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No. EL/3.2.182(Part)

Date: As signed

Principal Chief Electrical engineer,
Central Railway, Mumbai-CST-400001


Sub: Technical Audit Report No. RDSO/2025/EL/TAR/0038 Rev. '0' dated 13.03.2025 on Traction motor (6FRA6068) maintenance at Electric Loco Work-Shop/Bhusaval.

Ref: (i) RDSO's letter no. EL/3.2.182 dated 20.02.2025.

(ii) MoM issued vide RDSO's letter No.EL/2.2.13 dated 03.02.2025.

In Ref. to subject mentioned above the Technical audit for maintenance practices of Traction motor (type 6FRA6068) has been carried out by RDSO at ELW/POH/BSL from 24.02.2025 to 26.02.2025.

The detailed Technical Audit Report is hereby enclosed for your kind information please.


(Sanjay Kumar Tiwari)
for Director General/Elect

Copy to:

1. ED/EE/RS- (1 & 2), Railway Board, Rail Bhawan, New Delhi-110001: for information only.
2. CWM/POH/BSL: for information & necessary action.

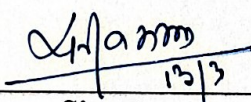


GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

**Technical Audit Report of Electric Loco Work Shop
/BSL for maintenance of three phase locomotive
Traction Motors (TM) type-6FRA6068**

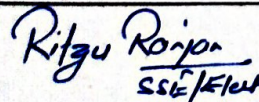
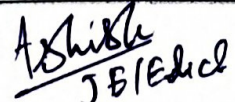
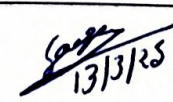
Report No.: RDSO/2025/EL/TAR/0038 Rev '0'

Issue Date: --13/03/2025

Approved by	
PED/Traction	Signature

Audit Done By
RDSO/LKO

Issued by
Traction & Power Supply Directorate
Research, Designs and Standards Organisation
Manak Nagar, Lucknow-226011

Prepared By	Checked By	Issued By
 SSE/ELWT	 J E/Edict	 13/3/25

Status of Revision

SN.	Date of Revision	Page No.	Revision	Reason for Revision
1.	-	-	0	1st Issue of Technical Audit Report

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<i>Ritzu Rorjon</i> SSE/ELT	<i>Aswini</i> SB/ELT	<i>Sas</i> 13/3/25

Technical Audit report on 3-phase TM overhauling practices at POH/BSL

ELW/BSL had experienced five cases of traction motor bearing failures in F/Y 2024-2025. These traction motor were overhauled by ELW/BSL during POH. Due to large no of failure occurring in TM overhauled by ELW/POH, it has been decided during meeting held at RB on dated 29/1/2025 for "Traction Motor Bearing reliability improvement" to conduct technical audit of traction motor type 6FRA6068 overhauling practices at ELW/BSL. Accordingly SSE/RDSO Lucknow had carried out technical audit of traction motor overhauling practices of three phase traction motor type 6FRA6068 of ELW/BSL from 24.02.2025 to 26.02.2025. Observations noted during audit are as under:-

A) Bearings storage:-

- i) Adjacent to the traction motor assembly area, the bearing storage room is provided. The room has provision of number of concrete shelves for storage of bearings. Bearing boxes were found lying on floor of the room instead of properly stacking in shelves. It was advised that practice of FIFO (first in first out) is being followed but no such demarcation has been done. The bearing storage room was provided with two number split AC's and both were found in working condition and the room was sufficiently cool.



Bearings lying on shop floor

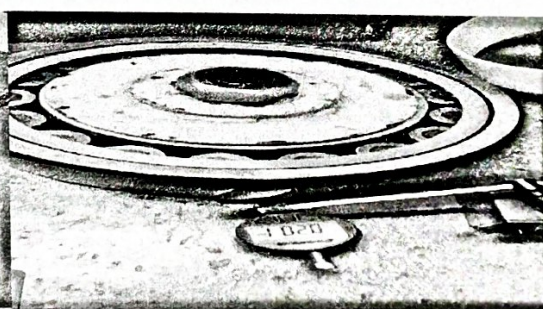
Bearings placed in the corner

Two installed split ACs

- ii) Free radial clearance of all bearings were checked using dial gauge with least count of 1 micron and noted before use of particular bearing.



FRC Measurement of NDE



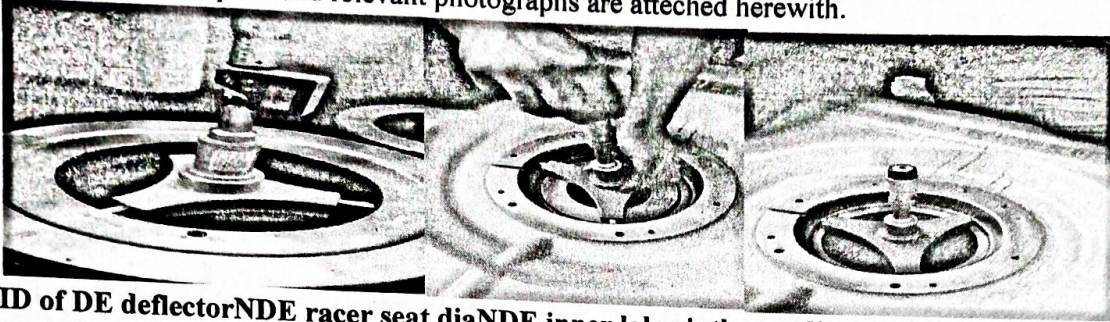
FRC Measurement of DE

- 2 ELW/BSL rejected 2 Nos of DE (NU2236) bearings on account of less FRC (Free Radial Clearance) of 159 & 161 micron of M/s NBC India (M.f.g- 09/2024) and two Nos FAG/India bearing due to overheating issues during light run test.

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B) Recording of various parameter during assembly of TM type 6FRA-6068:-

- i) RDSO issued final check sheet for recording of various parameter during assembly /overhauling of TM type 6FRA 6068 to PUs, ZRs & OEMs vide letter No. EL/3.2.182/Comments/3 Ph dated 02.12.2024. One TM assembly was witnessed by SSE/RDSO and various parameters were recorded during assembly. The details of dimensions measured are provided in the filled check-sheet attached as annexure to this report and relevant photographs are attached herewith.



ID of DE deflector NDE racer seat dia NDE inner labyrinth seat dia

SNo	FRC limits as per check-sheet	Observed value
1	FRC of DE bearing NU-2236 (170 to 220 Micron)	201 micron
2	FRC of NDE bearing NH-320 (105 to 140 Micron)	128 micron

- ii) Bore gauges of 1 micron least count was available with the POH shop for measurement of internal diameter of components as advised vide RDSO SMI-318. Out of total 3 no available bore gauges, two were found un-calibrated during audit.
- ii) During audit 3D-CMM report of TM assembly components was not available with the assembly shop. Neither it was available with the main store depot. 3-D CMM reports of assembly components are usually available maximum 60 days on portal, there after same cannot be down-loaded.
- iii) Various assembly components of TM 6FRA6068 (11 items) is stocked against four different PL numbers whose details are mentioned below.

SNo	PL number	Description of items/Drawing number
1	29940096	i) Inner Labyrinth (DE)/4TWD.096.043 ALT-7 ii) Outer Bearing Cap (DE)/1TWD.096.006 ALT-8 iii) Inner Labyrinth (DE)/4TWD.096.028 ALT-6 iv) Outer Labyrinth (DE)/4TWD.096.029 ALT-8
2	29940102	i) Set of Labyrinth ring NDE as per sketch no BSL/ELW/SK.No.6015 ALT-2
3	29940059	i) End Frame (NDE)/0TWD.096.003 ALT-13
4	29940060	i) End Frame (DE)/1TWD.096.005 ALT-11

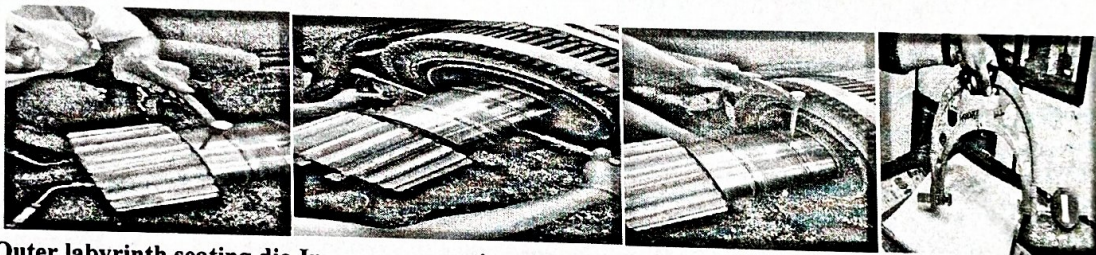
The set of labyrinths (DE& NDE) are getting replaced 100% during POH and end frames (DE&NDE) are getting replaced on condition basis. 05 No End frame DE, 05 No End frame NDE, 198 No 20 teeth pinion has been scrapped by POH/BSL in Feb 2025.

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It is noticed that set of labyrinth (NDE) are getting procured as per sketch no BSL/ELW/SK.No.6015 ALT-2. The sketch shall be revised due to change in drawing of clamp plate and bearing cap (NDE) by CLW. The end frame (NDE) to be changed 100% because CLW has changed the drawing of NDE end frame on 28/02/2024.

- iv) During assembly, components were checked with bore dial gauge and two point outside micrometers with least count of 1 micron. Details of measured dimensions during audit and specified standard dimensions are provided below:-

Name of item	Standard limit in mm	Measured dimensions in mm	Equipment used with LC	Remarks
DE end frame ID	319.950-319.990	319.957	Digital bore gauge (1 micron)	Dimension within limit
Outer labyrinth DE (ID)	179.748-179.783	179.756	Digital bore gauge (1 micron)	Dimension within limit
ID of inner racer DE	179.975-180.000	179.987	Digital bore gauge (1 micron)	Dimension within limit
ID of end frame NDE	214.948-214.970	214.949	Digital bore gauge (1 micron)	Dimension within limit
OD of outer racer DE	319.960-320.000	319.981	2 point micrometer (1 micron)	Dimension within limit
Shaft seating dia for (inner racer)DE	180.043-180.068	180.052	2 point micrometer (1 micron)	Dimension within limit
Shaft seating dia for (outer labyrinth)	179.843-179.868	179.846	2 point micrometer (1 micron)	Dimension within limit



Outer labyrinth seating dia Inner racer seating dia Inner labyrinth seating Snap dial gauge

- v) MPT (Magnetic particle test) was performed on the actual pinion, ultrasonic and DPT (Dye Penetration Test) tests specified in RDSO's assembly checksheet were not carried out by the POH shop on pinion.
- vi) TM Rotor shaft taperness could not get verified before inserting the actual pinion inside rotor shaft due to non-availability of taper plug gauge as per RDSO drawing No. SKEL-5032 alt-0 as advised vide RDSO SMI-278 .
- vii) Taperness of actual pinion shaft could not get verified due to non-availability of ring gauge as per RDSO drawing No.SKEL-5043 Alt-0 as advised vide RDSO SMI-278.
- viii) The color matching of pinion and rotor taper shaft is not carried out as prescribed vide RDSO SMI/278.

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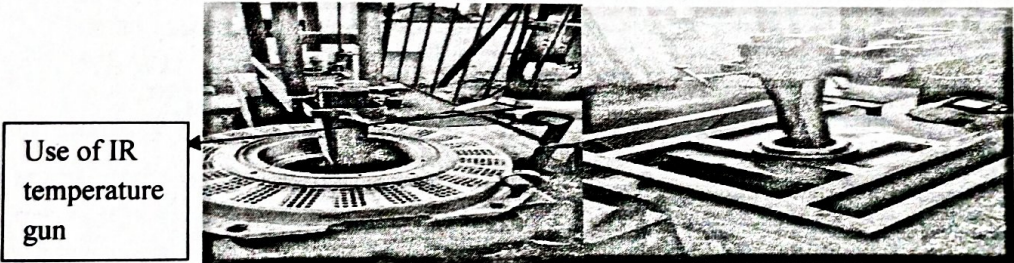
- ix) OD of rotor shaft after insertion of pinion at various locations is getting measured by two pointoutside micrometer with least count of 1 micron. The OD of rotor shaft after insertion of actual pinion to be carried out using dial snap gauge with least count of 1 micron as advised vide RDSO SMI/314.

Recommendation on above practices:-

- i) ELW/POH/BSL , workshop shall immediately start recording of various parameters during assembly/overhauling of TM type 6FRA6068 as prescribed vide this office letter No.EL/3.2.182/Comments/3 Ph dated 02.12.2024. Implementation of recording various parameters as advised vide check sheet issued by RDSO to be implemented immediately.
- ii) The practice of color matching of pinion shaft with rotor shaft should be started as advised vide RDSO SMI/278.
- iii) Ensure the availability of taper plug gauge as per RDSO drawing No.SKEL-5032 Alt-0 and ring gauge as per RDSO drawing No.SKEL-5043 Alt-0 as advised vide RDSO SMI/278 for ensuring taperness of rotor shaft and pinion shaft respectively.
- iv) Ensure availability of sufficient quantity of snap dial gauges with least count of 1 micron for measurement of OD of rotor shaft at various locations as advised by RDSO SMI/314. Available snap dial gauge was not in healthy condition henceforth measurement was getting done by two point outside micrometer.

C) Use of Induction heater during assembly:-

- i) Induction heater used for heating of various components during assembly of TM type 6FRA6068 was having no provision of temperature display and auto cut-off feature.
- ii) The temperature of various components during induction heating is getting monitored by using infrared temperature sensor gun. Which is not a correct practice because by measuring temperature using IR temperature gun actual temperature of job will be more than the reading recorded through IR temperature gun.



Use of IR temperature gun during induction heating

Recommendations:-

- i) Ensure availability of sufficient number of Induction heaters having provision of digital temperature display, auto cut-off and demagnetizing features as per RDSO SMI/301.

D)Measurement of insulation resistance of NDE bearing NH 320 :-

The Insulation resistance of insulated bearing coating were getting recorded with respect to earth at 530 Volts instead of 1 KV megger as prescribed vide RDSO SMI/278.

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- i) Insulation resistance of NDE bearing was measured at 530 V and came out 176 M-Ohm as per RDSO SMI/278 the specified value of IR of NDE bearing is 50M-Ohm at 1000 Volts.



NDE bearing IR measurement at 530 Volts

E) Weight balancing of rotors:-

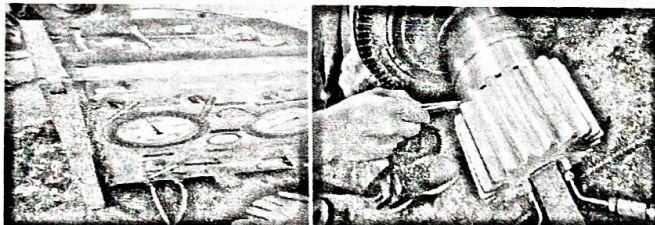
- i) The practice of rotor balancing was not getting ensured during POH by the rotor weight balancing machine at the TM assembly section as balancing machine were found in faulty condition same required to be rectified and recommissioned.



Faulty rotor balancing Machine.

F) Pinion insertion process:-

- i) The pinion was inserted inside the rotor after applying a pressure of 1900 bar.
 ii) After insertion of pinion the OD of the shaft at various location was getting measured within 5 minutes after insertion of pinion. However the immediate value may be more by a few micron due to increased temperature by pinion insertion (by 5-7°C). It is recommended to take OD of rotor shaft at various location (DE & NDE) after actual pinion insertion under ambient temperature for measuring correct predetermined better interference.(CLW WI: W21.410 Para 4.3.11)



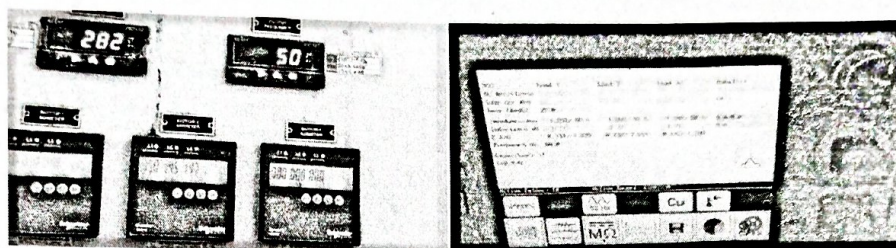
Pinion insertion and gap measurement between shaft and pinion

G) Assembled TM testing:-

- i) Tests on stator:- On the incoming stator following tests were performed by POH/BSL. Insulation resistance of windings and Inductance measurement between the phases. POH/BSL is aware of RDSO SMI/262 and only if variation between the phase inductance are less than 0.015mH the stator is treated healthy and is considered for fitment.

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- ii) Tests on Rotor:- To detect the broken bar of a rotor, growler test is also performed on the rotors as informed by POH/BSL.
- ii) Light Run test on assembled TM:-
During the light run test first the Traction Motor is rotate at lower of 200- 400 rpm for 5 minutes .Thereafter the TM was run at 1000 rpm with 50Hz supply. During the light run test the phase currents were 15.0 A, 14.5A,14.7A . The Traction motor was run in clockwise as well as anticlockwise direction for one hour (01 hour) each and bearing temperatures at the end of the light run tests were observed. As per POH/BSL the bearing temperature rise shallremains less than ($< 25^{\circ}$ Ambient).



VVVF drive for light run test

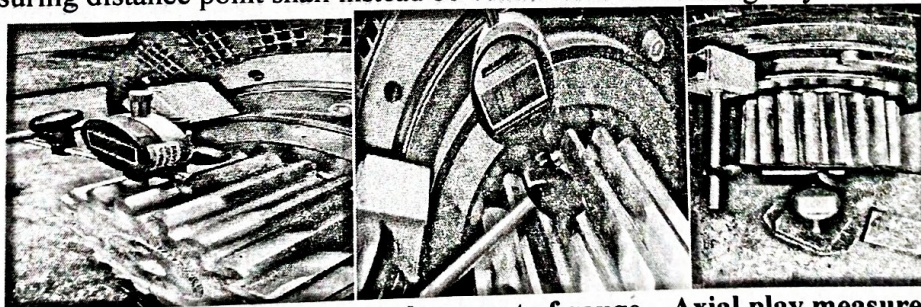
Inductance measurement of assembled TM

Recommendations:-

- i) During the light run test the TM shall be run at 100 rpm for 5-10 minutes so that the grease is uniformly distributed along the entire bearing . Thereafter the TM shall be run on 1000 rpm and not beyond this point vibration and bearing temperature shall be monitored. Vibration and noise shall be as per IEC 60349-2 values. Preferably the TM shall be run in both the directions upto 30 minutes.

H) Radial and Axial clearances tests on assembled traction motors:-

The axial clearance of the assembled TM was measured as 327 micron and is within the range of 200-400 micron as per RDSO check sheet dated 02.12.2024. While measuring the radial clearance of the assembled Traction Motor it was observed that the radial clearance was being taken at a place 80 mm away from the rotating labyrinth. The measuring distance point shall instead be 40mm from the rotating labyrinth.



Wrong placement of gauge Right placement of gauge Axial play measurement

Recommendation: SMI/278 needs to be followed and measurement of radial clearance shall be done at a distance of 40mm from the rotating labyrinth end. RC of 153 micron was observed when measured at a distance of 80mm and RC of 152 micron was observed when measured at a distance of 40mm.

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D) Summary of Technical Audit report & recommendations:

- i) Implementation of Recording of various parameters during assembly/ overhauling of TM to be ensured immediately as advised vide RDSO's letter No.EL/3.2.182/Comments/3Ph dated 02.12.2024 , same needs to be implemented immediately.
- ii) Taperness of Traction Motor shaft could not be verified because of non-availability of taper plug gauge as per RDSO drawing No.SKEL-5032 Alt-0. POH shop needs to procure sufficient number of taper plug gauge and use the same for measuring taperness of traction motor shaft as per RDSO SMI/278.
- iii) Ring gauge for measuring pinion shaft taperness was not available with the POH shop. Sufficient number of ring gauges shall be procured to measure pinion shaft taperness as per RDSO drawing SKEL-5043 Alt-0 as per RDSO SMI/278.
- iv) Ensure availability of sufficient quantity of snap dial gauge with least count of 1 micron for measurement of OD of rotor shaft at various locations as advised by RDSO SMI/314. Snap gauge available with ELW/POH/BSL was found faulty, use of snap gauge shall be ensured.
- v) The induction heater used for heating the various assembly components do not have provision of temperature display and cut-out features. Temperature of job is getting measured by using IR temperature gun which is not correct practice. Hence induction heater to be installed in required quantity having feature of temperature display, temperature setting, auto cut -off and de-magnetization as per RDSO SMI-301.
- vi) The rotor weight balancing machine was observed to be faulty and rotors were not getting dynamically balanced during overhauling. Balancing machine required to be rectified and recommissioned by the POH shop.
- vii) The fitment of inner racer, labyrinth should be undertaken only after cooling of rotor shaft up to ambient temperature based on OD of rotor shaft (DE & NDE) measured after pinion fitment under ambient temperature condition as per guideline /Work instruction (CLW WI:W21.410 Para 4.3.11).
- viii) During assembly of TM ,ELW/BSL is not measuring the distance between outer edge of Inner Labyrinth (DE) to outer edge of Inner Labyrinth (NDE) which is 696 ± 0.2 mm as per CLW's Drawing No.1TWD.096.111 for balanced rotor assembly (Modified).It should be measured during assembly of TM using gauge No 3TJF.096.040 (CLW WI:-W21.514).
- ix) During assembly of TM , ELW/BSL is not measuring the distance between outer edge of Inner Labyrinth (DE) to shaft face (139.5 ± 0.1 mm) and distance between outer edge of Inner

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Labyrinth (NDE) to shaft face (72mm) using depth gauge and same to be ensured (CLW WI:- W21.514).

- x) Assembled TM Radial Clearance not taken at required distance of 40mm. The radial clearance of the Traction Motor shall be taken at an axial distance of 40mm from the rotating labyrinth. The detailed procedure of RC measurement of assembled TM with permissible limit is mentioned in RDSO SMI/278, same needs to be followed by POH/BSL.
- xi) POH/BSL is not downloading the CMM report of assembly components. Same should be downloaded for cross examination at shop floor by available means. If not downloaded on time, the 3D-CMM report shall not be available for downloading after 60 days of its upload.
- xii) Insulation resistance of NDE bearing shall be measured as per RDSO SMI/278 the specified value of IR of NDE bearing shall not be less than 50M-Ohm at 1000 Volts.
- xiii) It was observed during audit from 24.02.2025 to 26.02.2025 that only one of the bore gauge was calibrated and other two bore gauges were un-calibrated. Identification and timely calibration of gauges shall be ensured.

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