

Maintenance Pocketbook for SB , TAO-659 Ver 1.0

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INTRODUCTION

Axle suspension bearings are a vital part of traction system. They are oil film sleeved bearings. There is a severe impact due to track irregularities, lateral thrust & wheel skid. Approximately 60% of suspension bearing failure are due to oil starvation and remaining 40% failures are attributed to mixing of SB oil with gearcase oil, material failure, bad workmanship & crew account. Consequently if, SB is failed on line then the section is blocked for traffic. The cost of changing axle, SB, rehabilitation of axle cap & TM including manpower, comes to 2.5 lakhs approximately.

CHECKS BEFORE DISMOUNTING OF SUSPENSION BEARING:

- ◆ 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 sand with mounting block.
- ◆ Sealing condition of TM mounting bolts.

- ◆ Oil leakage from pump gasket, axle cap gasket, TM bolts , oil pump mounting bolts & mating surface of SB at CE, magnet 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 halves.
- ◆ Condition of oil pump.

**CHECKS AFTER DISMOUNTING THE
SUSPENSION BEARING**

- ◆ Oil pump (priority dismantled 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 jolly for blockage etc.
- ◆ Tightness of block on its foundation, which should not to be got loose.

- ◆ Free movement- simply driving by hand. Condition of pump gasket.
- ◆ Indicate/ note the worn out portion (condition of SB, 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 halves of SB from magnet frame & axle cap.
- ◆ Condition of back dowel & its housing on axle cap as well as half of SB on axle cap.
- ◆ Pitting mark etc. on both halves of SB at axle cap as well as magnet frame.
- ◆ Condition of axle cap gasket & surface.
- ◆ Any sort of deformity/damage at the end of the axle cap.
- ◆ Condition of wickpad cover and its gasket.
- ◆ Oil level in the upper sump at both ends i.e. PE & CE.
- ◆ Magnetic drain plug.
- ◆ Contamination of impurities, foreign bodies, metal pieces in oil at lower sump.
- ◆ Condition of wick pads assembly.
- ◆ Any deformity/damage appears at bearing housing & bore.

- ◆ Condition of threads for bolts M 36.
- ◆ Condition of gear in two halves.
- ◆ Condition of stoppers i.e. height & sharpness of stopper collar.
- ◆ Distance between stoppers (collar to collar distance).
- ◆ Size of axle journal diameter (three places) both at PE & CE.
- ◆ K-value of main gear & TM pinion.
- ◆ Distance between TM lugs.
- ◆ Distance between TM lugs.
- ◆ Condition of sandwich mounting block.
- ◆ Condition of gear case.
- ◆ Condition of gearcase felt (woollen).
- ◆ Condition of gearcase rubber felt (sealing), must be tight by adjustable.
- ◆ Condition of cardium compound.

**CHECKS BEFORE REASSEMBLY OF
SUSPENSION BEARING:**

- ◆ Measure the diameter of housing bore at least at three locations along the length of bearings, so that rattling of SB may be avoided.
- ◆ Measure axle journal diameter at least at three places on both PE & CE.
- ◆ Dowel pin on axle cap & half of SB should not be elongated.

- ◆ Edges for both half of a SB(either PE or CE) should be matched.
- ◆ Condition of threads on stator, gearcase boss & axle cap for oil pump should not be slacked.
- ◆ Stopper to stopper distance on wheel set should be $915 + 0.5 - 0$
- ◆ Check tightness of gear in two halve.
- ◆ Always use a wheel set having standard axle journal diameter i.e. 210, 208.5, 207, 205.5
- ◆ Entire axle cap must be well cleaned and free from dirt & dust.
- ◆ Clean & check gearcase for crackness etc.
- ◆ Check collar portion of SB for damage & deformity.
- ◆ Maintain diametrical clearance between 0.3 to 0.7 mm.
- ◆ Re-boring and machining should be avoided.
- ◆ Felts should be extra hard, properly baked with grease & should be secured by riveting.
- ◆ Oil pump should be perfectly tested.
- ◆ Gasket should be pasted by an adhesive on oil pump as well as on faces of axle cap.
Allow to dry out.

- ◆ Check spring action ,clogging of pads.
- ◆ Never use flat spring washers.
- ◆ All felts must be replaced during each and every change of either SB, TM or both.
- ◆ Rubber felt sealing between gearcase & axle must be secured by metallic adjustable belt.
- ◆ Maintain gap between bogie lugs as $304 +0 -0.75$ & between TM lugs as $304.8 + 0.75 -0$.
- ◆ Check height of nose pad (New 305 mm).
- ◆ Check condition of nose pad vertical pins, pin keeper and suspension holder. Run test with wheel set must be conducted at least for one hour before final fitment.

**INSPECTION SCHEDULE OF AXLE
SUSPENSION BEARING**

Part to be inspected	Section	Work to be carried out	I A	I B	I C	A O H
Traction motor axle Suspension bearing	M 1	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 bolt for tightness. Check the diametrical & lateral clearance & record.	*	*	*	*
Felt wick	M 1	Remove complete wick assembly & clean wicks by soaking them in specified lubricants.	*	*	*	*

		<p>After Soaking remove the foreign material from the lubricating surface with soft bristle brush; do not use wire bristle.</p> <p>Test wick by applying clean oil to lubricating surface. If oil is quickly absorbed condition of wick is good.</p> <p>Discard wick, if lubricating surface is burnt damaged or worn.</p> <p>Replace wick, when worn to 6 mm.</p>			*	*
Oil pump	M 1	<p>Remove oil pump assembly complete & test for its proper functioning.</p> <p>Dismantle, overhaul the pump.</p> <p>Inspect gear teeth for wear and damage.</p>			*	* * *

PREVENTIVE MEASURES:

The cases of SB metal out can be considerably reduced by implementing following preventive measures:

- ◆ Ultrasonic testing of all SBs before fitment.
- ◆ Avoid machining & re-boring of SBs.
- ◆ Limiting remating of a SB shell upto, three times (Max.), if shell is not distorted.
- ◆ Carefully handling during fitment.
- ◆ Stopping hammering on bearing for any reason.
- ◆ Try to use new bearings on passenger locos & released / old / locally remattalled / inferior bearings on goods locos or inferior services.
- ◆ Providing 100% replacement of SBs, gearcases, oilpump assembly, gear in two halves and main gears, if K- value is beyond the limit during POH.
- ◆ Introduction of new bearings regularly.
- ◆ Use of bronze collared bearings.
- ◆ Replacing of stoppers during re-discing / re-axling of wheel set.
- ◆ Checking / repairing for each and every ready wheel set for fitment which are received after transition.
- ◆ Adopt centrifugal method instead of gravity method for re-babbling suspension bearings.

COMMON DEFECTS, APPEARANCE & CAUSES

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S N	Type of defect	Appearance	Causes
1	Plastic deformation and / or melting	Superficial melting and flow of white metal may be confined to edges.	Overheated surface due to inadequate clearance, excessive load or insufficient oil supply.
2	Cracking and/ 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	Cavitation erosion due to changes in pressure of oil fills associated with

		joint faces or grooves. b. Pitting in both bearing and mating surface.	interrupted flow. Due to electrical discharge between mating surfaces, resulting from inadequate earthing.
4	Bond failure	Loss of lining, sometimes over large areas.	Poor pre-tinning of shells and incorrect lining technology.
5	Wear of bearing lining	a. Bear of bearing surface b. Bearing seizure due to metal to metal contact arising from breakdown of lubricant fill. 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.
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TYPE OF DEFECTS

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

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

ANALYSIS OF SB FAILURE

Analysis of SB failure prima facie shows starvation of lubricating oil in 60-70% cases.

The non availability can be due to :

1. Not topping up of oil during Trip Inspection (2000 Kms for Goods, 1500 Kms for coaching Locos).
2. 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 given below :

A. Failure of oil circulating system :

This primarily has three important reasons

1. Dis-lodging of pump from the housing :

This takes place due to incorrect fit of pump body & oil pump support. The correct fit is checked by measuring the dimension of oil pump support which is $86 +0.054 + 0 \text{ mm}$ and the pump body which is $86 +0.058 +$

0.0238 mm. If the dimensions are beyond the limit the pump starts rattling due to loose fit. This causes loosening of hex head screw M 12x30 and ultimately the pump drops from the support along with pin.

2. Poor discharge of pump:

Whenever the pump is overhauled it should be tested as per CLW's specification No. 4TES.092.004 dated 09.09.71 as follows :

- a. Preliminary check : The pump is suitably driven by a variable and reversible motor in either directions. There was no abnormal noise, vibration etc.
- b. Performance test :
 Free Delivery : The pump is run at different speeds with the outlet free in both directions and the output (Litres per minute) is obtained as follows :

RPM	OUTPUT
180	Motor failed 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
145 Litres per hour.

OR

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

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 halves. This can be caused by large lateral clearance between the axle suspension bearing and the stopper of the axle.

The taper portion of the pump gear spindle ,where the pinion is fitted is provided with a tapped hole of M 10x25. The cross section area is not sufficient to wear the load. The wear of the spindle during running also causes rattling with the load of pinion which is reversible in nature. This loads

results in fatigue failure of the spindle. To prevent this, the wear in the shaft has to be checked and it is to be ensured that the shaft is not fitted loose in the housing. The axle cap bolts are tightened with a torque wrench to a torque value of 50 m-Kg. 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.

B. Quality of wicks pad :

If the wicks pad do not provide adequate capillary action , the oil from the 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 shall be immersed in suspension bearing oil for 24 hours. If the oil reaches the pad portion which can be checked by moving finger on the pad

surface, the wicks pads capillary action is correct.

C. Contamination of suspension bearing oil

The contamination of oil can take place due to :

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

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

Testing for contamination in suspension bearing oil :

Spreading tendency of an oil depends on the 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
1.	Fresh oil	Uniform distributed spot without any specific stain on filter paper.
2.	Slightly contaminated (SCT) due to ingress of gear case compound.	Light brownish with chocolate tint evenly distributed
3.	Badly contaminated (BCT) due to ingress of gear case compound into the system.	Deep brown with chocolate tint.
4.	Slightly deteriorated (SDT) indicates partial deterioration of oil.	Slight blakish colour with evenly distributed tint.
5.	Burnt oil (BT) indicates deterioration due to burning and overheating .	Blakish colour with evenly distributed tint.
6.	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.