सत्यमेव जयते

GOVERNMENT OF INDIA

MINISTRY OF RAILWAYS

Technical Audit Report of Electric Loco Shed, Lallaguda, for maintenance of bearings of three phase locomotive Traction Motors (TM) and Motor Suspension Units (MSU)

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Approved by	29.3.16
EDSE(Co-Ord)	**Signature**

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Electrical Directorate
Research, Designs and Standards Organisation
Manak Nagar, Lucknow-226011

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Status of Revision

SN.	Date of Revision	Page No.	Revision	Reason for Revision
1.				Originally issued in letter form vide letter no. EL/2.2.13 dated 16.12.2015
2.		All	0	Issued in Technical Audit Report Format

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1. Technical audit of maintenance practices for 3-phase traction motor bearings:

Technical audit of maintenance practices for 3-phase traction motor bearings has been carried out jointly in association with M/s FAG & M/s SKF on 2.12.2015 & 3.12.2015. Observations are given below:

(i) **Bearing storage*:*** Bearings were stored in a dry room, separated from other components. Stacked horizontally on pallets not more than 5 bearings in a single stack but adjacent to wall. Shed uses FIFO system to use the bearing from the stores.

Recommendation: Advised to keep the bearings little away from walls to avoid ingress of water/moisture.

(ii) **Handling:** Bearings are kept carefully to a place nearer to the mounting area to avoid any damage. Handling of bearings was done with bare hands.

Recommendation: Bearings should be handled with protective industrial gloves. Lint free cloth should be used for cleaning purpose.

(iii) **Measurements taken before mounting:** Shaft diameter in both DE & NDE sides were taken by outside digital Micrometer & found within limits. The end frame housing bore diameter (for DE & NDE) also measured with bore dial gauge with least count of 1 Micron & found within limit.

(iv) **Bearing mounting area:** Found almost clean & separated from dismounting area.

Recommendation: Further scope of improvement to clean the area is still there.

(v) **Wall Charts display & work instruction:** Necessary wall charts displaying critical parameters, work instructions & MOH activities were available at places.

(vi) **Grease:**

i) The grease used for the bearings is Servoplex SHC 120.

ii) Grease is kept in a big covered drum nearer to the mounting area & used in a small covered container while mounting. A separate covered room has been provided for storage of the grease.

iii) Greasing is done by Hydraulic grease gun with proper measurement of grease which has been verified during this audit.

iv) Greasing schedule followed by the shed is as under

Type of Loco	Quantity of grease		Schedule	Remarks
	NDE	DE		
WAP 7	35 strokes	105 strokes	1st IB & 2nd IA	i) During IB after IC/Major Schedule ii) During IA after IC (every 6 months)
WAG 9	25 strokes	75 strokes		

Note: 1 stroke = 4.3 Gms

Shed is providing different grease quantity in WAG-9 & WAP-7 locomotives.
It was informed that grease does not come out from the grease outlet provided at NDE side. A trial was conducted and when 74 strokes (318 gm) of grease were pumped through inlet of 6FRA 6068 TM at NDE side fitted in WAP 7 Loco No 30298, the grease just appeared at the outlet.

(vii) **Heating the bearing inner rings & the End frame**: Bearing inner rings are heated with the induction heater kept in an open atmosphere and the end frames are heated in the heating oven. The induction heater used is very old Inventum make without having the basic facilities like temperature display, temperature hold, auto cut off & de-magnetization. Temperature of the rings was measured by hand held temperature gun which was also not calibrated.

NDE side inner ring was heated up to 65 degree Celsius and DE side inner ring was heated up to 82 degree Celsius

To heat the end frame inside the oven, the inside temperature of the oven is kept at 170 degree Celsius.

It is also observed that during placing the inner ring over the induction heater edge, the racer was not suspended fully & rubbing with the metal base.

Photo 1: Old Induction Heater

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Recommendation: ELS/LGD has been advised to procure and use induction heater having basic features of temperature display, temperature hold, auto cut-off & de-magnetization.

(viii) Measurement of mating parts: Shed has made the check sheets for measurements of all critical mating parts before fitment.

Recommendation: All shed should follow the same practice & non confirming mating parts should not be used for assembly to avoid failures.

(ix) Measurement of Radial Clearance (RC) after assembly: Shed is measuring DE end RC by use of feeler gauge in case of WAG-9 and by using jack and dial gauge in case of WAP-7 locomotives.

RC of one traction motor (TM No. TMTG-874 (unmodified), RTG-567/533 CLW Sch-1; with bearing details: DE side New SKF (Germany) 11 036M; NDE side New SKF (Germany) 336L) was measured both by feeler gauge and jack method and results are given below

DE 70 micron by feeler gauge.
NDE 60 micron by feeler gauge.
DE 95 micron by using jack and dial gauge at 40 mm distance on pinion (110X0.86).

Recommendation:
Shed is advised to use the method of RC measurement as given in SMI-278.

(x) Colour matching of pinion with tapered shaft: Shed is not checking the colour matching of tapered shaft of pinion.

Recommendation:
Shed is advised to follow SMI-278 completely.

(xi) Mounting of the bearings: For Cylindrical roller bearing the outer ring with roller assembly already fitted in end frame should be lowered carefully in magnet frame to avoid oblique mounting and mounting marks on inner race. Little swiveling movement should be done on end frame to avoid mounting marks.

2. **Joint inspection for MSU failures**

(i) ELS/LGD has experienced increasing trend in MSU failures in WAG-9/WAP-7 locomotives. Since April 2013, 20 MSU had failed in WAP-7 locomotives and 5 in WAG-9 locomotives. Majority of these failures are due to breakage of supporting ring socket head screw (15 in WAP-7 & 2 in WAG-9).

(ii) Out of 20 failures in WAP-7, 15 failure are due to breakage of supporting ring head screw broken; 1 case is due to bearing abnormal sound; 1 case is due to DE bearing cage broken; 1 case is due to non-gear end MSU bearing stopper hub shifted (slipped from press fit position);1 case is due to bull gear side labyrinth ring fixing bolts broken, and 1 case is due to smoke from MSU NDE bearing.

(iii) Out of 5 failures in WAG-9, 2 cases are due to supporting ring socket head screw broken; 1 case is due to NDE grease throwing, 1 case is due to abnormal sound and 1 case is due to shifting of MSU towards bearing end and rubbing of bull gear and gear case.

(iv) Joint inspection of failed 4 number MSUs available on shop floor as detailed below, had been carried out on 3.12.2015 in association with M/s KMRI & M/s KPE:

S. N.	**Loco No.**	**MSU**						**Reason of failures.**
		D.O.C	**D.O.F**	**Wheel set in**	**Position**	**Gap b/w bearing support ring and bearing housing (0.1 – 0.7 mm)**	**Lateral Play (0.25-0.48 mm)**	
1	30286	10.2.11	11.11.15 KP	TG 27-28	5	0.25 mm	Cannot be checked, as bearing seized	Smoke emission from DE side MSU bearing
2	30253	28.10.09	13.11.15 KP	TPP 20-09	1	0.15 mm	Cannot be checked, as bearing seized	Smoke emission from NDE side MSU bearing
3	31251	17.08.10	16.11.15	TG 02-28	3	Cannot be measured as, supporting ring shifted	0.8 mm	Supporting end fixing bolts broken and fallen.
4	31472	30.03.14	02.12.15 CLW	TG 30-53	2	Less than 0.05mm	6.5 mm	Lateral play more.

(v) The lateral play and gap between supporting ring and bearing housing was measured in good wheel sets and recorded below.

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S.No	DOC	MSU make	Wheel set No.	Gap between bull gear side bearing supporting ring & bearing housing (0.1 – 0.7 mm)	Lateral Play (0.25 – 0.48 mm)	Remarks
1	Under commissioning	TEW	A 1197	Less than 0.05mm	1.2 mm	Received from ELW/BSL
2	09.11.12	KM	TG 12-23	Less than0.05mm	1.0 mm	received from ELW/BSL in place of TPP 17-12 (OLD serviceable wheel set)
3	Under commissioning	KP	ELW 3612	Less than 0.05mm	0.8 mm	Received from ELW/BSL
4	21.05.15	KM	TPP 24-08	Less than 0.05mm	1.0 mm	Wheel set provided at GZB in place of A 1820
5	28.10.09	KP	TPP 22-09	Less than 0.05mm	0.6 mm	Received along with loco No. 30258 &RD +ST/OH done at ELW/BSL on 04.05.15
6	31.10.09	KM	TG 12-25	0.20mm	0.9 mm	Received along with loco No. 30262
7	07.07.08	KM	TG 13-14	Less than 0.05mm	0.25 mm	Details not available
8	07.04.11	KP	TPP 48-15	Less than 0.05mm	0.4 mm	Received along with loco No. 30290 &RD + ST/OH done at ELW/BSL. On 18.09.15

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(vi) M/s KPE& M/s KMRI will submit their detailed technical report separately to RDSO.

(vii) As per ABB Drg. No. 3EHW 411 480, Item no.14, M 12X30 (8.8 class) socket head screw is provided in supporting ring and it has to be tightened with 80NM torque.

(viii) No broken screw could be collected from ELS/LGD due to inaccessible location. Sample of 'LB' make sockethead screw removed from MSU labyrinth of released wheelset has been collected from ELS/LGD and sent for chemical and metallurgical examination to M&C directorate. RDSO has observed that as per CLW specification no. CLW/MS/3/049 Alt. 4, 'LB' is not approved make for use in MSU application of WAG-9 locomotive.

(ix) Lateral play of MSU (axial end play in NDE bearing) should be in range of 0.25 to 0.48 mm. It has been measured in 2 failed MSUs and 8 spare wheelsets and it was out of range in 8 cases and within range in only two cases.

(x) Gap between supporting ring and suspension tube should be in range of 0.1 to 0.7 mm. It has been measured in 3 failed MSUs and 8 spare wheelsets and it was out of range in 8 cases and within range in only 3 cases.

(xi) From the above, it is apparent that the clearances specified by the OEM are not followed properly. RDSO will issue a detailed technical circular on MSU separately.

(xii) ELS/LGD has been advised to collect the data sheets of failed MSUs from Workshops.

3. **Observations related to Hitachi Traction Motor**

(i) Commutator profiler is lying defective.

(ii) Drop test procedure was seen and the staff and supervisor were counselled for following the proper procedure as given in SMI-51. The staff was not aware about significance of placement of current and potential probes. It was also advised to use a proper probe having current and potential leads spaced apart 20mm.

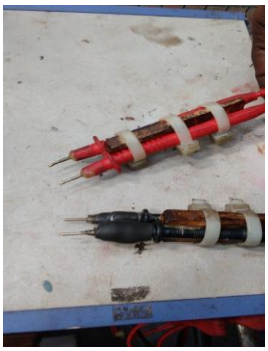

Photo 2: Drop Test Probes

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(iii) It was informed that ELS/LGD had stopped using Bactol Red and TVA1410 is used.

(iv) It is observed that shed is varnishing the brush box holders. It should be stopped with immediate effect. The painted brush boxes should be cleaned at the first available opportunity.

Photo 3: Varnished Brush Holder

(v) V-grooving (End Chamfering) is not being done on commutator segments after machining; it may leads to flashing of TM due to accumulation of carbon dust. Shed is advised to follow the Special Maintenance Instruction No. RDSO/ELRS/SMI/31 dated 24.10.78 for undercutting and chamfering of Traction motor Commutators completely.

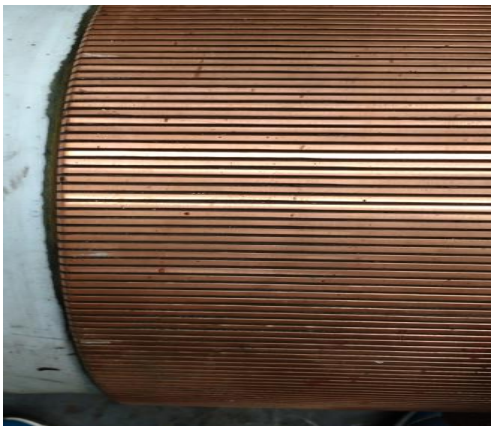

Photo 4 & 5: Commutators without V- grooving

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4. **Other observations:**

(i) ELS/LGD had informed that MS-387 (to provide grease outlet at NDE side) had been implemented in 623 TMs out of total 954 TMs. It has to be verified/ carried out in remaining 331 TMs.

(ii) **Storage of grease**: In order to prevent contamination and moisture ingress, grease shall be stored and handled as per RDSO TC NO RDSO/2010/EL/TC/0104- Rev-0.

(iii) **Monitoring of TM History & Codal Life**:
While reporting/investigating any failure on traction motor, its complete history needs to be checked. e.g. Manufacturing date of TM, rewinding dates and agency of rewinding, whether TM has completed its codal life etc. It will help in analysis and establishing the failure patterns, if any.

(iv) **Interaction with other sheds**:
Officers and supervisors of the shed should be in regular communication with their counterparts in other sheds about the performance of their respective equipments. Majority of the problems are maintenance related, not design related and regular interaction will help in overcoming them.

(v) **Implementation of RDSO's SMI/MS/TCs:**
These documents are available on RDSO website. The shed has to evolve a system so that the section shall have not only copies of all these relevant documents, but their implementation plan too. This has to be monitored by respective officers & supervisors on regular basis.

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