

**GOVERNMENT OF INDIA-MINISTRY OF RAILWAYS
RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW - 226 011**

No.EL/ 3.2.108

Date 31.01.2000

**SPECIAL MAINTENANCE INSTRUCTION
NO. RDSO / ELRS / SMI / 0216 – 2000 (Rev '0')**

1.0 TITLE : Maintenance practices , schedules , Do's and Don'ts to be followed for axle box assembly of WAP 1 /4 ,WAG 7 class of Electric Locomotives .

2.0 OBJECT: The problem of breakage of clamping plate bolts in middle axle boxes of WAP1/4 class of locomotives is being reported by the Railways since long. Subsequently with the induction of more and more WAG7 locomotives having similar type of axle box bearing arrangement, the problem of clamping plate bolts breakage in the middle wheel axle boxes of both WAP1/4 and WAG7 class of locomotives became more prominent beside problems of rotation of inner outer racers, rubbing of thrower in its housing, thrower being hit by roller of axle box bearing.

INSTRUCTION: Detailed analysis of the failures has revealed the lacunae in maintenance and manufacturing practices. Therefore following instruction are reiterated for compliance by C.L.W. , POH Shops , and Electric Loco Sheds.

3.1 DURING VARIOUS MAINTENANCE SCHEDULES :

The maintenance schedule for the axle boxes of WAP1/4 and WAG7 locomotives should be as under;

- i) Axle boxes of WAP1/4 locomotives to be overhauled during AOH and those of WAG7 to be overhauled during IOH as per procedure given by OEM/ RDSO. During overhauling, the initial filling quantity of the grease will be 2.75 Kg/axle box. For general instructions on attention to thrust pad type roller bearing and axle boxes, RDSO's MP.MI -04.004, alt '3' should be referred.
- ii) The end covers of newly overhauled / commissioned axle boxes should be opened after first 8000 KMS in case of WAP1/4 locomotives and first IA inspection in case of WAG7 locomotives to examine the condition of the grease near the bearings for metal contents and if it is in good condition. If everything is O.K. then end covers should be refitted and amount of grease lost in the end cover or during grease examination should be replenished by injecting into the axle boxes.
- iii) During IC (four monthly schedule), following schedule on the axle boxes of WAP1/4 and WAG7 should be followed;

- a) Open the end cover, clamping plate and remove loose bearing components from the axle box end till bearing and inner race are visible.
- b) Take the appropriate grease sample from the grease available near the bearing and send it for lab examination.
- c) Examine visible portion of the bearing and inner race for any abnormality.
- d) Inject grease in the axle box through calibrated grease gun pumping 100 strokes.
- e) Reassemble bearing components after cleaning them and replenishing the grease lost in the process of dis-assembly and re-assembly of bearing components.
- iv) Only for WAP1/4 locomotives, during IB schedule, end cover only should be opened to check the condition of grease and taking the grease sample from near the bearing and decision should be taken based on grease /bearing components' condition.
- v) The grease samples collected above in (iii) (b) & (iv) should be analysed in the lab as per procedure given below to determine for metal . In case metal content is more than 0.25 gms per 100 gm of grease, loco should be lifted and axle box is to be removed for detailed examination.

3.2 GREASING SCHEDULE :

S.N.	Class of locomotive	Schedule	Grease quantity to be injected
1.	WAP1/ WAP4	IC	100 strokes * of the grease gun through grease nipple alongwith replenishment of the grease lost while opening bearing end components and inspection of bearing
2.	WAG7	IC	-do-
3.	WAP1/4	AOH ** (Axle box to be overhauled)	2.75 Kg per axle box
4.	WAG7	IOH(Axle box to be overhauled)	-do-

- A healthy grease gun gives around 3 gms of grease per stroke on no load.
- **Overhauling schedule of axle boxes for WAP1/4 locos have been recommended as AOH because of their heavy duty.

3.3 MONITORING OF TEMPERATURE OF AXLE BOX :

For checking the axle box temperature of running locomotives, infra-red type temperature sensor recommended by RDSO vide Technical Circular No.EIRS/TC/0044 dt.26.7.99 should be available at all maintenance points and temperature of the axle boxes should be checked and recorded immediately on their arrival. In no case, a locomotive temperature rise of axle box more than 27 deg °C above ambient should be allowed to run without thorough examination of the concerned axle box.

3.4 DURING MANUFACTURING OF WHEEL SETS :

The utmost care should be exercised while machining axle in the CLW and workshops in respect of maintenance of various critical tolerances at important locations. No relaxation is to be permitted as far as tolerances of the axle bearing seat is concerned.

3.5 CHECK LIST FOR AXLE BOX ASSEMBLY MAINTENANCE:

- 1.0 Check the bearing seat on axle for following before mounting the inner racer;

	<u>Max</u>	<u>Min</u>
1.1 Axle journal dia	150.090 mm	150.065 mm
1.2 Ovality	0.0125 mm	-
1.3 Surface finish	0.8 Ra μ m	-
1.4 Taper	0.00015 mm/mm	-
2. Check the inner racer bore. Its dia should be as follows ;
Max - 150.022 mm
Min - 149.997 mm
3. Select the inner race in such a way that interference between the bearing seat on axle and inner race is in the range of 0.060 mm – 0.093 mm.
4. The axle box outer bore should be as follows ;
Max bore dia - 270.052 mm
Min bore dia - 270.00 mm
5. The clamping plate bolts for bearing of M/s NEI should be of property clause 8.8 and that of M/s FAG should be are of 10.9. These bolts should be tightened uniformly with 9 Kg-m torque using a torque wrench.
6. 1)The width of inner racer and distance piece of M/s NEI for WAP1/4 locos is 80.0 mm and 44.0 mm and for WAG7 locos is 80.0 mm and 52.0 mm respectively.
2)The width of inner racer and distance piece of M/s FAG for WAG7 locos is 86.0 mm and 40.0 mm and for WAP1/WAP4 locos is 86.0 mm and 32.0 mm respectively.
7. Checks to be carried out after axle box is assembled ;
 - a) Axial movement of 10.0 mm on middle axle boxes and 0.5 mm on end axle boxes.
 - b) Clearance between clamping plate inner collar and end face of axle as 3.0 mm
 - c) Radial clearance of 1.0 mm between outer spacing ring and clamping plate on middle axle boxes.
 - d) Minimum clearance of 1.0 mm between axle box end cover and axle box housing.
8. Grease to be used in the axle box;
 - i) Servogem RR-3 of M/s IOC
OR
 - ii) Multigrease LL3 of M/s Balmer Lawrie
Ref: RDSO's MP.MI-4 of June 1994)

9. Grease quantity to be used in the axle box;
 - i) During overhauling – 2.75 Kg/axle box
 - ii) During topping up in IC schedule – 100 strokes of the grease gun
(approximately 200 gms)
10. Maximum limit of metal content to be allowed in the axle box grease;

WAG7 } < .25 gms / 100 gms of grease
WAP1/4 }
11. The throwers of WAG7 axle box bearing and WAP1/4 axle box bearing appears to be same from outside dimensions but they are different in inside machining. It must be ensured that they do not get interchanged.
12. Inner racers and thrower should be heated up to a temperature not exceeding 130 deg C for a period not more than one hour before mounting.
13. After racer is mounted on the journal, 70 % to 90 % of initial interference between inner racer and journal should reflect by way of increase in outer dia of inner racer.
14. The felt seal should be treated with grease before fitment. After fitment it should be 1.5 mm above surface.
15. On the end axle boxes, after the clamping plate bolts are fully tightened, the clearance between outer thrust collar and inner thrust collar should be between 4.5 mm to 6.5 mm. The actual value should be determined with a filler guage. Conical thrust pad should be replaced if above clearance is not maintained.
16. While fixing axle box end cover, ensure sealing ring between axle box housing and end cover.
17. During overhauling of the axle box, always rotate the outer racer a quarter turn (15 ° deg) to bring into operation unused part. Mark the clock position and the date on which the said part brought into service by electric etching pencil on the outer race. This will minimise the danger of premature fatigue and / or spalling of load zone on the racer.
18. At the time of mounting the axle box on the middle wheel of WAP4/1 & WAG7 class of locomotives, it must be ensured that bore on the end face of both side of axle is of proper size i.e. 100 + 0.06 / -0.0 mm in dia and 8.00 mm in depth. In those cases where, bore is more than 100.00 mm, care should be taken to maintain the radial clearance of 1.0 mm between outer spacing ring and clamping plate. Wheel sets having depth of groove on the end face less than 5.0 mm must be sent back to workshops for rectification.
19. The interference limits between inner racers and bearing seat on journal for WAP1/4 & WAG7 class of locomotives should be from 0.060 mm to 0.093 mm. After inner racer is mounted on the journal and in cooled down to ambient temperature, the outer dia of the inner racer should be measured. If inner racer is fitted properly, there must be an increase in the outer dia of inner racer by 70 % - 90 % of initial interference between inner racer and journal.

20. The axle box cover also acts as a clamping plate for bearing components mounted in the axle box housing. Therefore, during assembly, it must be ensured that there is a positive gap of minimum 1.0 mm between axle box housing and axle box cover with all four axle cover mounting bolts in fully tight position.

17 INSPECTION PERFORMA FOR AXLE BOX HOUSING

CHECK SHEET FOR INSPECTION OF AXLE BOX HOUSING			DATE	
ITEM : Axle Box Housing			LOCO:	
DRG.No. :			POSITION:	
AXLE BOX NO. :				
Sr. No	Parameter	Specification	Observation	Remarks
1	Bore	270.0 -0.00 / +0.052		
2	Bore depth	294.0 +/-0.10		
3	Centre distance	260.0 +/-0.5		
4	Bush ID	70.0 -0.00/+0.19		
5	Dist.Over liner	310.0 -0.6/+0.00		
6	Bore	199.847 - 0.00/+0.127		
7	Step Bore	235.687 - 0.00/+0.25		
8	Bore	216.687 +/-0.25		
9	Width	69.0 +/-0.127		
10	P.C.D.	315.0 +/- -0.2		
11	Tapped hole	M22.0 x 50.0		
12	Dist bet Liner	210.00 - 0.00/+0.6		
13	Total Height	363.00		
14	Lab side width	44.0 - 0.5		
ALL DIMENSIONS ARE IN MM				
INSPECTED BY			APPROVED BY	

3.6 PROCEDURE FOR MOUNTING OF THROWER TYNER RACERS AND DISTANCE PIECE ON THE JOURNAL:

3.6.1 Oil bath heating :

The oil being used for heating the bearing components should be either of the following;

- YANTROL - 150 (HPL)
- SERVOLINE-150 (IOC)
- SERVOSYSTEM 68 (IOC)
- ENKLO - 68 (HPL)

- Inspect the axle journal for its correct size, surface finish, permissible taper and ovality as per the relevant drawing.

- II. Select the inner racer by measuring the inner bore so that interference between inner racer and bearing seat on journal is between 0.060 mm – 0.093 mm. Also measure the outer dia of selected inner racer at this stage.
- III. Clean thoroughly the bearing seat on axle and all the taped holes (so that they are free of any chips).
- IV. Clean thoroughly the thrower, inner racers and the distance piece with kerosene oil and subsequently with petrol when dried up.
- V. Put on the supply for oil bath and wait till temperature is attained as 130 deg^o C and temperature controller cuts off the supply to the oil bath.
- VI. As soon as the supply to the oil bath is cut off by the temperature controller, immerse thrower and inner racers separately in the oil bath in such a way that they should remain suspended in the oil.
- VII. After around 20 minutes remove thrower from the oil and shrink it on the axle ensuring its positive abutment with axle shoulder. Use a pusher tool and a 'L' gauge as to ensure its seating on its proper place. Ref: RDSO's MP.ML.04.004.alt '3'.
- VIII. Immediately after, shrink the two inner racers separately with distance piece between them on the axle using a pusher tool. Care must be taken to make sure that all abutting faces are in contact and the mounting is square.
- IX. After step viii above, measure the distance between outer inner racer and journal end face. It should be around 20.0 mm if all components have sat on their place properly.
- X. Measure the outer dia of inner racer after it is cooled down to room temperature. There must be an increase in the outer dia by 70 % to 90 % of the initial interference between inner racer and journal.

3.6.2 Using induction heating

- I. The procedure similar to above from para 1 to IV should be followed.
- II. Place thrower in the induction heater and heat up to 120 deg^o C, set with the help of temperature controller. On attaining a temperature of 120 deg^o C, take out thrower using a tong or by wearing asbestos gloves and shrink it on the axle as per procedure given above in para VII.
- III. Now heat both the inner racers upto 120 deg^o C and shrink them separately with inner distance piece in between them on the axle as per procedure given above in para VIII.
- IV. Check the distance between outer inner racer and end face of axle as well as outer dia of inner racer as per para IX and X above.

3.7 WEAR DEBRIS ANALYSIS OF AXLE BOX GREASE :

3.7.1 Methodology :

Grease samples from all the twelve axle boxes of the locomotive undergoing IC/AOH/IOH schedule inspection for WAG7 and IB / IC/ AOH / IOH for WAP 1/ 4 schedule inspection are collected separately in separate containers. The grease is collected from a thin metallic stick from the area near the bearings. Approximately 100 gms of sample is weighed for each axle box and transferred to a beaker. Now approximately 250 cc of petrol is added to each beaker and they are covered with glass lids. After 10-15 minutes, each grease sample with petrol is stirred vigorously for about 5 minutes using electric stirrer so that the grease

gets dissolved completely with petrol leaving the solid particles as sediments. The contents are allowed to settle for 15-20 minutes, so that suspended metallic and non-metallic contaminants settle at the bottom of the beaker and soap content of the grease float at the top. The soap and oil content is separated from the solids by decantation taking care that metallic particles are drained out.

The sediments in the beaker containing contaminants of residual grease are further stirred by adding 100 cc of fresh petrol. The solids are allowed to settle for about 10 minutes and separated from the liquid by decantation. The process is repeated till the oily substance is completely separated from the solid contaminants. These solid particles are dried in a oven for 1 hour at 80 deg centigrade and cooled to room temperature.

3.7.2 Quantitative Analysis :

1. The total weight of contaminants present in each container is weighed in a balance and the weight is noted. Let this weight = W_1 mg
2. The ferrous portion of the contaminants is removed with the help of a magnetic rod. The left over portion is again weighed in a balance and the weight is noted. Let this weight is = W_2 mg. This will be the weight of the non-ferrous content in the axle box.
3. Weight of the ferrous content present in the particular axle box = $(W_1 - W_2)$ mg

3.7.3 Observations and actions to be taken :

<u>Amount of metallic content</u>	<u>Action to be taken</u>
1. If ferrous content is less than 0.25 gms in 100 gms of grease sample.	The axle box condition is considered satisfactory and it is allowed in service after replenishing with fresh grease, if no other abnormality is noticed.
2. If ferrous content is more than 0.25 gms in 100 gms of grease sample.	The axle box is to be removed from the locomotive after lifting the loco. The axle box should be dismantled to check for any defect.

3.8 DO'S AND DON'TS :

DO's and DON'Ts of Axle Box Bearing Maintenance

- 1.0 DO's :-
- 1.1 Store all bearings / bearing spares in a dry and sheltered place. All precautions must be taken to ensure that no dampness is available at the storage place.
- 1.2 Except bronze cage, all bearing parts and all machined surfaces of axle box and its parts should be kept greased to prevent rusting while in storage.
- 1.3 Bearings should be stored flat, resting on their entire circumference.
- 1.4 Adopt 'First In First Out' while drawing the bearing from the stores.
- 1.5 Keep your hands clean while handling bearings.
- 1.6 During assembly operations, ensure that absolute cleanliness is maintained.

- 1.7 If it is found necessary to do electric welding anywhere on locos with axle roller bearings, the grounding cable must be clamped to/ or near the part being welded to prevent any current passing through the bearings.
- 1.8 Use asbestos gloves while handling hot thrower / inner racers.
- 1.9 If thrower and inner racers are not being immediately mounted on journals that are ready in all respects, then bearing seat on journals should be protected at all times against possible damage from moisture, dust / dirt or other substances.
- 1.10 If wheel and axle assembly is not being immediately fitted in the bogie, turn each axle box a few times every few days to prevent the parts from remaining in the same position for any appreciable length of time.
- 1.11 While assembling the axle box after overhauling in major schedules, always inspect for fretting corrosion between inner racer and axle journal. Fretting reduces the solid contact between the inner racer and the journal, causing the inner racer to become loose.
- 1.12 While overhauling the axle box in major schedule, always check the axle box bore to ensure it is within prescribed limit.
- 1.13 Keep a complete inspection record at the shed at all times using axle box and axle serial no. and axle box location alongwith make of axle box and bearing on all locos for future reference.
- 1.14 While welding manganese liners on the axle box, keep the axle box submerged in the water except the area where welds are to be applied to avoid any possibility of distortion.
- 1.15 Always use calibrated pressure grease gun for axle box greasing.
- 1.16 Use only the grease recommended by RDSO vide MP.MI-4 of June 1994
- 1.17 Always protect the axle box and its accessories from dirt and dust until reassembly.
- 1.18 Ensure periodic calibration of measuring instruments and gauges.
- 1.19 Check the free rotation of the bearing prior to its mounting. Also check the radial clearance of the bearing prior to its mounting and ensure that the same is within specified limits prescribed by the bearing manufacturer.
- 1.17 For accurate measurement of axle / axle box dimensions, digital calipers micrometers with an accuracy of 0.001 mm of the reputed make like M/s. Mitutoyo, Japan should be available in CLW, all the workshops as well as in electric sheds. These instruments should also be got calibrated periodically. Use of digital measuring instruments will eliminate the possibility of human error during measurements.
- 1.18 Induction heaters, both for mounting and dismounting of inner racers should be available in the CLW, workshops and sheds. Induction heater for mounting of inner racer are common for all type of bearings but induction heater for dismounting of inner racers are basically induction coils of specific size meant only for a particular dia inner racer.
- 1.19 Utmost care should be taken to ensure application of proper pressure at the time of pressing of wheel discs on the axle, as excess pressure is likely to create swelling on the journal near the bearing seat. All such axles if found in the sheds, should be sent back to workshops for rectification.

2.0 DON'Ts

- 2.1 Bearings should not preferably be stored in assembled condition.
- 2.2 Do not remove bearing parts from original packings until immediately before assembly.
- 2.3 Do not allow the temperature to exceed more than 130° deg C while heating the thrower / inner racer at the time of mounting.
- 2.4 No welding of manganese liners should be done on axle boxes with bearings in position.
- 2.5 Never mix up the two different brands of greases in the same axle box.
- 2.6 Do not over grease the axle box.
- 2.7 Never allow the axle box to run warm continuously without thorough examination.
- 2.8 Do not heat the grease to facilitate application.
- 2.9 Avoid mixing up of the components of different bearings or make.
- 2.10 Never use flame heating or welding torches for extracting the racers/ throwers which are to be reused or once again to be put into service.
- 2.11 Never compromise with critical dimensions / tolerances on axle box or bearing.
- 2.12 Avoid use of cotton waste or dirty clothes to wipe the bearings.
- 2.13 Never scratch or nick the bearing critical surfaces.
- 2.14 In case of improper finish on the bearing seat, it should not be manually polished either in the sheds or workshops as it is likely to cause the ovality on the bearing seat.

4.0 INSTRUCTION DRAWING :

BEARING AND AXLE BOX DRG. DETAILS OF M/S NEI AS WELL AS M/S FAG

S.N	Type of Axle Box	Type of Bearing		Type of Locomotive	Axle Box Drg. No.	
		FAG	NEI		FAG	NEI
1.	Conventional	WJ/WJP 150 x 270 M1.C4	L6204 L6205	WAM4, WAM4A, WCAM1, WCG2, WAG5A, WAG5H	901-02- 101	92-4271 C
2.	High speed with thrust pad	WUZ 150 x 270 M1.C4	RB 5020	WAG7, WCAM3, WCAG1	901-20- 101	X-171
3.	High speed with thrust pad	WUZ 150 x 270 M1.C4	RB 5020	WAM4, WAG5 WCAM2	901-17- 101	X-105
4.	High speed with thrust pad	WUZ 150 x 270 M1.C4	RB 5020	WAP1/WAP4	901-26 101	X-122

4.2 FITS AND TOLERANCES AS WELL AS BOUNDARY DIMENSIONS OF ROLLER BEARINGS USED IN NEI AXLE BOXES
(NEI's letter No. R & D/X-122E/MF-2052 dated 17.8.99)

1. Boundary Dimensions of Bearing Races and Loose Lips :

S.N.	NEI BRG No.	Part Description	Size & Tolerances (mm)	Max. Dia (mm)	Min. Dia (mm)
1.	L6204/ L6205	Outer race and roller assembly	Outer Dia = $270 \pm 0 / -0.035$ (Ref : ISO-492 & IS:5692, Class Normal)	270.00	269.965
2.	L6204 L6205 RB 5020	Lipped Inner Plain Inner Plain Inner	Bore = $150.022 \pm 0 / -0.025$ (Ref : ISO-492 & IS:5692, Class Normal)	160.022	149.997
3.	L6205	Loose Lips	Bore = $150.101 \pm 0.025 - 0.0$ (Part in located on journal)	150.126	150.101
4.	RB5021 RB5022	Special Loose Lips	Bore = $151.003 \pm 0 / -0.250$ (Part in located on L/R TRK)	151.253	150.753

2. Fits with respect to Journal Dia and Housing Bore :

Journal Dia (mm)	Inner Ring Bore (mm)	Fit	Class of Fit
150.090 (Max) 150.065 (Min)	150.022 (Max) 149.997 (Min)	0.043 mm to 0.093 mm (Interference fit)	p6 STD
Outer Race Outer Dia (mm)	Housing Bore Dia (mm)	Fit	Class of Fit
270.000 (Max) 269.965 (Min)	270.052 (Max) 270.000 (Min)	-0.0 mm to 0.087 mm (slide fit)	H7 STD

5.0 APPLICATION: Axle and Axle Box Assembly of WAP 1 , WAP 4 and WAG 7 class of Electric Locomotives.

6.0 AGENCY OFF IMPLEMENTATION : All Electric Loco Sheds , POH Workshops . C.L.W.


7.0 PERIODICITY OF IMPLIMENTATION : IC , AOH, POH, Mfg. Stage

8.0 REFERENCE :

1. RDSO's report No. ELRS / IR / 0091 (Rev. 'O') of OCT. 1999.
2. RDSO's MP.MI .04.004 alt '3'
3. CLW's Axle drg. No. 06/2/11/3 alt '2'

9.0 DISTRIBUTION : As per Mailing List No. EL/ M / 0028 / Ver '0'

Encl. NIL


A. K. Gupta
 For DG / Elect Std