as per CLW drawing no. OTWD.092.014 Alt. 13 is 250 +0.046+0 mm and outer diameter of bearing shell is 250 +0.130 +0.084 mm. The diameter of housing bore is to be measured every time whenever, the bearing is to be assembled. This will detect any increase in housing diameter. The measurement is to be carried out at least at two locations along the length of the bearing portion and two readings right angle to each other at each location. This will detect any skew in the bore. Increase in housing diameter results in rattling of the suspension bearing and may cause failure.

- Dowel pins must be provided in place with hole on bearing, slightly in pocket piece and slightly in other half. Bearing should be interference fit of 0 to 0.8 thou. Before fitment on axle, matching of edges of suspension bearing should be checked on shop floor.

- Traction motor alongwith axle cap, suspension bearing housing bore must be symmetric throughout the length at pinion end & Commutator end.

- The condition of threads in stator for mounting the axle cap alongwith suspension bearing on axle.

2.3.2 **Wheel set**

- **Distance between stoppers on wheel set :** Stopper to stopper distance to be measured on each & every wheel set, weather it is changed in the locomotive and/or traction motor is replaced. This distance should be 915+0.5-0.0 mm as standard. Record to be maintained.

- Measure collar to collar distance, which should be 915 + 0.5 mm, adjust if required.

- Condition of gear in two halve teethes, check for looseness, change if required.

- Measure axle journal diameter at least at three places on both pinion end & commutator end.

- Ovality should not be varied more than permissible.

- Always try to use wheel set having standard diameter i.e. 210, 208.50, 207, 205.50 mm at both pinion end & commutator end having tolerance of + 0 mm.
  - 0.046 mm

- Measure K - value of main gear.

2.3.3 **Axle cap**

- Complete axle cap (inside & outside) must be well cleaned.
- Precisely check smoothness of the surface where axle cap gasket is to be provided. There should not be any ovality.
- Specially check both the ends (collar portion) for any sort of deformity.
- Dowel must be fitted rigidly in the housing to avoid relative movement of suspension bearing.
- Check inside threads for slackness to the oil pump.

2.3.4 **Suspension bearing**

- **Diametrical and lateral clearance of suspension bearing :** The manufacturing diametrical clearance between axle and journal bearing is from 0.260 mm to 0.352 mm. The maximum clearance tolerated should not exceed 0.7 mm.
- **Ovality of axle journal :** Measure the axle journal diameter at least at three places and find out the ovality which will be helpful to maintain the diametrical clearance on matting surfaces at both pinion end and commutator end. Practically it is experienced that this clearance may be maintained from 0.3 mm to 0.7 mm.

- The lateral clearance measurement can be done based on method given in RDSO drawing No. SKDL 2924. The limits specified are 2 mm (New) and 7 mm in (Service).
- Maximum permissible wear of white metal on thrust faces is 2.5 mm on each side. To allow this measurement a inspection hole M 20 on commutator end side of axle cap is provided. This is as per Alt. 12 of CLW drawing No. OTWD. 092.014/Alt.13.
- Always try to use standard size of bearing according to standard journal size so that boring or matching of bearing could be avoided.
- Chamfering should be proper.
- Handle gently so that any sort of damage on shell as well as on white metal lining could be avoided.
- Clean the collar portion properly in case of old bearing.
- Provide extra hard wooden felt, properly baked in grease and secured by riveting at collar portion in the cleared grooves.

2.3.5 **Oil pump**

- Always provide tested/ ready oil pump.
- Holes on pump foundation should not be elongated.
- Paste pump gasket by an adhesive to avoid leakage of oil.

- Handle gently to avoid damage on brass block, bucket, gear teeth etc.
- No excessive play on main gear is permitted.

2.3.6 **Miscellaneous**

2.3.6.1 **Wick Pad**

- Properly socked in suspension bearing oil for 12 to 24 Hrs.
- Check spring condition & action.

2.3.6.2 **Bolts**

- Clean all 08 No. bolts for mounting traction motor & oil pump of size M36 & M12 respectively, check their threads also.
- Never use flat spring washers.

2.3.6.3 **Gasket**

- Gaskets should not be torn out.
- Paste the gasket by RTV/ Dunlop rubber adhesive & allow to open atmosphere for drying out.

2.3.6.4 **Felt on Gear case**

- Clean the gear case and check for cracks, weld if required.
- Provide felts into the grooves for sealing the gear case to avoid leakage/mixing of Cardium compound with suspension bearing oil.
- Rubber felt must be tighten by metallic adjustable strip (belt).
- Check threads in the gear case top, bottom & side bosses as well as bolts of size M 30x60 and square head bolt M 30x80, replace with new, if required.

2.3.6.5 **Nose Pad**

- **Gap between bogie lugs:** Clearance between traction motor lugs and bogie lugs should be checked and made standard as 304+0 -0.75 mm between bogie lugs and 304.8+0.75 -0 mm between traction motor lugs.
- Always check dimensions of nose pad before fitment.
- Condition of horizontal & vertical pins alongwith split pins.

2.4 SUSPENSION BEARING MOUNTING PROCEDURE

Press ready half set of suspension bearing (Pinion end & Commutator end) in stator housing & axle cap, slight striking with nylon/plastic/wooden hammer. Don't strike with steel hammer directly on suspension bearing. Now lift the traction motor by crane cautiously, so that suspension bearing could not be fallen down from stator housing. Lower gradually upon the axle till, traction motor rests on the axle & bogie lugs. Now lift axle cap alongwith suspension bearing, lower gradually on axle and match with stator, hold in the same condition. Screw all 08 Nos. Traction motor mounting bolts alongwith spring washer to the axle cap & stator. Tighten these bolts diagonally 1-2 threads at a time with a torque wrench of 50 M-Kg. Remove the cilling of overhead crane & finally check tightness of all the bolts once again, seal them by sealing wire. Insert nose pad in between traction motor & bogie lugs . Fit the rubber felt sealing by means of adjustable metallic belt. Mount bottom half of gear case first by securing bolts of size M 30x60 mm & M 30x80 mm to the bottom & side bosses, then mount upper half of gear case by tightening their flanges by providing two nos. bolts, M 20x80 mm with castle nut & split pin at both extended flanges. Fill up the Cardium compound up to the mark in gear case. Finally provide oil pump on axle cap ensuring that teeth of driving gears do not damage with teeth on gear in two halve.

Now fill up approximate 20.2 litres of suspension bearing oil T- 77 or Servo Prime 76 of IOC, into the lower sump on axle cap. Lift the wheel set alongwith traction motor from rail/ shop floor & fix on the test bench. Conduct run test with wheel set at least for one hour. Check oil leakage from various joints, performance of oil pump. Measure the temperature rise of suspension bearing with the help of thermometer, which should not be more than 20°C above ambient temperature. Check oil level in top & bottom sumps. In case if there is any abnormality noticed during the test, it should be rectified before putting in service.

CHAPTER 3

INSPECTION SCHEDULE OF SUSPENSION BEARING

Part to be inspected	Section	Work to be carried out	IA	IB	IC	AOH
Traction motor axle Suspen-sion bearing	M1	Check oil level & top up if necessary.	*	*	*	*
		Check up oil leakage from joints.	*	*	*	*
		Replace oil when found dirty during IC & AOH.			*	*
		Oil samples to be tested for presence of moisture & dirt.		*	*	*
		Inspect axle & bearing surface.				*
		Check traction motor axle cap bolts for tightness.		*	*	*
		Check the diametrical & lateral clearance & record.				*
Felt wick	M1	Remove complete wick assembly & clean wicks by soaking them in specified lubricants.			*	*

Part to be inspected	**Section**	**Work to be carried out**	**IA**	**IB**	**IC**	**AOH**
		After soaking , remove the foreign material from lubricating surface with soft bristle brush; do not use wire bristle.			*	*
		Test wick by applying clean oil to lubricating surface. If oil is quickly absorbed condition of wick is good. Discard wick, if lubricating surface is burnt damaged or worn.			*	*
		Replace wick, when worn to 6 mm			*	*
Oil pump	M1	Remove oil pump assembly and test for its proper function.			*	*
		Dismantle, overhaul the pump.			*	*
		Inspect gear teeth for wear and damage.			*	*

3.1 MONTHLY SCHEDULE

- Check the level and condition of oil, its colour in axle cap, and cardium compound in gear case. Use dipsticks. Replace if contaminated with dirt, dust or inter mixed.

- Remove and check the condition of lubricating pads for blackening, burning, glazing metallic chips, traces of cardium compound etc. Clean pads and replace, if worn out/distorted, damaged.

- Check the condition of oil pump and gear. Check the tightening of split gear. Tighten if slack and lock the screws. Ensure and adjust engagement of split gear with oil pump, correct it if required.

- Ensure tightness of axle cap bolts, gear case bolts on traction motor and lock them.

3.2 BI-MONTHLY SCHEDULE

Ensure all monthly checks and the following additional points.

- Check the availability and tightness of gear case and axle cap bolts.

- Test lubricating oil in laboratory for chemical analysis and contamination.

3.3 FOUR MONTHLY SCHEDULE

Ensure all bi-monthly checks and the following additional points.

- Check the condition of lubricating pads and replace, if worn/damaged or deformed.
- Check the gear case for any damage and cracks etc. and repair before putting in the service.
- Check the magnetic drain plug, clean and re-assemble

3.4 IA & IB INSPECTION

- Visual inspection "Check for any oil leakage from wicks cover, suspension bearing pump, axle cap and dummy plug". Suspension bearing oil samples to be collected and tested for contamination.
- Check oil level & its condition. In case, if it is found contaminated, oil of that particular suspension bearing should be changed.
- If, oil level found less, add new suspension bearing oil.

3.5 IC & AOH

- If, in the incoming locos, no oil is found in top sump, the pump should be dropped and tested. If, there is

oil in bottom sump but no oil in the corresponding top sump, this implies that pump is defective.

- If, in the incoming locos no oil is found in top sump as well as in the bottom sump, in this case also, pump should be dropped and tested. This is a condition which implies that bearing might have run without oil.

- In case, a locomotive is received in the shed with wheel skidded condition, this also implies that due to jerks, planetary gear of the oil pump could have damage, in this case also, pump should be dropped and tested.

- In case, locomotives are received from line for more than 50 days without undergoing trip inspection, in this case all six pumps also should be dropped and tested.

- Whenever, oil pump is dropped its gasket must be changed.

- Overhauling of pumps should be carried out.

- Check and record the discharge rate of oil pumps which will ensure the quality of overhaul.

CHAPTER 4

SUSPENSION BEARING MAINTENANCE

4.1 LUBRICATION

In TAO-659 traction motor, the pinion end and commutator end bearings have a common oil sump in the middle of the integral axle bearing cap, having a capacity of 20.2 litres. An axle driven gear pump is used to lift and feed the oil for two woollen wicks on each bearings. The pump delivers approximately 117 litres oil at 110 KMPH, @ 3 cc per revolution. Lubricating wicks should be changed whenever, traction motor is changed. In case, same pad is required to use, it should be thoroughly cleaned to remove carbon, dust, glazing/ metal chips etc. After cleaning, pad should absorb oil quickly which can be tested by putting a few drops of oil on the face. The wicks should be soaked in oil at least for 12 hours before use. It is difficult to inspect wicks on position hence special attention should be given to it, when loco is lifted and bogies are run out. All gaskets for axle cap and pump should be pasted with **Dunlop rubber adhesive**. Care should be taken while fitting the axle cap, not to tear the gasket. The gasket should be pasted on axle cap and not to magnet frame of traction motor. It is also important to thoroughly scrap and remove oil and gasket before fitting the new one. The tightness of axle cap bolts should be 50 Kg.m. using a torque wrench for each bolt is a healthy practice.

Since handling is cumbersome and time consuming hence other convenient tools may be used for tightening. But a sample check may be done by torque wrench as possible. After replacing the bearing, the traction motor must be light run in the bogie itself by floating the wheels. This is done by keeping the two axle boxes of the wheel set on stools made for the purpose. A voltage of 100-120V DC is necessary to run the traction motor. This practice is useful in checking oil leakage and pump working. In case of major defect in fitting, the bearing would also run warmer than normal. The lateral and diametrical clearance should be measured immediately after lowering the traction motor on the axle.

- Use Servo premium 76 oil (SP-76) for bearings.
- Top up oil, up to top mark of dipstick.
- Put one drop of oil from suspension bearing sump on blotting paper. If it leaves brown stain on spreading, replace the oil.
- Drain the existing oil from the sump by drain plug. Pour kerosene from the filling cup into suspension bearing sump. Allow kerosene to remain in sump for sometime. Open drain plug and allow the contents to drain. Close drain plug. Pour fresh suspension bearing oil in the bearing.
- Clamp two halves of bearing together. Keep a lamp inside the bearing. The light of the lamp should not be visible through the joint of two halve.

This will ensure no leakage from mating surfaces.

- Assemble only matched halve of the bearing. Mark both halve identical.
- When boring the bearing, ensure concentricity of bore with respect to outer diameter of bearing shell. Use dial gauge for checking centring of tool. Maximum permitted eccentricity is 0.02 mm.
- Keep bore diameter of bearing 0.7 mm more than axle journal diameter. Measure this diameter at least at two locations by inside micrometer along the length of bearing. Each location takes two readings right angles to each other. By this, taper in bore can be detected.
- Measure outer diameter of bearing shell by vernier calliper/out side micro meter. It should be between 250+0.84mm & 250+0.130 mm.
- Check taper of the bearing shell by keeping each half of shell on a plane surface. Fix dial gauge base on the plane surface and pointer on bearing shell. Set zero in dial gauge then drag the dial gauge end to end along the length. The pointer should not deviated more than 0.30 mm.
- Measure stator housing bore diameter at least at two locations, by inside micrometer. The bore diameter should be 250+0.046 mm. If, this diameter is more than 250+0.130 mm, the bearing shell will loose in housing.

- Always maintain stopper to stopper distance between 915.5 mm and distance between extreme thrust faces of pinion end & commutator end bearings between 912.6 to 913.4 mm after assembly. This will ensure lateral clearance of 2.9 mm (max.) and 1.6 mm (min). Lower lateral clearance may damage thrust faces of white metal.

4.2 WICKS

- Change wicks pads also, whenever traction motor is changed.
- Remove carbon, dust, bearing metal chips from the pad.
- Check capillary action of wicks by keeping the wicks immersed in fresh suspension bearing oil for 12 hours to 24 hours. If the pad becomes oily, the wicks pad is acceptable.

4.3 OIL PUMP

- Test the oil pump for rated discharge by dropping in every IC for goods and IB & IC for passenger according to condition and record.
- Check tightness of the pump body on its base by taping the pump body lightly with hammer. If, a ringing sound is heard, then fit is correct.
- Use 0.8 mm thick gasket with rubber adhesive for pump.

4.4 AXLE CAP

- Tighten the axle cap bolts with a torque of 50 Kg-m.
- Paste new gasket on the mating facing of axle cap, not on magnet frame face.
- The gasket should not tear off during fitting the axle cap on magnet frame.
- Apply a coat of adhesive compound at bearing edges and thrust faces to control chipping of white metal from edges or thrust faces.
- After complete assembly of traction motor in bogie conduct run test on traction motor by lifting the axle boxes and wheels from the rails.

4.5 MACHINING OF SHELLS

Re-boring the new bearing to suit the journal size in case of non standard sizes of axle journals is not good practice, but may be unavoidable in certain situations. It is, therefore necessary to ensure the concentricity of the bore with outer diameter of the shell. A centre lathe or boring machine should be reserved only for bearing machining to maintain accuracy. Dial indicators only should be used for centring the bearing on lathe. The eccentricity of the lathe centre should be periodically checked and within 0.01 mm. Side relief (taper along the edges) to the full bearing length should be provided when purchasing new bearings from the firm to avoid filling in shed.

- After proper chinning and filling bearing shells to be clamped. The gap at joint due to uneven surface should not be more than 0.03 mm. The machining must be very fine finish and very smooth. All machinists must be provided with proper carbide tip tools.

- Heavy cut should not be given to the bearing during machining. Maximum cut permitted is 0.3 mm only.

- Bond strength of suspension bearings should be tested by ultrasonic tester till such time bond tester is procured.

- Visual checking of the bond strength should be done by artisan at the place of assembly for any damage during transportation from machine shop.

- During assembly of the traction motor the diametrical clearance should be checked and practically it should be 0.5 to 0.7 mm.. However, theoretically it should be 0.26 to 0.352 mm (Nominal) and 0.7 mm (Max.).

- All the new assembled traction motor should be tested for one hour on test bench for temperature rise. Temperature should be measured with thermometer in oil sump of suspension bearing. If, temperature rise is above 20°C from ambient then the motor should be rectified.

- The standard proforma should be filled up for each new/assembled traction motor as per appendix B.

- Loco in which the suspension bearing oil leakage, is kept under watch, their number should be displayed at PPIO so that they can be called at regular interval for proper attention.

- Re-metalling of the shell to be done only twice, for this, some colour coding can be done on the bearings which has been re-metalled.

- The axle should not have any ovality at the suspension bearing seat. All the axle collars should be checked visually for any damage/deformity. If there is any, it should be rebuilt and properly machined.

- No suspension bearing should be fitted in axle cap or traction motor, directly hitting by hammer. If hitting is required, a wooden block should kept on bearing and the light hitting should be done on wooden block only.

- The permanite gasket being fixed in between the axle cap and traction motor should be fitted only after proper cleaning of the surface.

- No oil leakage should be permitted from suspension bearing during testing of assembled traction motor on test bench for temperature rise.

- Felt to be treated with grease and baked before use for 2 Hrs. at 120°C. The felt should be flexible but should not be porous.
- Oil level should be checked in upper sump through dipstick. This checks should be carried out immediately after service running. Oil level below the bottom mark of the dipstick indicates lack of oil delivery. Mark on the sump dipstick indicates the minimum and maximum oil levels.

- The amount of oil to be added can be approximately calculated by knowing that the difference between the maximum & minimum marks on the sump dipstick represents a useful oil quantity of about 5.2 Litres.

- Check the oil wicks through the individual inspection cover on the upper part of the container. Ensure that oil pad wears correctly on the axle and that it does not foul the axle cap or the bearings. The pad linkage should have free movement.

- If, too much wear or clogging of the pads rubbing face is noticed, and in particular if, the wooden pieces are worn and show slots of 1 mm deep minimum (on a new piece, 3 mm deep), it is necessary to replace the complete pad.

- After each inspection, the sump cover, inspection panels, joints and dip-stick should be correctly re-fitted to avoid the interaction of any foreign matter.

- Avoid damaging the gasket, if this is replaced. Ensure that oil pipe orifice is present in gasket.

4.6 CLEANING OF OIL STRAINER FOR PUMP

- Remove the lubricating pads.
- Empty carefully any oil remaining in the axle bearings.
- Pour kerosene oil in sufficient quantity in order to carry away all the dust & impurities which could have accumulated in the bottom of oil through or in the corners. The kerosene oil can be left in place for about 10 minutes.
- Now, empty kerosene oil and pour a small amount of lubricating oil in the bearings, heated to 90°C. Empty this lubricating oil which is used for cleaning kerosene oil traces from the rough.
- Ensure that drain plug is correctly fitted & tighten alongwith a good gasket.
- Before mounting, check the condition of the lubricating pads.
- Check condition of the felt sealing-joints, in case of replacement.
- At the end of these operations re-assemble the axle cap & fit the pump support with its attached pump.

- When the bearings have been replaced or serviced, after tightening of the axle-bearing cap, make sure that they are in line and their sealing, checked with marking blue, is acceptable.

4.7 ULTRASONIC TESTING OF BEARING

Ultrasonic flaw detection should be done for new, re-metalled, as well as in service, bearings removed during AOH/IOH. The testing should be done in collar and the dovetail portion also for old and released bearings.

4.8 CODING AND DOCUMENTATION

Documentation is of immense help in monitoring bearing condition and planning for future procurement or replacement.

Each bearing may be punched with a code and a number as shown below :

New bearing	N
First time re-metalled	01
Second time remetalled	02
Maker's code	OMG, VKE, DVB, etc.
Size code	ST,S1,S2,S3
Example	N/DVB/ST/ 567

New bearing, M/s DVB make, standard size serial No. 567

4.9 **PREVENTIVE MEASURES**

The cases of suspension bearing metal out can be considerably reduced by :

- Ultrasonic testing of all bearings before fitting. During AOH, it is essential to test the bearings and those found defective in ultrasonic test may be used on goods service locos, if they pass sound test.

- RDSO's specification E7/18 of Dec'94 and QAP of CEE, C.Rly for re-metalling/new metalling of suspension bearings should be strictly followed whether in shed/ shop/ trade. A bearing shell should be re-metalled only twice. The maximum permissible ovality on outer diameter of shell is 0.3 mm and that of bore is 0.03 mm.

- Edges of the bearing along the joints should be tapered throughout (Side relief). It is useful to apply adhesive compound over the edges after cleaning the surface by solvent. In case of slight metal out at edge/collar/bedding. Cyanoacrilic adhesive TL 415 of TOUGHLOC brand or any other similar product may be used. Experience shows that a bearing with 5% metal out may be safely used. It is useful to apply adhesive on new and re-metalled bearings before fitment.

- The bearing should be handled carefully while carrying fitment, no hammering should be allowed on the bearing for any reason.

- It is seen that the bonding failure in the case of old bearing is 40% or more whereas in new bearings it is 15% or less. Hence there is need for continuous input of new bearings. The ratio of failures, pinion end to commutator end, is **2.5:1**. On this basis, it is necessary to change 20 to 25% pinion end bearing and 10 to 15% commutator end bearing annually. In sheds, new bearings should be used on WAM-4 (passenger service) locos and released bearings should be used on WAG-5 locos or on inferior services.

- During POH, it is advisable to provide 100% replacement of suspension bearings, gear cases, GITH, oil pumps and pinion for pumps. This will eliminate considerably the loco lifting in shed and will improve outage.

- The cases of collar metal out contribute substantially to failures. The damage to the collar is due to rough surface of axle stoppers. Lateral clearance should be within 2 mm (min) and 7 mm (Max.). The stoppers should be machined if the surface is not even and square with journal. To get the clearance within limits, the axle stopper (Commutator end) may be moved by using a puller and shims may be tack welded between stopper and wheel boss. A cyclic check of stopper distance and surface finish is necessary to reduce failures.

CHAPTER 5

DEFECTS AND ANALYSIS

5.1 COMMON DEFECTS, APPEARANCE & CAUSES

Sr.	Type of defect	Appearance	Causes
1	Plastic defor-mation and melting	Superficial melting & flow of white metal may be confined to edges	Overheated surface due to inadequate clearance, excessive load or insufficient oil supply.
2	Cracking and/or crazing	a. Loss of area of lining by propagation of cracks, loading to isolation of particles. b. Intergranular cracking and surface rumpling.	Excessively high dynamic loads giving rise to fatigue failure. Cracking may result from over speeding or due to misalignment Thermal fluctuations associated with operation & rest, resulting in cracking due to an isotropic thermal expansion of white metal grains.
3	Erosion	a. Removal of bearing material, in regions near joint faces or grooves.	Cavitation erosion due to changes in pressure of oil-films associated with interrupted flow.

Sr.	Type of defect	Appearance	Causes
		b. Pitting in both bearing and mating surface.	Due to electrical discharge between mating surfaces, resulting from inadequate earthing.
4	Bond failure	Loss of lining some-times over large areas.	Poor pre-tinning of shells and incorrect lining technology.
5	Wear of bearing lining	a. Wear of bearing surface. b. Bearing seizure due to metal to metal contact arising from breakdown of lubricant oil film. c. Uneven wear of bearing surface.	Dirt particles contaminating the lubricant. Inadequate supply of lubricant due to insufficient pump capacity or blockage in supply line, overloading, distortion of bearing surface. Mis-alignment of bearing assembly.
6	Wear of mating surfaces	Scoring on mating surface by particles partially embedded in the bearing surface.	Insufficient embeddability in bearing alloy or presence of excessive large foreign particles.

5.2 TYPE OF DEFECTS

The following type of defects are experienced on suspension bearings TAO-659.

- Dropping of white metal lining from steel shell.
- Scoring of journal on account of starvation of oil.
- Improper lubrication due to contamination of suspension bearing lubricating oil and gear case compound.
- In-adequate lubrication or starvation of oil.
- Use of incorrect lubricant.
- Excessive diametrical clearance between axle and suspension bearing.
- Uneven wear of white metal due to bad assembly, bent axle, machining defect/ misalignment of axle journal & suspension bearing.
- White metal chipping off.

5.2.1 Dropping of White Metal Lining from Steel Shell

This may due to improper casting procedure of white metal causing poor adhesion. For good mechanical strength as well as thermal conductivity of bearings, an adhesion as perfect as possible between steel shell and white metal lining is necessary for which condition represents :

- Adhesive strength of about 1.64 Kg/cm^2 (average).
- Shear strength of about 4.88 Kg/cm^2 (average).

Good adhesion of the white metal on the shell is checked by :

- Non-destructive test : Visual examination, Ringing test, Ultrasonic test.
- Destructive test : Adhesion between two metals by extorting force on the babbit layer.

(A well babbitted bearing `Ring' clearly when slightly struck with hammer. After final machining of the bearing, lens examination of the parting line of the two metals allows detection of possible flaws).

5.2.2 **Scoring of Journal**

This occurs due to starvation of lubricating oil. Possible reasons are described below:

- Non functioning of oil pump.
- Dislodging of pump support by loosening of fasteners.
- Bad quality of wick pad and improper capillary action.
- Non engagement of oil pump pinion with gear in two halve on axle.

- Leakage of oil from worn-out felt gasket, magnetic drain plug and matting surfaces of magnate frame and axle cap.
- Breaking of spindle of oil pump pinion.
- Improper topping of oil.
- Improper wearing of lubricating pad with axle.
- Failure of oil pump due to damaged/broken split gear and oil pump pinion teeth.

5.2.3 **Use of incorrect Lubricant**

Failure of suspension bearing occurs because of incorrect lubricant used. The correct lubricant recommended by RDSO vide RDSO's MI No. MPMI-4 of June'94 are as under :

- Turbinol - 77 (HPC)
- Bharat turbinol - 78 (BPC)
- Servoprime - 57 (IOC)
- Servoprime - 76 (IOC)

Care should be taken that different grade of oil must not be mixed because chemical package of crudes will make something new oil.

5.2.4 **Defective Fitment**

There are about 10 to 15% cases of bearing failure due to fitment defects. The indication of bad fitment are :

- **Ovality of stator bore** : This happens as a result of shrinkage of axle cap due to hot bearings. In all cases of hot bearing the stator bore for suspension bearing should be checked for ovality and maintained within 0.2 mm by machining. Grinding manually should be avoided.

- **Over sized stator bore** : In some locos stator having bore of 252 mm diameter, instead of 250 mm but the bearings fitted in them are of 250 mm diameter. The bearing fits loose in the housing and causes failure. Such stators should be detected and corrected by machining after building up the stator bore by welding. C2 class machinable electrodes may be used and zigzag technique should be adopted for welding to prevent distortion. The axle cap should be embossed with stator serial number by welding in large size to avoid mismatch and easy identification.

- **Other measures :** The distance between the axle stoppers should be maintained within 915+2 mm. The sandwich mounting block should be in good condition. At least one earthling brush with cable should be provided in each bogie. Absence of earthing brush is likely to cause current flow through axle roller and suspension bearings.

Magnetic drain plug with copper washer should be provided to trap iron particles. The bearing should not have oval holes for dowels.The dowel hole in axle cap should be built up and re-drilled if, oval. The journal sizes should be as stipulated by RDSO. Inner surfaces of stoppers should be smooth.Taper in journal should not be more than 0.02 mm. GITH should be checked for tooth wear, burrs & tightness. When fully tightened, the faces of two halve gear should not touch each other (A gap of 0.1 mm is desirable).The hardness of gear in two halve should be checked at the time of procurement and ensured to be higher than that of pinion. If, it is observed that hardness of pinion is higher then the pinion is to be annealed to reduce the hardness from 250-300 BHN to 200-230 BHN.

- The diametrical clearance to be checked, practically it should be 0.5 to 0.7 mm.. However, theoretically it should be 0.26 to 0.352 mm(Nominal) and 0.7 mm (Max.). It is seen that very low clearance results in bearing rubbs with journal and oil film formation/ circulation is affected0 causing premature failure.

- The lubricating wick pad should be 100% changed in AOH as well as when traction motors are changed for any reason. The pads should be checked for movement in axle cap and good contact on journal. The springs of the holder frame should be changed if,they found elongated.

- All gasket of axle cap, pump, suspension bearing felts and gear case felts should be changed whenever traction motors are changed for any reason.

5.2.5 **Uneven Wear of White Metal during Assembly**

The housing diameter requires periodical checking by measuring in two locations right angle to each other. If this is not done the housing diameter continues to increase allowing clearance for the bearing to vibrate. In case of oval housing the bearing shell remains tight at places giving an impression of correct fit but there will be clearance at other locations.

5.2.6 **Chipping off White Metal from Thrust Faces**

It is noticed that case of white metal chipping off from thrust faces is quite high. The lateral movement
of motor is guided by thrust faces. Measurement of lateral clearance at the time of assembly to be maintained as per drawing. subsequent measurement can detect chipping off white metal.

From the nature of chipping off, it is observed that higher thermal extension of liner with respect to its steel base can causes this type of failure. To allow thermal expansion, a break of 5 mm in layer of babbit metal on collar end as shown in figure 5.1, may be provided.

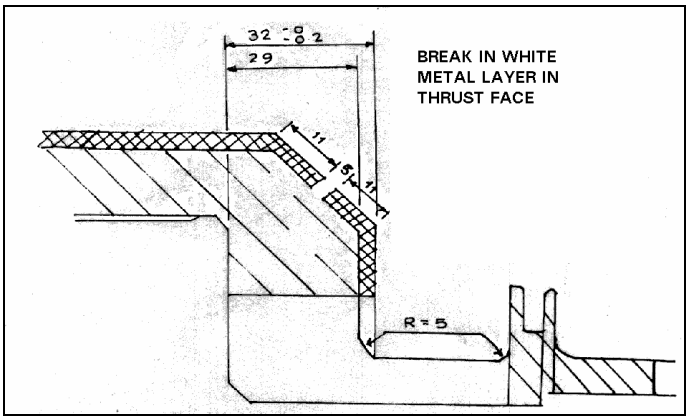

Figure 5.1

5.2.7 **Overdue Trip Inspection and Starvation of Oil**

It is seen from actual records of some goods locos that the trip inspection has not done for as many as 60 days, while suspension bearing needs filling of oil every 10 to 15 days. A joint/operating circular under the signature of CEE and COM should be issued on all Railways clearly mentioning :

- Drivers should not take charge of electric locomotive if the last trip inspection has passed 12 days or more in case of goods locos and 6 or more days in case of passenger locos.

- The DAR action has to be taken against the drivers violating the above orders and action has to be widely published.

5.2.8 **Leakage of Suspension Bearing Oil**

Leakage of oil is takes place from worn out felt, gasket, magnetic drain plug and matting surfaces of suspension bearing/magnet frame/axle cap. The felt joints are intended to constitute as tight a seal as possible between fix part and moving part. Before replacement with new felts they should be immersed for 24 Hrs. in the oil used for lubricating the bearing. At the time of re-assembly, non drying fluid sealant (e.g. THREE bond 1102) may be applied to the matting surfaces of suspension bearing and to the contact surface of flange with the magnet frame & axle cap.

Leakage of suspension bearing oil can be minimised by taking the following measures:

- Application of 732 RTV Silicon sealant on the matting faces of the two halve of suspension bearing in the felt area:

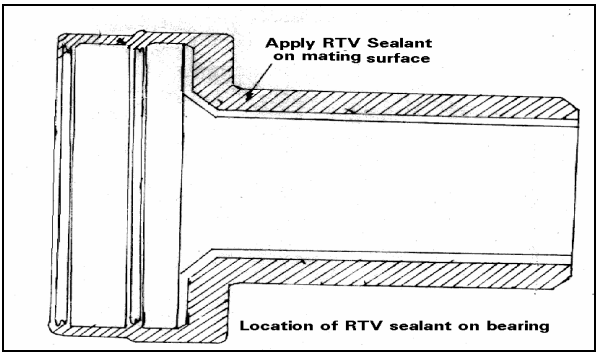

Figure 5.2

The mating faces in the felt area remain exposed and are not covered by the axle cap. The area which is under the axle cap is sealed with the help of champion sheet provided at the axle cap joints. The lubricating oil leaks from the mating area which is not covered by the axle cap. This leakage can be arrested by applying RTV 732 Silicon Sealant at the joining faces of suspension bearing at the felt area as shown in figure 5.2.

- Flooding of upper sump containing wicks pad is experienced in high speed locomotive:

This is due to higher discharge of oil pump at higher speed. Oil level in such case rises above the wicks level, affecting lubrication. To avoid this, drilling by pass hole in axle cap of suspension bearings to discharge the excess oil of upper sump to lower sump as shown in figure 5.3

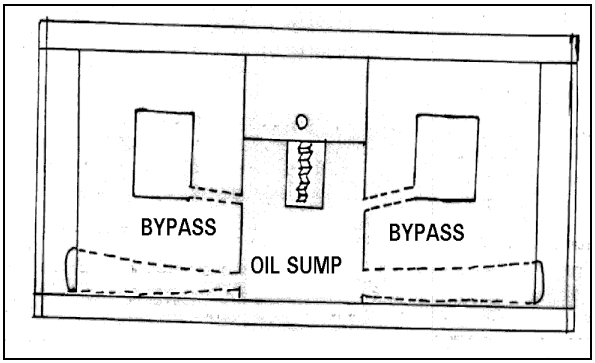

Figure 5.3

- Leakage of oil through the axle cap :

  In about 30 to 40% cases, it is noticed that cap is not provided in the oil filling cups. Even when the caps are provided they fall off due to excessive vibration of stator frame.

  To prevent the falling of oil caps and leakage of suspension bearing oil subsequently, spring loaded oil caps may be provided as shown in figure 5.4.

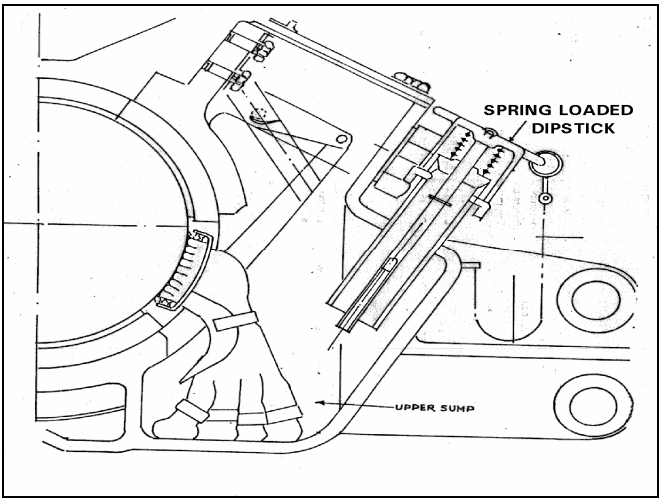

Figure 5.4

5.2.9 **Other Measures**

- Re-habilitation of traction motor and axle cap in case of suspension bearing seizure :

  The pinion end side bearing fails/seizes first as most of the torque is transferred through this side only. This causes uneven temperature rise in axle cap resulting in distortion. Due to this, gap is developed in between the mating faces of axle cap and magnet frame of traction motor . The gasket provided at the mating face is not sufficient to prevent the leakage of this gap. It is necessary to build up the mating faces and re-machine the surface to get the required dimension.

- Handling with suspension bearing :

  At the time of changing of suspension bearings, care should be taken to prevent dropping of these bearings from a height. Dropping from height results in deformation in the matting surface as it is the weakest portion. No hammering should be allowed on the bearing for any reason.

5.3 ANALYSIS OF SUSPENSION BEARING FAILURE

Analysis of suspension bearing failure prima facie shows starvation of lubricating oil in 70% cases. The non availability can be due to :

- Not toping up of oil during Trip Inspection (2000 Kms for Goods, 1500 Kms for coaching Locos).
- Leakage of oil from axle cap. The surface matching of two half i.e. magnet frame & axle cap requires colour matching to prevent oil leakage from this joint. Oil can also leak from oil filling cup of the axle cap due to failing of dipstick Spring loaded dipstick can prevent this.

The other causes of suspension bearing failure are given below :

5.3.1 Failure of Oil Circulating System

This primarily has following four important reasons:

5.3.1.1 Dis-lodging of pump from housing

This takes place due to incorrect fitment of pump body & oil pump support. The correct fitment is checked by measuring the dimension of oil pump support which should be 86+0.054 mm & for pump body 86+ 0.058 mm

+ 0 mm + 0.0238 mm

If the dimensions are beyond the limit the pump starts rattling due to loose fitment. This causes loosening

of hex head screw M12x30 and ultimately the pump drops from its support along with pin.
At the time of assembly the initial tightness of the hex head screw, should be checked by tapping the pump body and hearing a ringing sound.

5.3.1.2 **Poor Discharge of Pump**

Whenever the pump is overhauled it should be tested as follows :

Preliminary check: The pump is suitably driven by a variable speed and reversible motor in either directions. There should be no abnormal noise, vibration etc.

Performance Test: Free Delivery : The pump runs at different speeds with the outlet free in both directions, the output (Litres per minute) obtained should be as following :

RPM	OUTPUT
180	Motor fails to run the pump
400	1.5 Litres per minute.
550	2.0 Litres per minute.
800	3.0 Litres per minute.

Acceptable minimum discharge at 820 RPM is 145 litres per hour and per revolution 3 cc .

OR

Speed in Kms.	Discharge in ml.
10	330
20	760
30	950
40	1380
50	1580
60	1900
70	2250
80	2550
90	2850
100	3100

5.3.1.3 **Braking of Oil Pump Gear & Spindle of Oil Pump Pinion**

The oil pump gears can brake if it is not correctly engaged with gear in two halve. This can be caused by large lateral clearance between the axle suspension bearing and the stoppers of the axle. The taper portion of the pump gear spindle, where pinion is fitted, is provided with a tapped hole of M 10x25. This cross-sectional area is not sufficient to bear the load of pinion. The wear of the spindle during running also causes rattling with the load of pinion which is reversible in nature. This load results in fatigue failure of the spindle. To prevent this, the wear in the shaft should be checked and ensured that the shaft is not fitted loose in the housing.

5.3.1.4 **Non Functioning of Oil Pump or Non-Engagement of Oil Pump Pinion & Gear in two halve**

This oil pump is reversible rotary gear type & is required for lifting the oil from a sump at a lower level and delivering the same at a higher level. Where the pump is completely dismantled, careful cleaning of the pump and its strainer is necessary. Before refitting, gear teeth is to be inspected for wear and damage. It is to be checked that the lower ball is bearing correctly on the seat. The pump alongwith its support should be replaced when axle bearing cap is mounted in place so as to check correct meshing of gears. Use of higher thickness of gasket on the pump support may also contribute to insufficient engagement of pinion. The main cause of this failure is the mismatch and misalignment between the two. The misalignment can be caused by large lateral clearance between suspension bearing and axle.

5.3.2 **Quality of Wicks Pad**

If, the wicks pad do not provide adequate capillary action, oil from upper sump will not be transferred between the bearing and axle. Also if, the wicks pad is not touching the axle surface, due to incorrect pressure on it or wearing out, the lubrication will be affected.

To check the wicks pad for capillary action, the wick portion should be immersed in suspension bearing oil for 24 hours. If, the oil reaches at pad portion which can

be checked by moving finger on the pad surface, the wicks pads capillary action is correct.

5.3.3 **Contamination of Suspension Bearing Oil**

The contamination of oil can take place due to :

- Ingress of gear case compound (Cardium compound) in suspension bearing oil.
    - The Level of Cardium compound in gear case is kept on higher side.
    - The felt gasket fitted with the bearing is of poor quality and is not properly fitted.
- Wear of white metal and mixing with suspension bearing oil.

Both these can be prevented by checking the condition of suspension bearing oil as per the method given below. This method will also indicate possibility of bearing seizure, before it actually takes place.

5.3.3.1 **Testing for Contamination in Suspension Bearing Oil**

Spreading tendency of an oil depends on its quality. The **blotter spot test** is done to test presence of contaminants like gear case lubricants, dust, packing material and water in suspension bearing oil. In this test comparison is made of the dispersancy of the oil with

that of fresh lubricating oil. This test can be carried out during all maintenance schedule.

Method of test : The suspension bearing oil is allowed to drop and soak on Whitman filter paper No. 2.

Observation :

Sn.	Sample	Colour of the spot
01.	Fresh oil	Uniformly distributed spot without any specific stain on filter paper.
02.	Slightly contaminated (SCT) due to ingress of gear case compound.	Light brownish with chocolate tint evenly distributed.
03.	Badly contaminated (BCT) due to ingress of gear case compound into the system.	Deep brown with chocolate tint.
04.	Slightly deteriorated (SDT) indicates partial deterioration of oil.	Slight blakish colour with evenly distributed tint.

Sr.	Sample	Colour of the spot
05.	Burnt oil (BT) indicates deterioration due to burning and overheating .	Blakish colour with evenly distributed tint.
06.	Deteriorated oil (DT) .	Grey/Green evenly distributed tint.

Action required: SCT, SDT oil may be used further. BCT, BT and DT oil is required to be changed. BCT, BT and DT further indicated that bearing and axle surface are rubbing with each other.

CHAPTER 6

BABBITTING

6.1 GENERAL

The detailed procedure for white metalling (Babbitting) of both used and new axle suspension bearings of traction motors is furnished here. The main aim of this procedure is to obtain an adhesion as perfect as possible between steel shell and babbit (white metallic lining), which is necessary for good mechanical strength as well as good thermal conductivity of bearings.

6.2 FOR USED AXLE SUSPENSION BEARING ONLY

6.2.1 Demetalling of Shell

Suspension bearing shells requiring re-babbitting to be kept in furnace at a temperature of 400-450°C in a tray. The white metal will melt and accumulate in tray. Take out the bearing shell from the furnace and scrap them to remove any left over metal with a suitable mild steel strip and finally clean the surface with asbestos cloth.

6.2.2 Inspection of Bearing Shells

Inspect the bearing shells for any deformations such as ovality in bore diameter, deformation in collar thickness and felt grooves etc. Ovality should not be

more than 0.3 mm. The dimensions of the bearing shells
should be as per drawing only. The shells not confirming to the dimensions or having any deformation and cracks detected by ringing test/ultrasonic test should be straightway rejected.

6.2.3 **Condition of Fixtures/Clamps/Separating Strips etc.**

All the fixtures/clamps and separating strips etc. must keep in clean condition when not in use and also should be protected against rusting by a coat of graphite painting stopping off paste may be prepared by mixing 1 Kg of magnesium with 2.5 litres of sodium silicate and 1.2 litres of water.

6.2.4 **Matching and Cleaning of Bearing Shells**

To have good bond strength between bearing shell and white metallic lining, it is essential that shell should be thoroughly cleaned and should not have any rusted, greased/carbonised surfaces or any other irregularities.

6.2.5 **Machining of Shells**

Machine all the surfaces of bearing shells which are to be tinned and white metalled by providing a cut of 0.05 mm to ensure that no rust/carbon/any other irregularities and foreign remain.

6.2.6 **De-greasing and Washing of Shells**

After machining, bearing shells should be degreased by using white sprit/try-chloroethylene/dilute hydrochloric acid. Then wash the bearing shells with hot water having a temperature of 60 to 70 °C.

Note : De-greased and washed surfaces of the bearing shells should not be touched by hand.

6.2.7 **Protection of the Portion of Bearing Shells which are to be Tinned**

Apply a coat of stopping off paste having following composition with the help of brush on the surfaces or parts of bearing shells which are to be tinned and white metalled.

Composition of stopping off paste **:**

Magnesium oxide	-	1 Kg.
Sodium silicate	-	2.5 litres.
Water	-	1.25 litres.

6.2.8 **Procedure for Tinning**

Materials and plant required for tinning of bearing shell :

a. Pour tin as per BS-2801, Grade Sn. 99.85
b. Tin bath unit
c. Flux

Prepare the flux with following ingredients :

Zinc chloride	-	32.6 % by weight
Ammonium chloride	-	2.1 % by weight
Hydrochloric acid	-	6.7 % by weight
Water	-	58.6 % by weight

6.2.9 **Pre-heating of Bearing Shells**

The bearing shell should be preheated at a temperature of 250 ± 10°C in a temperature controlled oven fitted with thermocouple and pyrometer etc. It is essential to avoid projection of tin while dipping the bearing shells in the tin bath.

6.2.10 **Fluxing of Bearing Shells**

Apply liquid flux by brush on heated bearing surfaces which are to be tinned and white metalled.

6.2.11 **Tin Bath**

Maintain the temperature of tin bath at 300 ± 10°C. Use fully pure tin as per BS 2801, Grade Sn. 99.85. Cover the molten and heated tin having temperature 300 ± 10°C with a thin layer of molten flux prepared, just sufficient to cover the tin and keep the bath clean. Remove surplus periodically.

6.2.12 **Tinning of Bearing Shells**

The preheated bearing shell with the flux brushed should be immersed slowly in the tin bath having temperature of 300 ± 10°C for 2 to 3 times for a total period of 5 to 8 minutes, depending upon the size, to ensure that all the surfaces of bearing shells has tinned properly and there is no sign of blackening. At each time of removing the bearing shell from tin bath clear the brass from the surface of tin bath and remove excess tin from bearing shell surface with a fluxed brush and at the same time check the continuity of the tin layer on the bearing shell. Finally after obtaining very shine finish, keep the bearing shell for cooling. These tinned surfaces should be protected from any damage.

6.3 **PROCEDURE FOR WHITE METALLING**

6.3.1 **White Metal**

To have good bond strength, use white metal as per IS 25-1979 grade 84. Temperature of white metal should maintain at 430°C to 460°C and dross should be removed from top of the molten white metal by prickling Ammonium chloride powder and screening with an asbestos sheet.

6.3.2 **Assembly of Bearing Shells**

During assembly of bearing shell halve, put a separator strip in between two halve and block the windows of lubricating pad with the help of some suitable plugs and then finally clamp them . These strips are used to ensure that both halve of the bearing shell get separated easily after white metalling.

6.3.3 Methods of White Metalling

There are two methods of white metalling

- Centrifuging method
- Gravity method

Centrifuging method is superior than gravity method and as well as provide better bond strength. However, in the absence of facilities of centrifuging method, gravity method may be adopted, but in the mean time facility for centrifuging method should be created.

Assembled bearing halve should be heated at 250 ± 10°C in a temperature controlled oven fitted with thermocouple and pyrometer etc. Apply a coat of flux on the heated bearing surfaces. Immersed the heated bearing shell in the tin bath having temperature between 280 to 300°C and keep it for such time, its temperatures reaches up to 280°C.

6.4 CENTRIFUGING METHOD

The heated bearing shell should be removed from the bath and placed in spinning machine immediately to avoid any heat loss.

Keep the guard of machine in position and run the spinning machine at set speed. Molten white metal having temperature of 430 to 460°C should be poured through the funnel, while spinning machine is running at set speed to avoid metal being poured directly down the bearing surfaces. Care should be taken to avoid splashing of molten white metal, as far as possible. After pouring the white metal run the spinning machine further for 2 to 3 minutes and spray water continuously to cool the bearing surfaces.

6.5 GRAVITY METHOD

6.5.1 Heating of Core

Put the core in furnace and heat it up to temperature of 700 to 800°C. The diameter of the core should be very close to the inside diameter of the fixture to get good heating. Put the tinned shell in furnace and heat up to 400°C and keep the shells in furnace further up to one and half hour to absorb heat. Before taking out the shell from furnace , put the heated core into the fixture so that fixture temperature may also rise up to 400°C before clamping the shells over it. Take out the bearing shells from the furnace and apply slight tin once again all over the surface alongwith Ammonium chloride powder and rub the surface with the brush. Apply the flux and clean the surfaces of bearing shells. Clamp the shells over the fixture and seal the joints with a separator strip and put plugs in the apertures for lubricating pads. However, before pouring of white metal, the bearing shell temperature should not be less than 250°C.

Pour molten white metal having temperature in between 400°C to 460°C into heating shells up to required level. Stir it with suitable metallic rod to release the trapped air inside the white metal. Allow it to cool down.

6.5.2 **De-clamping**

The bearing should be removed from spinning machine or fixtures. The clamps etc. should be opened and separator strips , plugs used for blocking lubricating pad window should also be removed to separate the two halve.

6.5.3 **Machining of Shells**

After chipping and filling etc. The two halve of the bearing should be re-clamped and mount them on lathe machine. Check its concentricity by dial gauge with magnetic base and least count 0.005 mm. Do the required machining, concentricity and ovality of bore and outside diameter should be within 0.03 mm. Bearing should not have any sharp edges. The diametrical clearance should be as per the required drawing.

6.5.4 **Inspection**

Bearing should be checked as follows :

- Visual examination
- Adhesion test

- Ultrasonic test
- Di-penetration test.

CHAPTER 7

MODIFICATIONS PROPOSED

The suspension bearings can be made reliable to a great extent by implementing the measures suggested. There is still scope for improvement and towards a target of zero defect. It is therefore proposed that the following modifications may be carried out to achieve further improvement in performance.

7.1 MODIFICATION ON SUSPENSION BEARING & GEAR CASE

7.1.1 Modification to Reduce Gear Case Compound entry into Pinion End Suspension Bearing

It is noticed during schedule that in almost all locomotives the compound contamination with suspension bearing oil is too high. Due to this contamination, suspension bearing oil looses its viscosity and metal runs out. The compound enters in the suspension bearing collar portion due to centrifugal force. But the discharge of compound collected is very less due to less size of compound return hole (8mm x 53mm) in the bottom half of suspension bearing. Due to excessive collection of compound, it passes through felts (on suspension bearing & gear case of thickness 5.4mm & 4.6 mm respectively) and enter in sump of axle cap.

Also excessive accumulation causes the blockage of the hole.

- Therefore to increase the discharge rate of gear case compound from suspension bearing, it is proposed to provide two more holes in pinion end suspension bearing bottom half or existing size 8mm x 53 mm slot to be enlarged to 16 x 106 mm. This will reduce the accumulation of compound in the suspension bearing as shown in figure 7.1.

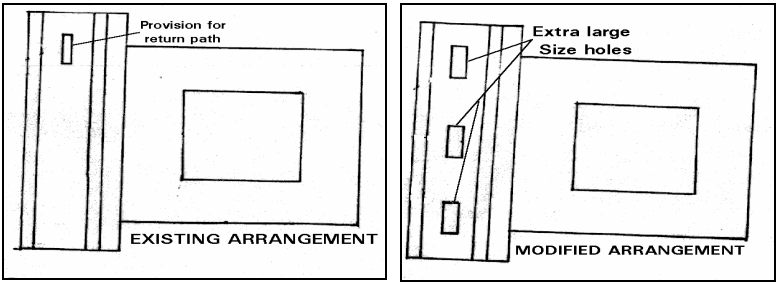

Figure 7.1

- A wool felt of 10 mm thick (IS: 1719 extra hard type) to be provided in place of existing wool felt of 5.4 mm thick.

- Felt/Shim of Synthetic/Nylon (Or any other non porous material) may be used in place of woollen felt.

7.2 MODIFICATION ON GEAR IN TWO HALVE

Replacement of squared headed screws of gear in two halve mounted on the axle by socket head cap screws(Allen screws) as shown in figure 7.2.

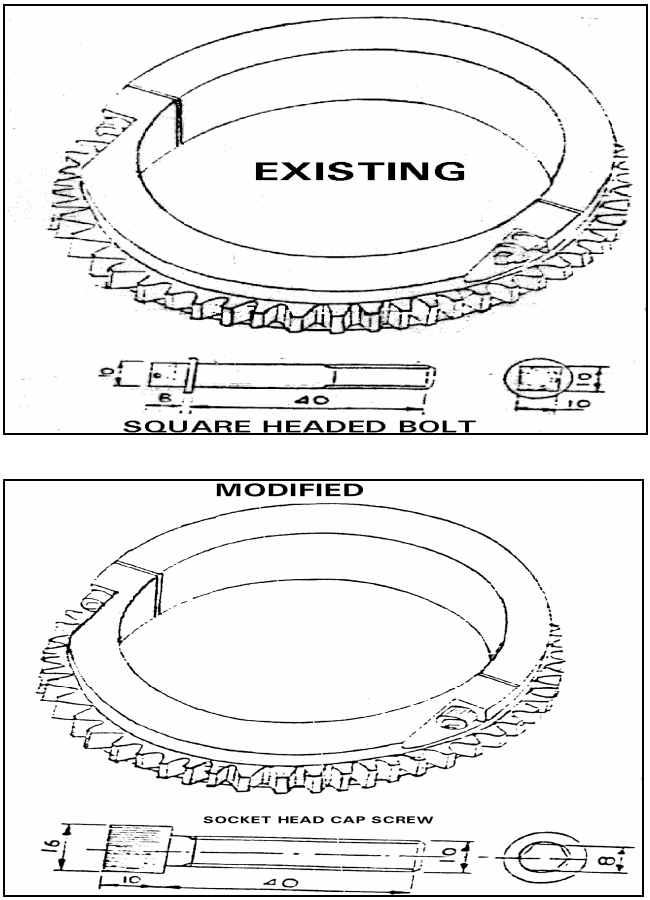

Figure 7.2

The gear in two halve mounted on the axle of locomotives drives the pinion of suspension bearing oil pump. The existing gear in two halve is tightened by four Nos. of square head screw of size M10 x 40 mm. But a considerable trouble is experienced while tightening or loosening the square headed screws because of the limited space available. Even proper tools for tightening the screws are not readily available. As such, socket head cap screws (Allen screws) of size M 10 x 40 mm with suitable spring washer may be provided. It will make possible to tighten the socket head cap screws (Allen screws by Allen key No. 8) on position without removing the axle from the bogie in case the same is found slack on the axle. Ultimately this will improve the reliability and reduce the down time of locos.

7.3 MODIFICATION ON LUBRICATING OIL PUMP

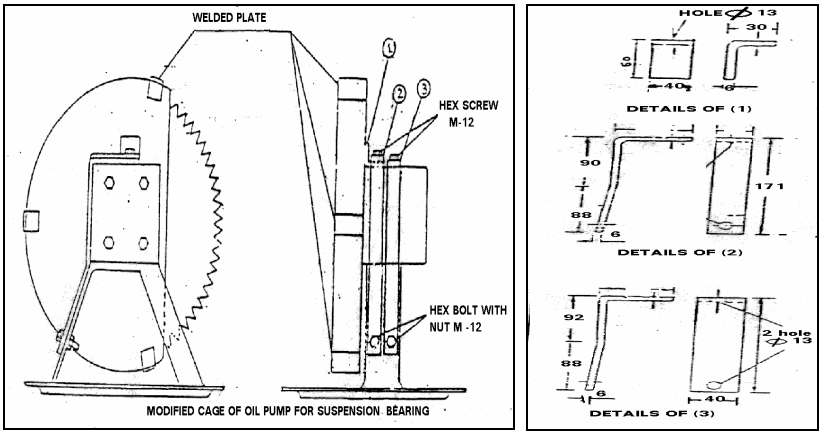

Figure 7.3

- Worked out of oil pump fixation bolts and strengthening oil pump bucket may be achieved by providing additional re-enforcement as shown in figure 7.3. This modification will ensure that oil pump and its bucket will remain in position even in case of failure of their fixation bolts.

- Reduction of weight of GITH pinion by curtailment of its width from 42 mm to 25 mm ultimately the weight will reduce from 4 kg to 2.3 kg (43% reduction).

- Nylon/Fibre or any other similar material having hardness from 150 to 225 BHN and light in weight may be used to manufacture the GITH pinion.

- The pinion shaft of oil pump with a tapped hole cross-sectional area of M10 x 25 is not sufficient to wear the load of existing GITH pinion causes breakage of pinion shaft from this location. Therefore, it is propose to increase the shaft length and secure the pinion with castle nut M14, as shown in figure 7.4.

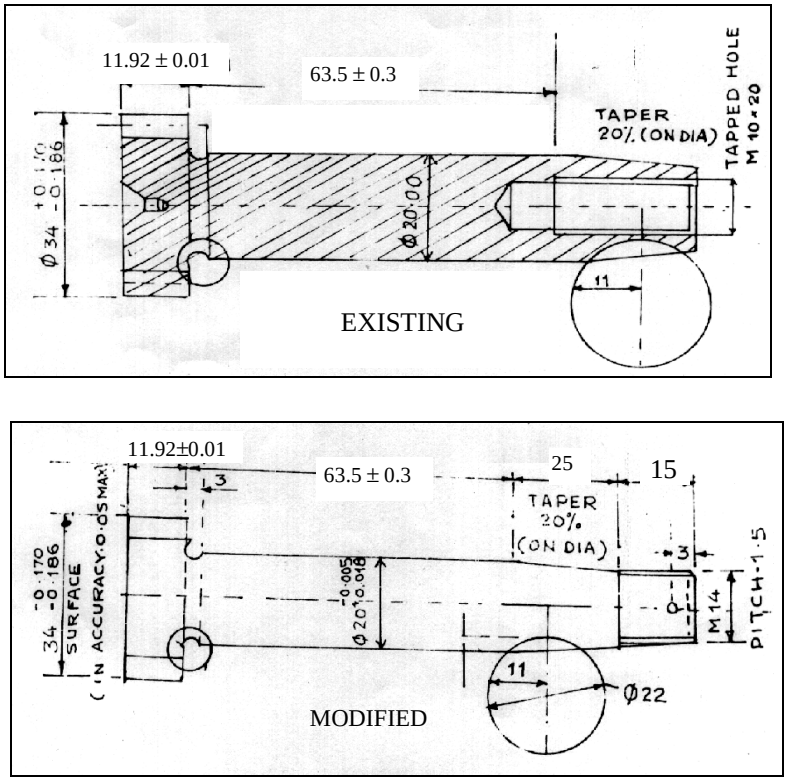

Figure 7.4

- Existing brass made oil pump body may be replaced with oil pump body made of steel alloy.

APPENDIX - A

SUGGESTIONS FROM VARIOUS ELECTRIC LOCO SHEDS

Sr. No	Shed/ Railway	Suggestions
01	ELS/BSL CR	RDSO had recommended "HELLISERT" inserts to avoid loosening of oil pump, its fixing bolt and axle cap fixing bolts.
02	ELS/ET CR	Inspite of torque wrench for tightening the axle cap bolts any suitable hydraulic tool should be used. Tested suspension bearing oil should be preserve in dust and moisture free atmosphere and a pipe line just like petrol pump to be connected, so that an artisan can fill up adequate quantity of suspension bearing oil easily. Entire white metal surface to be horned, so that maximum oil to be hold in horned pocket which will help to stop oil starvation.
03.	ELS/GZB NR	TM to be tested at least for 2 hours to ensure temperature rise on suspension bearing, any oil leakage, working of oil pump and wick pad etc.
04.	ELS/BRC WR	Instead of using plain packing, wire mash re-inforced packing should be provided between TM and axle cap.

APPENDIX-B

TRACTION MOTOR AND SUSPENSION BEARING CHANGING DETAILS

Loco No. ..... **Position** ..... **Date** .....**Shift** .....

1. TM/SB **Removed** **Provided**

a. Stator plate No. ....
b. Stator frame No. ....
c. Axle cap No. ....
d. Stator bore dia. ....
e. Last provided date ....

2. CONDITION OF SUSPENSION BEARING

PENION END AT(PE)	**COMMUTATOR END AT(CE)**
a. Collar	a. Collar .....
b. Edges	b. Edges .....
c. Whole body	c. Whole body .....

3. REMOVED BEARING

PE	**CE**
a. No.	a. No. .....
b. Make	b. Make .....
c. Last provided date	c. Last provided date ....
d. Previous size	d. Previous size .....
e. Current size	e. Current size .....

4. AXLE JOURNAL AT

PE	**CE**
Condition	Condition .....
Size a.	Size a. .....
b.	b. .....
c.	c. .....

5. REMOVED WHEEL-SET NO. .....

6. **COLLAR TO COLLAR DISTANCE** .....

7. PROVIDED WHEEL-SET NO. .....

8. COLLAR TO COLLAR DISTANCE .....

9. AXLE JOURNAL SIZE

PE	**CE**
a.	a. .....
b.	b. .....
c.	c. .....

10. DISTANCE BETWEEN BOGIE LUGS .....

11. FREE HEIGHT OF SANDWICH BLOCK .....

12. OIL PUMP CONDITION .....

13. CONDITION OF DOWEL PINS .....

14. WHETHER GEAR CASE OIL MIXING WITH SUSPENSION BEARING OIL .....

15. WICKS PAD

	PE	**CE**
a. Condition and movement	.....	.....
b. Condition of support assembly	.....	.....

16. SUSPENSION BEARING PROVIDED

	PE	**CE**
a. No.	.....	.....
b. Make	.....	.....
c. Size after fitting in axle cap and TM on shop floor		
a.	.....	.....
b.	.....	.....
c.	.....	.....

17. MATERIAL REQUIRED .....

18. REMARKS .....

SIGNATURE OF SHIFT INCHARGE

C/- Sr.DEE/DEE/AEE/Sr.SE (PPIO)