



Scope of Work & Special Terms And Condition Of The Contract

for

Operation and Maintenance

of

**Dabhoi Workshop (ELW/DB) and Maintenance
of 3 phase Locomotive (POH of WAP7 and
WAG9, IOH of Motorized Bogie of CO-CO type,
IOH of Traction Motor of 6FRA 6068 type) for a
period of 18 years**



**Ministry of Railways
Government of India**

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1.Scope of work and Technical Specifications

Name of Work: Operation & Maintenance of Dabhoi Workshop (ELW/DB) and Maintenance of 3 phase Locomotive (POH of WAP7 and WAG9, IOH of Motorized Bogie of CO-CO type, IOH of Traction Motor of 6FRA 6068 type) for a period of 18 years.

- The scope of work covers complete outsourcing of Maintenance of 3 phase Locomotive (POH of WAP7 and WAG9, IOH of Motorized Bogie of CO-CO type, IOH of Traction Motor of 6FRA 6068 type), Operation and Maintenance of Workshop including supply of all manpower, materials, spares, consumables, tools & plants, testing facilities, infrastructure up-gradation and allied activities required to ensure safe, reliable and efficient operation of locomotives during the entire contract period.
- The PSU shall be fully responsible for availability, reliability, safety, and performance of locomotives as per performance parameters defined in this contract. Also, the PSU shall be responsible for complete POH of Locomotive along with IOH of Motorized Bogie and Traction Motor as per OEM Manual/RDSO Specifications/RB Instructions.
- All works shall be carried out in accordance with Latest RDSO Specifications, OEM manuals / CLW maintenance instructions, Relevant IRS / IS / IEC standards, latest STR (Schedule of Technical requirements) and Railway Board instructions issued from time to time. The PSU shall carryout the work as per the detailed scope of work. However, in case of any discrepancies/doubts/clarification, the PSU shall refer the OEM manuals, latest RDSO/CLW/RB instructions for detailed procedure/ specification for the POH of the 3 phase locomotive and IOH of Motorized Bogie of CO-CO type, IOH of Traction Motor. However in case of any doubt/clarification PSU may discuss and clarify with the CWM/ELW/DB or his representative.

Contract Period: 18 years

Scope of Work:

- The locomotives to be taken up for Periodical Overhaul (POH) shall be finalized and allotted to the Workshop during the Annual POH Meeting convened by the Railway Board (RB).
- The PSU shall plan, schedule, and call the locomotives for POH in coordination with the Owning Shed after allotment of locomotives during the Annual POH meeting, strictly in accordance with Tender Document/agreement Clause No. 17.12.
- The Railways shall arrange to provide the locomotive up to the PSU Workshop i.e. ELW/DB, whereas internal workshop shunting, handling, and movement of the locomotive within the workshop premises shall be the responsibility of the PSU, as stipulated under Tender Document/agreement Clause No. 5.1.6(i).
- A joint pre-inspection of the incoming locomotive shall be carried out by authorized representatives of the PSU and the Owning Shed or CWM/ELW/DB representative prior to commencement of POH work . A joint pre-inspection record shall be prepared and duly signed with the railway and PSU representative, clearly identifying and documenting any major defects (defect deficiency list), damages, Proforma-C (Given by the owning sheds along with the locomotive) or abnormalities beyond the Schedule maintenance of POH.
- The Periodical Overhaul (POH) shall include complete dismantling, thorough cleaning, detailed inspection, repair and/or renewal,overhauling, replacement of components, testing, re-assembly, and final commissioning of the locomotive along with all its systems,

sub-systems, and associated equipment, ensuring full compliance with OEM manual and RDSO specifications & instructions and latest STRs ((Schedule of Technical requirements).

- All the Must Change Items during the POH should be replaced as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
- The PSU shall maintain the record for all the equipment overhauled/replaced (sectionwise) identifying the make, serial no., manufacturing year, etc.
- The scope of POH shall include, but not be limited to, the following systems and equipment:
 1. **Mechanical Systems:** Complete POH of motorized and non-motorized bogies,,Wheelsets, axle boxes, bearings and suspension, Brake rigging, brake cylinders, slack adjusters, Buffing and draw gear, couplers, Compressors, exhausters, cooling system, Gear cases, pinions and bull gears.
 2. **Electrical & Traction Equipment:** Traction motors (complete POH), Traction converter and auxiliary converter, Main transformer, Control electronics and cab equipment, Wiring harness replacement, Batteries and battery chargers.
 3. **Body & Cab:** Structural inspection and corrosion repairs, Painting as per RDSO approved scheme, Cab fittings, crew seats, desks, HVAC system, Safety fittings and fire detection systems etc.
 4. The complete process flow of POH of 3-phase locomotives is in the below flow chart. PSU may refer to this as the activity wise process flow for the POH of 3-phase locomotives.
- **Exhaustive** broad scope of work but not limited based on activity(PSU shall refers the OEM manual, RDSO specification for the detailed procedure) is as below:

A. OPERATION & MAINTENANCE OF DB WORKSHOP

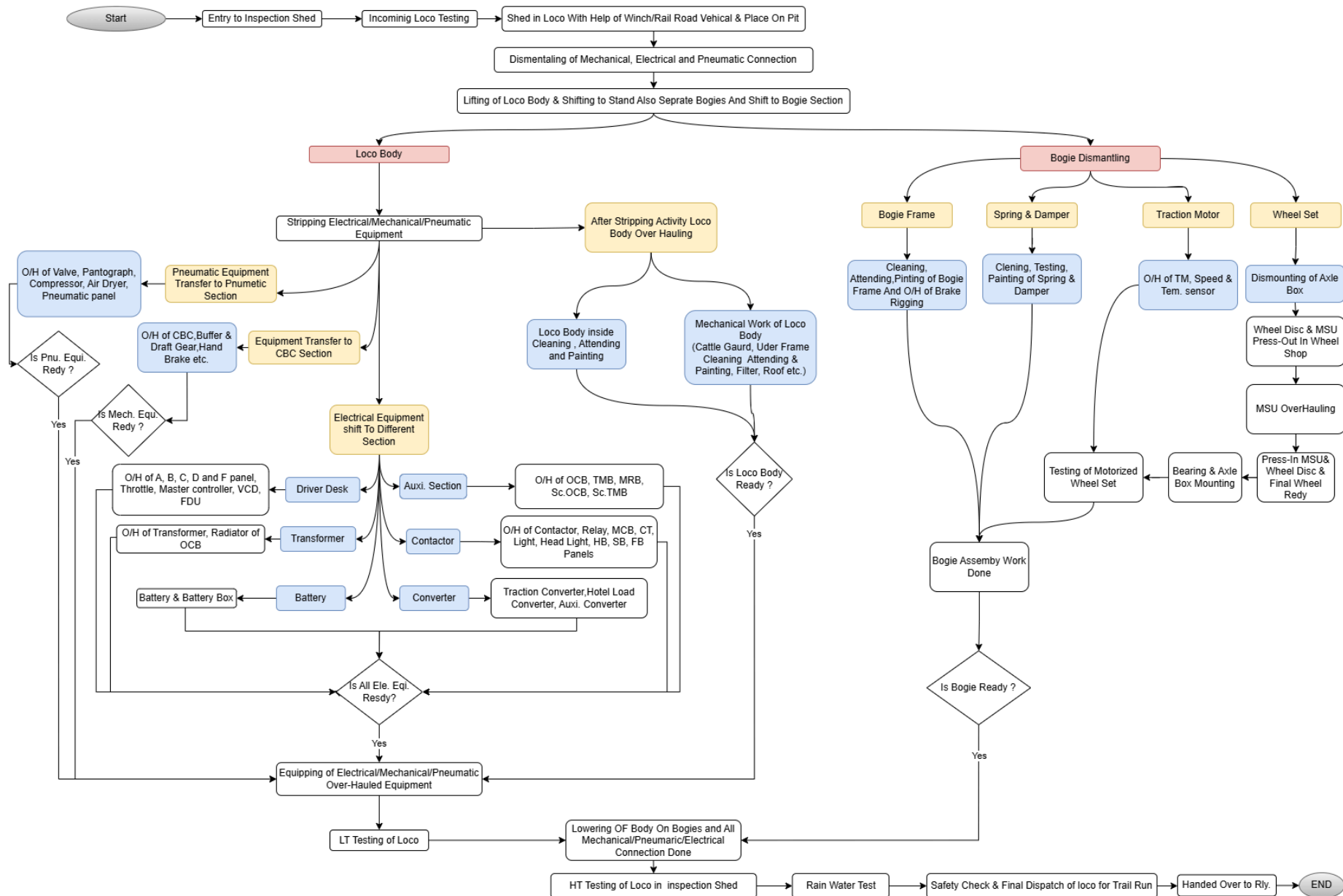
1. The PSU shall be responsible for the complete operation and maintenance of all infrastructure available at the DB Workshop, including existing infrastructure as well as infrastructure/facilities upgraded or newly created by the PSU, along with all Equipment, Machinery & Plants (M&P) and Tools & Plants (T&P) available or provided by the PSU.
2. The operation and maintenance activities shall be carried out so as to fulfil the PSU's maintenance obligations strictly in accordance with the provisions of Article 5 and Article 20 of the Tender/Agreement document.
3. The list (tentative list) of existing and available infrastructure, M&P at the DB Workshop is provided in Schedule-C (Annex-I) of the Tender document/Agreement and shall form an integral part of this Scope of Work and will be maintained by the PSU. However the complete list of facilities available will be provided to PSU during the handover time.
4. The PSU shall arrange and deploy, at its own cost, all Machinery & Plant (M&P) required to fulfil the maintenance obligations under the Agreement, other than those already available at the DB Workshop. Replacement of M&P shall be governed strictly in accordance with Clause 10.3.1 of the Agreement. PSU shall handover the old M&P as scrap to the nearest Railway scrap depot before claiming reimbursement for the new machine to ensure proper accounting of assets.
5. All T&P available at the DB Workshop at the time of handover, as well as T&P subsequently provided by the PSU, shall be operated, maintained and replaced by the PSU at its own cost.
6. The PSU shall be responsible for maintenance of existing gardening areas within the DB Workshop premises strictly in accordance with Clause 5.1.6 (h) and shall develop

additional horticulture areas/gardening areas, as required, at its own cost and in accordance with the directions of the Railway Administration.

7. The PSU shall operate and maintain all CCTV cameras available at the DB Workshop at the time of handover. In addition, the PSU shall provide, install, operate and maintain CCTV cameras for all new or developed infrastructure facilities created by the PSU, at its own cost, ensuring continuous surveillance and compliance with applicable security guidelines.
8. The PSU shall be responsible for the operation, maintenance, and upkeep of all facilities and systems at the Workshop, including but not limited to Mechanical, Civil, Electrical, S&T pneumatic, Solar plant , Plumbing, fire-fighting systems, canteen facilities, Rest house, internal security arrangements, housekeeping services, drinking water supply systems and sanitation, solar power systems, gardening and landscaping, Maintenance of lights and other electrical facilities(all electrical substations & equipment etc.), Cleaning, CCTV surveillance systems, waste treatment plants, First aid facility, rainwater harvesting plants (wherever available), diesel generator (DG) sets, and all other allied infrastructure and utilities available at the time of handover, in a safe, efficient, and serviceable condition at all times.

Process Flow of Periodical Overhauling of 3-phase Locomotives

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B. POH OF 3-PHASE LOCOMOTIVE(WAP-7 & WAG-9)

1) Erection Section - Loco Lifting & Stripping

1. Before placing the loco into erection section, a joint Incoming Testing (IC)/pre-inspection of the incoming locomotive shall be carried out by authorized representatives of the PSU and the Owing Shed, identifying and documenting any major defects (defect deficiency list), Proforma-C (Given by the owning sheds along with the locomotive) or any maintenance beyond (Conditional items other than Proforma-C) the Schedule maintenance of POH.
2. The PSU shall receive the locomotive in the erection section from the inspection shed / workshop line after the completion of all initial inspections, necessary documentation, handing-over formalities, the required proforma, and taking into account the maintenance recommendations provided by the owning shed.
3. The PSU shall disconnect and remove all electrical, pneumatic, and mechanical connections between the locomotive body and the bogies, including but not limited to cables, hoses, pipes, linkages, brackets, and associated fittings, strictly in accordance with approved safety procedures, maintenance instructions. .
4. Transformer oil and traction converter coolant shall be safely drained, collected, stored, and handled by the PSU in strict compliance with OEM instructions, environmental guidelines, pollution control norms, and RDSO guidelines.
5. The locomotive body shall be lifted using approved lifting arrangements, including cranes, tools, and tackles of adequate capacity, and shall be securely placed on designated berths/stands in the workshop, strictly following approved lifting plans, safety protocols, and RDSO guidelines.
6. After separation, the bogies shall be transferred to the Bogie Section for detailed inspection, overhaul, and further processing in accordance with the approved POH scope and applicable maintenance standards.
7. All equipment, sub-assemblies, and components mounted on the locomotive body shall be systematically stripped, properly identified, tagged, and recorded, and handed over to the respective concerned sections for inspection, repair, testing, or overhaul. Remove major exterior components, including the hoods, CBC, Draft gears, Cattle Guard, Side Buffer, Transformer, Main compressor, Battery Box and access panels like the window shutters and Electronic Brake Control (EBC) housing.
8. Interior components, including both cabs (CAB-1 and CAB-2), all auxiliary equipment (OCB, MRB, TMB), converters (SR, BUR, Hotel Load), All Panel (SB, HB, FB), Aux. Compressor and Tank (MR, AR) etc are stripped down. The locomotive undergoes a deep clean. All areas are scrubbed, cable trenches are cleared of debris.
9. Main and auxiliary compressed-air reservoirs, mounted at both ends of the machine room, shall be removed, inspected internally and externally, tested and overhauled. Inspection, testing and certification of air reservoirs shall be carried out strictly in accordance with the Maintenance Manual and applicable RDSO SMIs/TCs/MS, ensuring pressure integrity and safety compliance. A protective coat of paint should be done.
10. The entire locomotive body and under frame, including internal compartments and equipment mounting areas, shall be thoroughly cleaned to remove dust, dirt, oil residues, metallic particles, and all foreign matter prior to painting and re-assembly.
11. All cable is cleaned, physically inspected for damage, and subjected to Insulation

Resistance (IR), continuity, and resistance testing. Damaged lugs, cables and sleeves are replaced to prevent electrical sparking. Once the cables are labeled and bunched, the reassembly begins.

12. All pneumatic pipes should be blown and cleaned. Check for any physical damage and leakage, and repair/replace if required. Ensure no leakage and all pressure drops should be minimum as per SMI-11 or latest.
13. Rectification of all identified defects in the locomotive's body structure, underframe, and equipment foundations is mandatory. This must be accomplished using appropriate mechanical processes, which may include machining, welding, grinding, boring, tapping, or related operations. Critical to this process is ensuring dimensional accuracy, structural integrity, and strict compliance with RDSO specifications. The underframe areas must be thoroughly cleaned of all dirt and dust. After cleaning, non-destructive testing DPT / MPT shall be performed to detect any latent structural cracks before the final application of the underframe paint.
14. A detailed inspection and condition monitoring of the locomotive body shall be carried out by the PSU to identify any mechanical defects, structural damages, distortions, or abnormalities and the same shall be repaired.
15. All internal surfaces and under-frame of the locomotive body and equipment foundation areas shall be painted with approved primers and finishing paints, strictly as per RDSO Specification no M&C/PCN/100/20218 or latest, to ensure effective corrosion protection, durability, and long-term serviceability.

2) Bogie Section.

The PSU shall be responsible for complete inspection, overhauling, testing, rectification, replacement and certification of Bogie and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The motorized bogie (Co-Co type) is systematically decoupled from the locomotive car body. The primary electrical connections, traction motor (TM) bellows, pneumatic brake hoses, and sanding pipes are disconnected and sealed to prevent foreign material ingress. The bogie frame is lifted, and components including the Traction Motor, wheelsets, gear cases, suspension systems (primary and secondary springs/dampers), and brake rigging are completely dismantled.
2. After cleaning, Magnetic Particle Testing (MPT) and Dye Penetrant Testing (DPT) must be performed on critical stress zones. Traction link pivot post welding (both body and bogie side), axle guide fixing posts, all brake hanger fixing brackets, damper fixing brackets, and TM support/torque arm brackets shall be removed. Ensure Motor Support on Bogie Transom has a modified fillet radius of 15R to prevent cracks (as per RDSO MS-443 and SMI-269).
3. The structural integrity of the bogie frame and pivot head is strictly measured. The variation in diagonal dimensions of the bogie frame must not exceed 3 mm as per MP.IB.BD.02.16.01 (Rev.01) or latest. Deviations require rectification as per standard procedure. Verify Pivot Post Critical Dimensions according to standard specification. The Aclathan / Vulkollan ring is a mandatory replacement item (RDSO Spec 0053). A new modified housing for the Aclathan ring must be provided and critical dimensions checked before insertion.
4. For high-speed reliability, the existing Tread Brake Units (TBU) or Parking Brake Units

(PBU) must be completely replaced by a Conventional Brake Rigging System in accordance with RDSO Mod. No. 381 (Rev '0') or latest.

5. All pins, bushes, and pads of the brake rigging are replaced. Brake levers and hangers must be checked for cracks using DPT as per SMI-244 or latest. Provision of an additional safety sling on brake hangers/levers must be ensured to prevent falling on the line, as per SMI-244 and SMI-282 or latest. Use modified bottom slack adjuster pins with split pins and nuts to prevent dropping (MS-441 or latest).
6. Complete overhauling of the sanding equipment. Ensure the sand box is free of corrosion, replace all seals, gaskets, and hoses. Adjust the sander nozzles to exhaust just ahead of the wheel contact point (SMI-334 or latest). The Traction Motor Dropping Detection System (TMDDS) must be comprehensively overhauled and tested to ensure reliable and safe operation as per MS-496 or latest.
7. All primary and secondary helical springs are replaced during POH. Springs are tested on a load testing machine. Springs must be grouped by height bands (1 band or 2 bands) and colour-coded. Required liners to be placed on end axle boxes and middle axle boxes. All vertical, lateral, and yaw hydraulic dampers are replaced and tested on a damper testing machine.
8. The Axle Guide Rod and its spheriblocs, as well as Torque Arm spheriblocs, are replaced. Mounting/dismounting of spheriblocs must strictly follow SMI-330 and SMI-270 or latest.
9. Thoroughly inspect the gear case for cracks using MPT. Ensure all flange holes are correctly tapped. Check and repair/replace all sub-assemblies including the oil filling cap, spy glass, and breather assembly. Ensure tightening of suspension tube bolts (M30x140) at the specified torque. Check mechanical integrity and rotational clearances, verifying backlash between the main gear and pinion. Trial run for 5 minutes of motorised wheelset to be done before fitting of gear case for identification of any defects before gear case mounting.
10. Final check is conducted to ensure there is no leakage. Seal the gear case hermetically, ensuring zero leakage, and fill with the prescribed quantity of Servosyn gear 460 RR.
11. Run the assembled wheelset, TM, and gear case minimum 20 minutes in each direction as specified in the OEM manual or RDSO specifications. Monitor for abnormal bearing noise, unusual gear box sounds, and record the operating temperatures of the A/box Bearing, TM Bearing, MSU bearing and Gear case within prescribed range .
12. After lowering the bogie frame onto the wheelsets, the primary lateral clearance between the axle box and bogie frame must be strictly maintained between 15 mm to 22 mm as per TC-83 or latest. All Earthing Shunts must be provided between the bogie and the axle boxes (6 numbers per bogie) to ensure a proper earth return path, adhering to SMI-248 or latest. After all overhauling, inspections, and part replacements are complete, the bogie frame and its sub-assemblies undergo complete painting. This is done using approved primers and paints strictly in accordance with RDSO Specification No. M&C/PCN/100/20218 or latest to guarantee long-term corrosion protection.
13. All applicable Reliability Action Plan measures shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
14. ALL the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

15. SMI/MS/TC/STR for Bogie Section are as follows:

SN	Description	SMI/MS/TC/STR
1	Fitting of Nuts, bolts screws	SMI-01
2	Procedure for cleaning the pneumatic pipelines of the electric locomotives by "Blowing through"	SMI-11
3	Special Maintenance Instruction to prevent failing of brake hanger in middle axles of WAP-7 Locomotives	SMI-282
4	Provision of additional safety sling on brake lever of WAP 7/WAG 9 Locos.	SMI- 244
5	Maintenance of earthing system in 3 phase electric locomotive type WAP5/WAP7/WAG9 Locos.	SMI-0248
6	Maintenance instructions of brake hanger for WAP 7 /WAG 9 locos	SMI- 251
7	Maintenance & use of materials for traction link housing for 3phase electric locomotives.	SMI-259
8	Maintenance of Traction Motor support plate and Bogie nose to prevent crack/ breakage of Traction Motor support plate (Holder for Traction Motor suspension).	SMI-269
9	Special Maintenance Instruction for Axial Wear of serviceable Spheriblocs used in WAP5/WAP7/WAG9 Locomotives	SMI-270
10	SMI for Magnetic Particle Testing (MPT) of Traction Motor nose stay in conventional locomotives / EMUs / MEMUs / Metro Railways, TM suspension holder support and motor support in WAG9 / WAP7 locomotives and Traction Motor support arm in WAP5 locomotives.	SMI-311
11	Special maintenance instruction for Mounting/dismounting of spheri blocs on components used in three phase Electric Locomotives.	SMI-330
12	Modification in Brake Assembly of WAP7 Electric Locos	MS-369
13	Provision of conventional brake rigging in WAP7 Locomotive	MS -381
14	Modification in Brake hanger mounting brackets (Holder and Support) of WAP-7 / WAG-9 Electric locomotives to prevent crack/breakage of bracket.	MS-396
15	Modification to avoid dropping of slack adjuster assembly (Bottom) in case of breakage of its split cotter pin in 3-phase WAP-7 loco.	MS-411 Rev-1
16	Modification to avoid dropping of slack adjuster assembly (Bottom) in case of breakage of its split cotter pin in 3-phase WAP-7 loco.	MS-441
17	Modification Sheet for development of Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC type of Electric Locomotives.	MS-496
18	Modification in Vertical damper fixing Arrangement of WAP-7/WAG-9 locomotives.	MS-483
19	Traction Motor Dropping Detection System (TMDDS) in WAP-7/ WAG-9 / 9H / 9HC	MS-496
20	Modification in Tie-bar for all axle locations & its safety sling bracket for axle no.2, 3, 4 & 5 of conventional brake rigging arrangement equipped in WAP-7 and WAG-9HC three phase electric locomotives.	MS-513

21	Repair method of bogie frame	TC-01
22	Indigenization of lubricants for WAP5/WAP7/WAG9 Locomotives.	TC-34
23	Specification of welding electrode as well as welding procedure for welding of manganese liner on axle box as well as bogie horn pedestal of electric locomotives.	TC-45 Rev-2
24	Change in the material of brake blocks for Electric Locomotives	TC-49
25	Bogie clearances on WAG9 & WAP7 3-phase Electric locomotives.	TC-82
26	Norms for repair rehabilitations & replacement of cracked it mount cast steel bogie frames of Electric locomotive	TC-84
27	Limits for wheel set dimension variations and wheel wear of WAP5, WAP7, & WAG9 3 phase Electric locomotives.	TC-83
28	Technical Circular for repair of crack in welding of plate (Drg. No. 1209-01-312- 145) of Pivot Transom sub assembly of bogie frames for WAP7/WAG9 locomotives.	TC-149
29	Technical Circular for measurement of 'C' Clearance in MSU assembly of 6FRA-6068 Traction motors in WAG/WAP7 class Locomotives.	TC-151
30	Repair, rehabilitation of motorised bogie frames	STR-81
31	Elastic Ring used on Three Phase Electric Locomotives (WAP5, WAP9 & WAG9).	STR-96
32	Spheriblocs on 3 phase Electric Locomotives.	STR-50

16. Must Change Items for Bogie Section (Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest follows):

SN	Description
1	Set of primary spring and secondary spring for WAG9/WAP7 locos
2	Set of primary damper and secondary damper / shock absorber for WAG-9/WAP-7 locos
3	All Aclathan / elastic / vukollan ring and tab washer, all fastner of aclathan / vukollen ting retaining plate for wag-9/wap7 locomotives.
4	Gear case oil as per tc-34
5	Traction link and its fastener, pivot head ring
6	Brake hanger (2 nd poh of wap7 and 1st poh of wag9/9h)
7	Safety sling (For brake hanger & traction link), pin & r-clip,
8	Set of Bump stop for WAP9/WAP7 locos
9	Housing for traction link
10	Spheri bloc for axle guide rod and tm support arm for wag-9/wap-7 locos
11	Set of hardware for gear case,for wag-9/wap7 loco
12	Gear box oil seal, o ring , washer,tm fixing bolts, gauge glass oil seal,hoses
13	Tm support arm (2 nd poh of wap7 and 1st poh of wag9/9h)
14	Axle guide rod
15	Insulating base of springs
16	All pin & pad and bushes of brake rigging
17	All rubber components, hoses and fasteners on the bogie
18	Brake shoe, Brake shoe key

19	Overhauling kit for brake caliper
20	Hoses between bogie to brake cylinder, Bogie to body connection
21	Maintenance kit for brake cylinder of co-co bogie
22	All Nylock Nuts for lifting of locos at : A. Secondary Damper, B. Primary Damper top side, C. Traction Link, D. Gear Case Support arm/
23	All hardware (eg. nut , bolt , washer, screw , pin , o ring etc.)
24	All rubber item (eg o ring, hose, gasket , seal , etc)
25	Complete conventional break rigging along with pins, bushes & fasteners (If required)
26	Sand in all sand box, sander hose pipe, seal in the sand box lids, sanding equipment fasteners

3) Wheel Section

The PSU shall be responsible for complete inspection, testing, overhauling, rectification, replacement and certification of wheel section and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. In axle box dismantling, remove the front cover and axle end cap. Withdraw the bearing loose lip, carefully pulling axle box housing straight off the bearing using a crane, and place it on a rubber mat to protect the surfaces. Remove rear cover and extract the bearing outer race and roller set from the axle box housing. Remove the inner race by pulling it through the thrower with a hydraulic bearing extractor machine. Strictly avoiding the use of flame heating or welding torches on reusable components. The axle box overhauling must be executed systematically as per SMI-246 and TC-129 or latest guidelines.
2. The wheel discs, MSU and bull gear are floated off using the hydraulic oil injection method. Pressure must be strictly controlled as per critical value. Axle push to press off wheel discs, MSU and Bull gear by using hydraulic wheel press. All these processes to be done as per the maintenance manual of locomotives.
Before further processing, the rough/bare axle must undergo a strict Ultrasonic Flaw Detection test in accordance with TC-47 or latest to detect any internal, sub-surface flaws, or micro-cracks.
Check Axle journals for fretting corrosion, pitting, ovality, or taper. Also check Axle journal diameter, Taper and out-of-roundness. Check journal surface waviness using a metal ruler coated with marking blue in two planes at 90°. The combined width of valleys must be $\leq 2/3$ of the journal length. A new axle to be provided if necessary to maintain reliability of the locomotive.
3. MSU to be overhauled as per maintenance manual procedure.
 - a. All parts of the Motor Suspension Unit like Bearing of DE and NDE side and All labyrinth to be removed by use of induction heater must be cleaned with Kerosene/approved solvents, and overhauled. Check all labyrinths/Bearing visually for any dent, scratch and repair / reject if out of dimension as per drawing. Clean MSU tube and DPT/ MPT to be done on critical dimension before further process. Measure the bore diameter of the bearing seats of DE & NDE side and other critical dimensions. All dimensions should be within range.
 - b. DE and NDE bearings must be installed using an induction heater. Heat the inner racers using an induction heater to 100-110 °C and shrink-fit them onto the gear hub

- and axle respectively. Installed bearing using flexi coil induction heater and Assemble labyrinths using Loctite and specific torque as per maintenance manual.
- c. Maintain the 'C' clearance and 'X' clearance as per TC-151 or latest and MS-456 or latest using modified supporting rings to prevent premature MSU failures. After final fitting lateral play of the MSU must be maintained within range as per RDSO guide line.
 4. The new wheel disc must be bored to precisely match the axle dimensions. The axle itself is turned and finished as per CLW Drg. No. 1209-01.011-002 Alt-2. Critical Values like wheel bore diameter, Surface roughness and seat length as per drawing. Interference between wheel and axle strictly maintained as per TC-132 or latest. Press new bull gear (If required) according to TC-132 or latest.
 5. New Wheel disc Pressing Procedure Must follow TC-132 or latest.
 - a. Apply Paste on wheel disc and axle seat as per requirement to prevent scoring . The wheel is cold-pressed onto the axle using a highly calibrated hydraulic wheel press. The press-in contact force must strictly fall between as per drawing / TC-132 or latest. The outer wheel flange must sit at a specific distance from the outer edge of the axle hub flange. The distance between the hubs of the two wheel discs (Drive End to Non-Drive End) must be exactly 1596 ± 0.5 mm.
 - b. After the wheel press operation, a final Ultrasonic Test (UST) of the assembled axle must be conducted per TC-47 or latest to ensure structural integrity was not compromised during pressing. Also Dynamic Balancing wheelset must be ensured.
 - c. The wheelset must be subjected to wheel profiling on surface wheel lathe (wear - adapted profile) to match the profile dimensions, followed by journal burnishing on Axle journal turning and burnishing machine to ensure the proper finish, ovality and runout as drawing .
 6. Axle box fitment procedure should be in accordance with TC 129 or latest & SMI 246 or latest and RDSO guideline.
 - a. Measure Thrower seat OD and Bearing Journal OD. Also measure the ID of the inner race to calculate critical interference. Shrink-fit the thrower onto the axle by heating it up to 150°C . After that, apply a thin layer of SAE 30/40 heavy mineral oil to the journal.
 - b. Cold press the new CRU-150 Roller Bearing Unit onto the journal applying a minimum force using a hydraulic puller/pusher. Conduct Ultrasonic Testing (UST) on inner racers in the mounted position to detect deep-seated cracks.
 - c. Clean the axle box bore and ensure bore ID and bearing OD should be maintained and per drawing. Also maintain interference as per TC 129 or latest & SMI 246 or latest. Insert bearing into the Axle box and mount the Axle box Unit on the inner race. Critical radial play and axial play of bearing to be verified. Inject the exact quantity of Servoplex SHC-120 grease based on the bearing made using a calibrated digital meter. Never over-grease or mix greases.
 - d. For axle boxes 1, 6, 7, and 12, install the earth return carbon brush contact plate. Ensure the continuity and integrity of the earth return path by verifying the carbon brush length and measuring earth resistance. Torque front cover bolts.
 7. Once the wheelset is completely assembled, verified, and sealed, the exterior surfaces of the Wheel discs, Axle Box housing, and the MSU tube must undergo painting to prevent rust, corrosion, and environmental degradation, conforming to prescribed visual and protective standards.
 8. During run test monitor bearing temperatures rigorously; the temperature rise must be below 25°C above ambient. Check for any mis alignment, vibration or sound from the

axle box during the run test.

9. During Periodical Overhaul (POH) of the locomotive, all wheel discs having a diameter less than 1050 mm (after turning) shall be mandatorily replaced. The cost of such replacement of wheel discs shall be borne by the PSU. The released wheel discs shall be handed over to the Railway by the PSU.
10. All applicable Reliability Action Plan measures shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
11. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

12. SMI/MS/TC/STR for Wheel-shop Section are as follows:

SN	Description	SMI/TC/MS/STR
1	Wheel wear and application management	MP.IB.BD.02.16.0 1
2	Standardization of the gauge & instructions for measuring loco wheel diameter. (B.G)	SMI-214
3	Maintenance of Axle Box bearing for WAP7 & WAG 9 for Electric locomotive	SMI 246 Rev -2
4	Maintenance of Earthing System in 3-phase electric locomotives type WAP5, WAP7 & WAG9.	SMI-248
	Defining Periodicity of overhauling schedule of MSU of WAG9/WAG9H/WAP7 locomotives to prevent premature MSU failure	SMI-300
6	Use of Induction Heater for heating of Bearing seating area of Suspension tube instead of flame heating for fitment of MSU Bearings in WAG-9/WAP-7 locomotives.	SMI 306
7	Modification in drawing of supporting ring to achieve adequate 'C' Clearance in MSU assembly of 6FRA-6068 TM in WAG9/ WAP7 class of locomotives	MS 456 & TC 151
8	Approved Lubricants for 3-phase Locos	TC 34 Rev 4
9	Ultrasonic testing proceeding for axles of electric locomotives.	TC 47, Rev 2
10	Limits for wheel set dimension variations and wheel wear of WAP5, WAP7, & WAG9 3 phase Electric locomotives.	TC 83
11	Guide-lines for mounting, dis-mounting, inspection and maintenance practices of axle box bearing units for WAG-9/WAP-7 Locomotives.	TC 129
12	Procedure of pressing-in of wheels on axles in Electric Locomotives.	TC 132
13	Technical Circular for measurement of 'C' Clearance in MSU assembly of 6FRA-6068 Traction motors in WAG/WAP7 class Locomotives.	TC-151
14	Repair, rehabilitation of motorised bogie frames	STR-81
15	Gears and Pinions of Electric Locomotives	STR/22

13. Must Change Items for Wheel-shop Section are as follows(Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest follows):

SN	Description
1	Bull Gear (2 nd POH of WAP7 and 1st POH of WAG9/9H)
2	Cylindrical Roller Axle Box Bearing Unit For Wap-7/WAG9 Loco
3	Set Of Driving End And Non Driving Suspension Tube Bearing For Wag -9/Wap-7
4	Set Of Hardware For Axle Box including all fasteners
5	O Ring For Axle Box
6	Earthing Carbon Brush.
7	Servoplex Shc-120 (locl) Grease For Suspension Tube Bearing as per TC - 34
8	Axle Box bearing Grease as per TC - 34
9	Lubricant For Pressing In Of Wheels as per TC 132
10	Set Of Insulating Base Of Primary & Secondary Suspension
11	Set Of Hardware For Wag9/Wap7 Locos Suspension Tubes
12	Set Of "O" Ring For MSU
13	All Hardware (eg. Nut , Bolt , Washer, Fasteners,Screw , Pin , O ring etc.)
14	All Rubber item (eg O ring, Hose, Gasket , Seal , etc)

4) Traction Motor Section

The PSU shall be responsible for complete inspection, overhauling, testing, rectification, replacement and certification of Traction Motor and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The PSU shall carry out incoming inspection and electrical tests on the traction motor including Insulation Resistance (IR) test of stator windings. Inductance measurement between phases shall be conducted at the TM terminal box using an LCR meter as per SMI-262 or latest, ensuring the phase difference is within prescribed limits. Incoming radial and axial play shall also be measured using dial gauges and recorded.
2. The PSU shall undertake complete dismantling of the traction motor including removal of speed sensor, probe housing, pulse generator ring (PGR), clamp plate, angle ring, NDE bearing cap and other associated components using approved tools. The pinion shall be extracted using a hydraulic extraction system, and inner races and rotor labyrinths shall be removed using induction heating while maintaining prescribed temperature limits. Drive End (DE) and Non-Drive End (NDE) end shields and bearings shall be removed.
3. Detailed visual, dimensional and mechanical inspection of the stator, rotor, end frames and other components shall be carried out. Specialized tests such as Inductance Test, Growler Test, Dye Penetrant Test (RDPT), Ultrasonic Testing (UST) and Magnetic Particle Testing (MPT) shall be performed wherever applicable. Necessary repairs or replacement of defective components shall be carried out in accordance with applicable SMIs, Technical Circulars (TCs) and Modification Sheets (MS).
4. The stator, rotor and end frames shall be thoroughly cleaned using dry compressed air, vacuum cleaners, and approved halogen-free solvent cleaning agents like White Spirit or Xylol-CHR (chemically pure) to remove oil, grease, and contaminants from the stator and rotor. The stator and rotor shall be baked in a temperature-controlled oven to remove moisture. The stator shall then be varnished with approved anti-tracking varnish and allowed to dry to restore insulation strength.

5. All bearings, labyrinth rings, pins and associated accessories shall be replaced during POH. The bearing inner race shall be fitted on the rotor in accordance with RDSO Modification Sheet MS-415 or latest applicable standard.
6. The rotor shall be thoroughly cleaned and dynamically balanced. A surge comparison test (approximately 5 kV) shall be conducted on the stator winding to detect inter-turn faults, and a Growler Test (SMI-163 or latest) shall be carried out on rotor bars and end rings. UST and RDPT shall be performed on the rotor shaft, particularly at pinion and bearing seating areas, to detect internal or surface defects. Magnetic Particle Testing (MPT) as per SMI-311 or latest shall also be carried out at critical stress locations where required.
7. A new pinion shall be fitted in accordance with the procedure specified in RDSO SMI-278 or latest instructions. Prior to fitment, the taperness of the shaft and pinion shall be verified using approved gauges (RDSO Drawing No. SKEL-5032 and SKEL-5043 or latest). Dye transfer (colour matching) test shall be conducted to ensure proper contact between the pinion and shaft taper with minimum 90% contact area. The pinion shall be mounted using a hydraulic press arrangement with controlled pressure (approximately 1700–1900 bar and not exceeding 2000 bar) ensuring the specified travel of the pinion within the shaft.
8. Bearings and labyrinth rings shall be fitted on the rotor and end frames after verification of all critical dimensions in accordance with MS-415 or latest. Precision measuring instruments such as Dial Snap Gauges (SMI-314 or latest) and Bore Gauges (SMI-318 or latest) shall be used for measurement. Heating for shrink fitment shall be carried out using induction heating equipment as per SMI-301 or latest, ensuring temperature does not exceed 120°C. Proper lubrication using approved grease shall be carried out during assembly.
9. The PSU shall inspect, modify and standardize the traction motor speed and temperature sensor systems including associated cabling and connectors. Temperature sensor mounting shall comply with MS-350 or latest, with proper earthing of shielding as per MS-437 or latest. The gap between the speed sensing probe and the Pulse Generator Ring (PGR) shall be maintained between 0.5 mm and 1.0 mm as per TC-145 or latest. Adoption of IGBT type speed sensors shall be carried out where applicable in accordance with MS-458 or latest.
10. After completion of overhaul activities, the traction motor shall be assembled as per applicable SMIs, MS and TCs. Greasing shall be carried out as per SMI-307 or latest, and modified bellows arrangements shall be provided where applicable as per MS-476 / MS-472 or latest. Radial play shall be verified as per SMI-278 / SMI-336 or latest, and axial play shall also be measured to ensure compliance with prescribed limits before testing.
11. After assembly, the traction motor shall undergo a mandatory no-load run test on a VVVF test plant. The motor shall be run up to rated voltage and frequency (approximately 400 V, 50 Hz) and operated for about one hour in each direction. Bearing temperature rise, vibration and noise levels shall be monitored. The bearing temperature rise shall not exceed 40°C above ambient, and vibration levels shall remain within permissible limits. After satisfactory completion of all tests, the traction motor shall be certified fit for service.
12. After the incoming test and record data, the PSU shall carry out complete dismantling of the Traction Motor (TM), including removal of the pinion, labyrinth, speed sensor and other subassemblies. Initial dry cleaning and solvent cleaning of the stator, rotor and end frames shall be carried out to remove oil, grease, dust and contaminants.
13. All actions under the Reliability Action Plan shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
14. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest
15. **SMI/MS/TC/STR FOR TM are as follows:**

SN	Description	SMI
1	Fitting of Nuts, bolts, screws	1
2	Condition monitoring of bearings by SPM Meter	58
3	General guidelines to follow for balancing of rotor and blower impellers	152
4	General guidelines to follow for balancing of rotors and cooling blowers in position	199
5	Provision of rubber compound RTV 738 in the terminal box of three phase asynchronous traction motor type 6 FRA 6068.	209
6	Modified Method of VPI for three phase asynchronous traction motor type 6FRA6068	210
7	Improved Method of brazing of terminal bus rods on respective phase rings of the stator windings of three phase traction motor type 6FRA6068.	211
8	Pre-testing of speed sensor	252
9	Pre-testing of temperature sensors	260
10	Detection of rotor bar crack & stator defect for traction motor type 6FRA6068 used on WAG9 / WAP7 locomotives by measurement of inductance.	262
11	Use of extreme pressure lubricant paste for shafting of rotors of traction motors type 6FRA6068 and 6FXA7059 to prevent damage to stampings and scoring of shafts at the time of removal of shaft	272
12	Implementation for detection of rotation of outer racers of bearing and assembly components by checking metal content in grease sample 3 Phase traction motors type 6FRA6068 and 6FXA7059.	273
13	Ensuring proper fitment of traction motor bearings in 6FRA6068 TM	278
14	Use of Induction Heater for heating of End Shields/End frames of traction motors for bearing fitment	301
15	Implementation for periodicity & quantity of re-greasing in minor schedule in every alternate schedule (i.e. 1st IB, 2nd IA, 2nd IC) for Traction Motor (TM) type 6FRA6068.	307
16	SMI for Magnetic Particle Testing (MPT) of Traction Motor (TM) nose stay in conventional locomotives/EMUs/MEMUs/Metro Railways, TM suspension holder support and motor support in WAG9/WAP7 locomotives and Traction Motor support arm in WAP5 locomotives.	311
17	Use of Dial Snap Gauges for measurement of shaft diameter of traction motor for Electric Locomotives.	314
18	Use of Bore Gauge for measurement of internal diameters of End Shield/Racer during bearing fitment.	318
19	Improving reliability of armature shaft by not rebuilding armature shaft by welding for conventional and three phase locomotives.	321
20	Use of grease gun equipped with digital grease meter for greasing of roller bearings of traction motors and MSU bearings of electric locomotives.	322
21	Procedure of measurement of axial clearance and limit of axial clearance for Traction motor type 6FRA6068.	323
22	Procedure of measurement of Radial Clearance of Bearings	336
	MS	MS NO.
23	Modification of Drive End - Outer Labyrinth of WAG9/ WAP7 Traction Motor type 6FRA 6068	314

24	Modification of fixing arrangement temperature sensor fitted on traction motor type 6FRA 6068 of WAG9/WAP7.	350
25	Modification to support the DE and NDE side overhangs and augmentation of insulation scheme of stators of Three phase traction motor type 6FRA 6068 during	355
26	Modification to support the DE and NDE side overhangs and augmentation of insulation scheme of stators of Three phase traction motor type 6FRA 6068 during	356
27	Provision of change over switch in Traction Converter for speed sensor of Traction Motor	371
28	Modification of Bellows and its Mounting arrangement of existing Traction Motors type 6FRA 6068 used in WAG9/WAP7 class of locomotives (retrofitment).	373
29	Modification of Bellows and its Mounting arrangement on New Traction Motors type 6FRA6068 used in the WAG9/WAP7 class of locomotives(new manufacturing).	374
30	Ensuring availability of Grease outlet channel at NDE side of TM type 6FRA 6068 used in WAG-9 and WAP-7 locomotives	387
31	Measurement of dimensions of various assembly components and ensuring adequate interferences during replacement of TM bearings.	415
32	Use of 5 mm solid end plates in place of existing 5 x 1 mm thick spot.welded laminated end plates assemblies for stators & rotors of TM type 6FRA 6068.	423
33	Modification to avoid failure of temperature sensors due to increase in resistance value of temperature sensor cable shielding.	437
34	Modification in resistance ring to increase the radial gap between resistance ring and end ring in Scheme-II design of rotors for traction motor type 6FRA6068	438
35	Modification in drawing of outer bearing cap (DE) to drain out ingressed gear case oil from TM type 6FRA6068.	439
36	Implementation of bearing cap NDE to achieve adequate lateral thrust in Traction motor (TM) assembly of 6FRA6068 TM in WAG9/ WAP7 class of locomotives.	460
37	Modification for providing dummy plate in cab roof in place of Air Conditioning unit.;	461
38	Implementation for modification in drawing of Outer bearing cap DE to achieve adequate lateral thrust in Traction motor (TM) assembly of 6FRA6068 TM in WAG9/WAP7 class of locomotives.	466
39	Modification in Hex. Socket CSK Head Screws for fixing of Traction motor Bellow plate to achieve adequate mechanical strength in Traction motor (TM) type 6FRA6068 for WAG9/WAP7 class of locomotives.	472
40	Modification in Mounting arrangement of Leather Bellows of Traction Motors type 6FRA6068.	476
41	Adoption of Traction motor labyrinths of TM type 6FRA6068 as per original dimensions given by ABB to eliminate problem of gear case oil ingress in TM.	478
42	Modification Sheet for increasing grease outlet hole on End Frame DE side from 9 mm to 12 mm in Traction motor type 6FRA6068.	485
43	Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC	496
	TC	TC
44	Indigenization of lubricants for WAP5/WAP7/WAG9 rev 4	34
45	Implementation for storage & handling of lubricant/greases used in Electric locomotives.	104

46	Technical Circular on Year of manufacturing codification on TM & MSU	117
47	General Guidelines for uses of Videos Bore scope for checking the inaccessible location of electric locomotives to avoid failures.	144
48	Technical Circular for Interchangeability and Maintainability of Hall Effect Speed Sensors provided in IGBT based 3-phase electric locomotives.	145
	STR(Schedule of Technical Requirements)	STR
49	Repair, rehabilitation of motorised bogie frames	81
50	Gears and Pinions of Electric Locomotives	22

16. Traction Motor - Must change items as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest

SN	Description
1	Set of cylindrical roller Bearing(DE & NDE) along with Outer/inner labyrinth pins and accessories for three phase traction motor type 6FRA 6068
2	Pinion shaft for WAP-7 loco 20 teeth / Pinion shaft 21 teeth for WAG-9.
3	TM Holder plate for traction motor suspension of WAP-7/WAG-9 (2 nd POH of WAP7 and 1st POH of WAG9/9H)
4	TM speed sensor (2 nd POH of WAP7 and 1st POH of WAG9/9H)
5	TM Temperature sensor complete assembly with cable (2 nd POH of WAP7 and POH of WAG9/9H)
6	TM Terminal Board Assembly
7	Speed Sensor Prob Housing
8	Bellow Plate of TM
9	End Plate O ring & the gasket of the terminal box of TM
10	Gasket of Temp. Sensor
11	Bellows of TM
12	Power Cable of TM
13	Kit for temp sensor assembly and Temperature strip
14	Servoplex SHC-120 (IOCL) grease for traction motor bearing of WAG-9/WAP-7
15	Holder fixing bolt
16	Helical inserts of junction box of TM
17	All plastic conduit pipe
18	All Hardware (eg. Nut , Bolt , Washer, Fasteners, Screw , Pin, Insert etc.)
19	All Rubber/Plastic item (eg O ring, Hose, Gasket , Seal , conduit pipes etc)

5) Auxiliary Section

The PSU shall be responsible for complete inspection, testing, rectification, replacement and certification of Auxiliary section and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs. In addition to above, modifications/reliability improvement measures / instructions related to compressors issued by Railway Board/RDSO from time to time shall be considered as part of scope of work.

1. Pantograph Equipment (PT)

- I. Overhauling of the pantograph shall include dismantling and cleaning of all parts, inspection and repair/replace frames, arms, panto pan, insulator, bearings, pins, main

springs and upper/middle articulation joints. A spring catcher shall be provided wherever applicable. Carbon strips with/without ADD(Automatic Dropping Device) and the complete overhaul kit shall be replaced as per OEM manual and RDSO latest guideline for maintenance of pantograph.

- II. Free movement of the bow shall be checked, copper shunts inspected and replaced if required, and all joints properly lubricated. Alignment and tightness of all components shall be verified.
- III. The PSU shall check for air leakage, verify pantograph raising and lowering time, confirm correct contact pressure, ADD and other sub system function, inspect pantograph pressure switches, and record all test results for certification and traceability.
- IV. Complete pantograph shall be changed as per RDSO Guideline (Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest)

2. Overhauling of Main Compressor (CP)

- I. The PSU shall be completely dismantled compressor and all parts cleaned in a clean environment, with mandatory replacement of all packings and rubber items.
- II. After oil drain, all components of the CP shall be dismantled like piston, cylinder, crank shaft, bearing, bushing, connecting rod, inter and after cooler and its fan ect. All components should be clean, inspected, repaired or replaced, as required. Piston, cylinder, piston ring, valve etc shall be replaced with new as per RDSO Instruction and OEM manuals (POH overhauling kit). The compressor shall be completely overhauled in accordance with the OEM Maintenance Manual and applicable RDSO Technical Circulars / SMIs.
- III. Intercooler and after-cooler and its copper pipe shall be cleaned, decarbonized , inspected , repaired / and refitted with new gaskets. Complete assembly shall be changed as per RDSO Guideline (Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest)..
- IV. After reassembly, the compressor shall be test-run first without cylinder heads to check free rotation and oil pressure, then with heads fitted at no load and at rated pressure ensuring normal current, stable oil pressure, and no leakage, overheating, noise, or vibration.
- V. Complete inter cooler and after cooler assembly shall be changed as per RDSO Guideline (Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest)

3. Overhauling of Auxiliary Compressor (MCPA)

- I. The PSU shall dismantle the Auxiliary Compressor (MCPA) and carry out detailed inspection of all components.
- II. Defective parts shall be repaired or replaced, followed by complete overhauling as per OEM manual(overhauling kit) and assembly of the MCPA.
- III. The assembled MCPA shall be tested strictly in accordance with the OEM Manual and applicable RDSO instructions, and deficiencies, if any, shall be rectified.

4. Overhauling of Auxiliary Blowers, Pumps and Heating Equipment

- I. The PSU shall carry out complete overhauling of the following equipment: Oil Cooling Blower (OCB), Machine Room Blower (MRB), Traction Motor Blower (TMB), Scavenger Blower of MRB, Scavenger Blower of TMB, Transformer Oil Circulating Pump, Converter Oil Circulating Pump (SR Pump) if applicable, Cab Heater and Cab Fan.
- II. The scope shall include:
 - Dismantling and thoroughly cleaning equipment.
 - Inspection and repair/replacement of all components as per OEM manual.

- Impeller crack detection using suitable NDT methods and dynamic balancing(SMI-199 or latest).t.
- Correct fitment and alignment, followed by checks for noise, vibration and bearing temperature during run tests.
- Assembly and test bench testing strictly as per the OEM Maintenance Manual.
- Run tests to monitor vibration levels, bearing temperature and bearing noise, with rectification of deficiencies, if any.

5. Overhauling of Induction Motors of Auxiliary Equipment (OCB, MRB, MCPA, Sc.MRB, Sc.TMB, CPA, OCP, SR Pump, Cab heater blower)

- I. After incoming testing, PSU shall dismantle, clean, varnish and overhaul induction motors of all auxiliary equipment.
- II. The scope shall include:
 - The motor should be dismantled , all components to be cleaned and checked.
 - Varnishing and backing should be done on the stator.
 - Electrical testing, including but not limited to Insulation Resistance (IR) test, Winding resistance measurement, Surge comparison test, Megger test, Rotor growler test for detection of rotor bar cracks.
 - Visual inspection, crack , dimensional verification of Motor Body, End frame and rotor to be checked. Repair/replace if required. Dynamic balancing of the rotor.
 - Verification of all critical dimensions as per OEM tolerances.
 - Assembly with new bearing installation and run testing to check bearing noise, temperature rise and vibration, ensuring compliance with prescribed limits.
 - OCB impeller shall be changed as per RDSO Guideline (Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest)
6. The motor should be assembled with an impeller for the blower or pump and tested for air delivery, vibration , temperature rise etc. on the test bench.
7. All air blower ducts should be inspected for any cracks, bending , corrosion or any other mechanical damage. It should be replaced. At time of assembly gasket, seal, o ring and other sealing components should be used(new) to ensure leak proof air delivery of the blower.
8. All applicable Reliability Action Plan measures shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
9. All the must changed items shall be changed in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
10. **SMI/MS/TC/STR for Auxiliary section are as follows:**

SN	Description	SMI/MS/TC/STR
1	Fitting of Nuts, bolts screws	SMI-1
2	Fits and limits on bearing of auxiliary motor used on electric locomotive	SMI-16
3	Procedure for bearing clearances of "free bearing" that is bearing off the machine.	SMI-23
4	Procedure for fixing the socket with the lead wires of auxiliary motor	SMI-32
5	Condition monitoring of bearings	SMI-58
6	Static balance procedure for panto type AM-12 type AM-18	SMI-64

7	Ensuring proper raising & lowering PT type AM-12	SMI-75
8	Fitment of outer race bearing in the bearing housing	SMI-78
9	Testing/checking of new bearing for auxiliary motor	SMI-79
10	Puller for extracting traction motor cooling blower	SMI-87
11	Gasket for cylinder heads of compressor / exhauster & pipe flanges for vac & comp.air circuit	SMI-100
12	Use of button head type of grease nipple on auxiliary motors fitted on electric loco	SMI-147
13	Guidelines to identify genuine and spurious/reconditioned bearing	SMI-148
	Special instruction for surge on 3-phase AC auxiliaries	SMI-149
14	General guidelines to follow for balancing of rotor and blower impellers	SMI-152
15	Characteristic properties of enamel used on enamelled winding wires	SMI-153
16	Characteristic properties of insulating varnishes	SMI-154
17	Periodic maintenance of AM12 type pantographs	SMI-192
18	Lubrication schedule for improving reliability of AM-12 type of pantographs and of similar design	SMI-198
19	General guidelines to follow for balancing of rotors and cooling blowers in position	SMI-199
18	Characteristic properties of impregnating resins and insulating varnishes	SMI-200 Amend-1
19	Special Maintenance Instruction (SMI) for AM-92 and IR-03H type pantograph	SMI-292
20	Standardization of scheduled maintenance practices for 1750 lpm capacity lubricated reciprocating compressor for electric locomotives	SMI-296
	Operational, Maintenance and Trouble Shooting of 2x500 kVA, IGBT based	SMI-297
21	Hotel Load Converter of WAP7 locomotives	
22	Special Maintenance Instruction for maintenance of Oil Cooling Unit(OCU) for 3- Phase Electric Locomotives	SMI-319
23	Technical Scope of Work for annual maintenance contract for 1750 LPM capacity lubricated compressors of Electric Locomotives	SMI-299
24	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various schedules for 3 phase electric locomotives.	SMI-332
25	Special Maintenance Instruction for maintenance of filters of Oil Cooling Blower (OCB), Machine Room Blower (MRB) and Traction Motor Blower (TMB) for 3-phase Electric Locomotives.	SMI-286
26	Procedure for impregnation of induction motor	SMI-86
27	Detection of rotor bar and end ring cracks on arno-converter and auxiliary motor by search coil and motor tester.	SMI-163
28	Provision of Metallised Carbon strips in place of steel strips on Pantographs type AM-12 or similar design. (SKEL-4303, Rev. 2 A3)	MS-265
29	To provide epoxy moulded terminal box cover for auxiliary motors of electric locomotives.	MS-290 (Rev.'1')
30	To provide a water discharge outlet in TM Scavenge Blower on WAG9, WAP5 & WAP7 class of Locomotives.	MS-328

31	Standardization of Panto Pan Assembly of AM-12 or similar Pantograph for Electric Locomotives and EMUs	MS-333
32	Provision of additional spring catcher of AM-12 pantograph	MS-389
33	Replacement of 10 mm ² cable type 4GKW-AX (Cable no. 1147,1148 and 1149) of oil cooling unit with 16 mm ² cable type 4GKW-AX to improve the reliability of three phase electric locomotives.	MS-395
34	Modification in the Pneumatic Control Unit of Schunk makes the High Reach Pantograph (HRPT) type WBL-85HR.	MS-511
35	Pantograph OHE ENTANGLEMENT	TC-19
36	Indigenization of lubricants for WAP5/WAG9 Locomotives.	TC-34
37	Adoption of metallised carbon strips on pantographs in place of silicon manganese still strips.	TC-71
38	Inter mixing of compressor oil Lubricators.	TC-85
39	Components to be changed during AOH / IOH & POH of similar Design Pantograph type AM12, IR01 & PAN01.	TC-94
40	Technical circular for storage & handling of lubricant/greases used in Electric locomotives /MEMUs/EMUs	TC-104
41	Connecting lead wire for Auxiliary Motors.	STR/12
42	Rewinding of Auxiliary Motors used in Electric locomotives	STR/14

11. Must Change Item as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest for Auxiliary section are as follows:

SN	Description
1	Complete pantograph (2nd POH of WAP7 and 1st POH of WAG9)
2	Metalized Carbon Strips
3	POH kit of Low speed pantograph type: AM12,IR01,PAN01 & EL 01 for freight locomotive As per TC -0094 (or) POH kit of High speed pantograph for M/E locomotive: Type AM92 and IR03H as per SMI -292 or latest , WBL 85 as per OEM manual. (or) POH kit High Reach pantograph for electric locomotive- As per OEM maintenance manual
6	POH Maintenance kit / Overhauling kit for main Compressor from OEM
7	POH Maintenance kit / Overhauling kit for inter cooler after cooler assembly from OEM
8	Copper Interconnecting pipes between intercooler and after cooler (2nd POH of WAP7 and 1st POH of WAG9/9H)
9	Complete Inter cooler after cooler assembly (2nd POH of WAP7 and 1st POH of WAG9/9H)
10	HP & LP piston Assy. As per OEM
11	Cylinder LP & HP.
12	Piston Ring pack – LP & HP Cylinder
13	HP and LP Concentric valves, valve kits and gasket.
14	Main compressor resilient Mounting & Mounting pads
15	Connecting Rod BUSH
16	Main compressor delivery hose and CP delivery pipe
17	Secondary Oil Filter, Gasket for concentric valve
18	Main Element and safety element of the air intake filter and other parts as prescribed in OEM's manual
19	Suction Air Filter Assy. For Main Compressor

20	Compressor Oil for main compressor and auxiliary compressor.
21	Carbon brush for auxiliary compressor motor
22	Overhauling kit for auxiliary compressor and air delivery hose between the auxiliary compressor and break frame
23	Traction motor blower filter, plenum, wear plate and duct seals
24	The seal between TM blower & ducting , TM blower and machine room floor, plenum box and body side panel, Inspection cover
25	Aluminium impeller for oil cooling blower unit, centrifugal designed for 3-phase loco
26	DE and NDE bearings with associated components of MRB Motor, TMB Motor, OCB Motor, Sc.MRB Motor, Sc.OCB Motor, Sc.TMB Motor, Main Compressor Motor, Cab heater blower motor, Crew fan Motor as per OEM or RDSO approved Vendor/Brand for auxiliary motor.
27	All rubber GASKET and SEAL of Oil cooler blower (OCB), Machine room blower (MRB), Traction Motor Blower (TMB), Sc. MR blower, Sc. OC Blower Sc. TM Blower at various location like filter, duct, dome, base, roof, machine floor, body side panel, inspection cover etc
28	TM & Oil cooler Blower scavenger : The hoses at the oil cooler blower filter scavenger boxes, the equalizer hoses between the TM & oil cooling blower and the filter, The seal at the oil cooler blower scavenger duct joint, The seal and gasket on the TM and oil cooler blower scavenger function, Rubber Hoses
29	Machine Room Blower Scavenger: The flexible duct between machine room blower scavenger motor and filter, Rubber hoses, The equalizing hoses, all seal and gasket in the ducting
30	All GASKET & 'O' RING FOR Transformer Oil Pump and Converter Oil Pump
31	All Hoses (Rubber hoses, equalizer hoses), seal, gasket and flexible duct of Sc.TMB, Sc.OCB and Sc.MRB
32	CAPACITOR for Sc Blower cab heater blower
33	The flexible duct between the machine room blower scavenger motor and filter
34	All side filters & roof filters (MRB,TMB,OCB,HLC) (2nd POH of WAP7 and 1st POH of WAG9/9H)
35	TMB and MRB Impellers

6) RSI (Traction Converter, Auxiliary converter/BUR, HLC, BA charger, Harmonic Filter Resistor) Section.

The PSU shall be responsible for complete inspection, testing, rectification, replacement and certification of RSI Section and associated equipment during POH, also testing, diagnostics, software management and preventive upkeep of all electronic boards and systems in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs. All electronic cards and assemblies shall be handled under ESD protection.

1. The Propulsion System and Hotel Load Converter system are already covered under the CAMC by the Railway sheds. Therefore, the PSU may liaise with the Railway sheds whenever a locomotive arrives at the Dabhoi Workshop for POH. The PSU may coordinate with the Railway sheds to call the OEMs representative for overhauling to the system under the existing CAMC.
2. **IV & UIC Coupler Maintenance**
Cleaning, lubrication and inspection of IV and UIC couplers. Insulation resistance testing of control and power pins. Phase sequence verification of all IV couplers. Proper tightening of fasteners, routing and clamping of cables and sealing of cable entry points. RDSO SMI -297

or latest to be followed.

3. Fiber Optic Cables

- I. Maintenance, overhauling and testing of FOC and associated interfaces shall ensure reliable signal transmission, fault detection capability and stable operation of electronic modules

4. Harmonic Filter Resistor

- I. The PSU shall carry out visual inspection of the harmonic filter resistor and replace damaged components and corroded hardware, as required.
- II. Electrical checks including contact integrity and insulation resistance testing shall be performed.
- III. Defective insulators shall be replaced strictly in accordance with applicable standards and instructions.

5. All activities under the Reliability Action Plan shall be implemented strictly in accordance with RDSO TC-142 or the latest applicable instructions.

6. SMI/MS/TC/STR for RSI section are as follows:

S.no	Description	SMI/MS/TC/STR No.
1	Fitting of Nuts, bolts screws	SMI-1
2	Method of evaluating crimped joint performance.	SMI 114
3	Checking the capacitance of the capacitors in ac damping, dc damping and snubber circuits of silicon rectifiers used on electric locos	SMI-139
4	Failure improvement of Valve Set in Power Converter for 3-phase electric locos	SMI-247
5	Testing of WRE gate unit card of Auxiliary Converter of 3-phase electric locos to analyze failure of gate unit card.	SMI-256
6	Improvement in reliability of gate unit cards of power converter of 3-phase locos by measuring dBm level of QFBR-1478C transmitter (Component No. 151)	SMI-257
7	Improvement in reliability of LWL cards (AFB635A01) and bus coupler cards (UFB660A01&UFB701A01) of 3 phase locomotives by	SMI-258
8	Instruction for development of testing setup of signal conditioning card (SAP) & senders for 3phase electric locomotives	SMI-260
9	Repairing & testing of WRE modules of auxiliary converter for 3 phase electric locomotives	SMI-261
10	Instructions for development of testing setup of gate unit of traction converter for 3 phase electric locomotive.	SMI-263
11	Procedure of repairing Valve sets of traction converter of three phase Electric Locomotives.	SMI-265
12	Technical Scope of work for Annual Maintenance Contract(AMC) of GTO based Traction Converter(SR), Auxiliary converters (BUR) and MICAS based Vehicle control unit (VCU) of Three Phase Locomotives	SMI-294
13	Operational, Maintenance and Troubleshooting of 2x500 kVA, IGBT based Hotel Load Converter of WAP7 locomotives	SMI-297 (Rev-1)
14	Technical Scope of Work for annual maintenance contract of brake system fitted in 3 phase electric locomotive	SMI-298
15	Flushing, filling and testing of coolant to be used in IGBT based WAP5, WAP7, WAP9 and WAG9-H locomotives	SMI-325
17	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various	SMI-332

	schedules for 3 phase electric locomotives.	
18	Repair and Maintenance of Motorized Line Contactors provided in IGBT Traction Converter of 3-phase electric locomotives.	SMI-338
19	Improved Grounding of ALG rack in TRACTION CONVERTER of 3 ϕ electric locomotives.	MS-365
20	Modification in Aux. converter of 3 phase Electric locos to improve reliability.	MS-372
21	Modifications in NS/AS Controller Cards (PPA988B02) and Gate Unit of Power Converter of three phase locomotives	MS-378
22	Replacement of ECSX make 24 MHZ crystals by FOX make crystals in electronic cards of three phase electric locomotives	MS-391
23	Modification to address failures of Auxiliary converter cards	MS-393
24	Modification in 3-phase electric locomotive to record message of VCD isolation status.	MS 397
25	Paralleling of interlocks of EP contactors and auxiliary contactors of three phase locomotives to improve reliability.	MS-413
26	Modification sheet for avoiding necessity of CAB changing in case of failure of processor cards of VCU of WAG9/WAG9H three phase locomotives	MS 429
27	Modification to address failures of DC link capacitors of 3x100 kVA, GTO based Auxiliary converter.	MS-436
28	Modification in the cooling circuit of M/s.BHEL makes an IGBT based traction converter to prevent air locking, spillage of coolant and fluctuation in coolant level.	MS-457
29	Adoption of IGBT type speed sensors in locomotives with GTO based traction converter	MS 458
30	Modification in three phase electric locomotives provided with MICAS based VCUs to ensure complete redundancy of FLG-1/2, HBB-1/2 processors cards.	MS 459
31	Modification in the existing Control Electronics (CE) resetting scheme to reset the control electronics(VCU) in Multiple unit locos.	MS 475
32	Conversion of GTO based locomotives into IGBT based 3-phase electric locomotives.	MS-473
33	Scheme for energy saving in three phase freight locomotives.	MS-482
34	Recording of Flasher light operation either due to fault or manually by Loco Pilot in case of emergency with time stamping in VCU of 3-phase Electric Locomotives.	MS-500
35	Removal of Harmonic Filter from WAP5, WAP7 and WAG9H class of 3-phase electric locomotives fitted with IGBT based Propulsion Equipments.	MS-504
36	Handling & cleaning of printing circuit board	TC-91
37	Technical circular for storage & handling of lubricant/greases used in Electric locomotives / MEMUs / EMUs	TC-104fiber op
38	Instructions for formation of Interconnected Loco Bus Station Network	TC-134
39	Standardization of Electronics Lab of 3-Phase Electric Locomotives Holding Sheds and Periodicity of Tests.	TC-135
40	Instructions for regular implementation of different SMLs/TCs/Technical Reports issued by RDSO from time to time to improve the reliability of Electronics of 3-phase electric locomotives.	TC 137
41	Trouble shooting of different make 2x500 kVA, IGBT based Hotel Load Converter of WAP-7 Locomotives.	TC-141

42	Guidelines for refurbishment/ rehabilitation of printed circuit boards of E70 Brake System for 3-Phase Electric Locomotives type WAP5, WAG9 & WAP7.	TC-148
43	SPECIFICATION FOR RELIABILITY OF ELECTRONICS USED IN ROLLING STOCK APPLICATION	ELRS /SPEC/SI /0015
44	Repair of printed circuit board of 3phase Electric Locomotives type WAP5 , WAP7 & WAG9	STR/47
45	Brake System and EP Assisted Brake System for Three Phase Electric Locomotives	STR-76

7. Must Change Item as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest for RSI section are as follows:

SN	Must Change Items
1	UIC socket seal gasket
2	Harmonic filter resistance junction box cable gland, seal
3	Seal of harmonic filter seal, Harmonic Filter resistor and insulators
4	Harmonic filter capacitor (2nd POH of WAP7 and 1st POH of WAG9/9H)
5	Set of Rotary Switch
6	All Program Switches Including HOM Switch, Selector Switch, SPDP Toggle Switch & D Type Fuses

7) Battery Section.

The PSU shall be responsible for complete inspection,overhauling , testing, rectification replacement, certification of Battery Section and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. Battery Maintenance:

The PSU shall carry out complete overhauling of the battery system, including replacement of Battery, Battery box, inspection of the new battery body, vent plugs and electrolyte level, ensuring that all vent holes are clear. Charging and discharging cycles shall be performed, and cell and battery voltages shall be measured and recorded. Battery terminals and connectors shall be cleaned and protected against corrosion. The new battery sets, secondary charging shall be carried out and the date of commissioning shall be recorded.

2. Earthing Switch (HOM)

The PSU shall inspect the earthing switch frame and contact surfaces for any damage or corrosion and ensure proper tinning for effective electrical conductivity. The mechanical operation of handles, blades and spring clips shall be checked, and interlocks and locking mechanisms shall be tested to ensure correct and safe functioning. Roof seals shall be inspected for watertightness, and contact components shall be lubricated with approved conductive grease to ensure smooth operation and reliable electrical contact.

3. All reliability-related actions shall be implemented strictly in accordance with RDSO TC-142 or the latest applicable instructions.

4. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

5. SMI/MS/TC for RSI section are as follows:

SN	Description	SMI/MS/TC No.
1	Characteristic properties of insulating varnishes	SMI 154
2	Method of evaluating crimped joint performance.	SMI 114
3	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various schedules for 3 phase electric locomotives.	SMI 332
4	Standardization of earthing switch arrangement on 3phase locomotives to make interchangeable of various makes VCB between single & 3phase locomotives	MS 345

6. Must Change Item as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest for RSI section are as follows:

SN	Description
1	Set of Ni-Cd battery (26 Nos)
2	Battery Box (2nd POH of WAP7 and POH of WAG9)
3	HOM Gasket and Other Rubber Parts of HOM
4	ALL Fasteners of battery boxes, battery box ventilation hose
5	ALL Hardware (eg. Nut , Bolt , Washer, Screw , Pin , O ring etc.)
6	All Rubber item (eg O ring, Hose, Gasket , Seal , etc)

8) Panel Section

The PSU shall be responsible for complete inspection,overhauling , testing, rectification replacement, certification of HB, SB, FB panels and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

- The PSU is responsible for systematically stripping panel components, which involves Relays and CTs, MCBs, Resistor, Condenser, Diode, Contactors, VCU card etc. Specialised maintenance to be done on all these components.
- All panel bodies should be checked for any physical damage and repair it if required. Door lock, latches and hinges to be checked for proper working. Labeling should be done for all cable and switches.
- HB and SB Panels Cubicle (HB-1,2 & SB-1,2 & FB Panel)**
 - The PSU shall inspect and attend panel structures for any deformation or damage.
 - Control and power wiring, connector, fittings, lug, sleeve, cable numbering shall be inspected, cleaned and tightened to ensure correct condition and to eliminate fire and reliability risks. Renumbering/Relabelling should be done if required.
 - SB panel couplers, diodes shall be inspected, tested and maintained.
 - Approved reliability and safety modifications shall be implemented to ensure safe and dependable operation.
- All control and power cables, solenoid valves and connector lugs shall be inspected for cracks, overheating or damage.Tightness of all electrical connections shall be ensured. Coupler pins and snap-type lugs shall be cleaned and checked for proper crimping to ensure reliable electrical continuity.Terminal shifting in HB panel in accordance with the MS-400 or latest and checking of condition of blocking diode in SB panel MS-488 or latest.
- Filter Cubicle (FB)**

- I. The PSU shall carry out overhauling, testing and calibration of the high-voltage RLC system, comprising contactors, capacitor banks, discharge and earthing resistors, and associated protection and sensing devices operating automatically with traction and timed discharge.
 - II. The FB cubicle shall be cleaned and inspected, structural parts and connections checked for condition and tightness, capacitor health and protection circuits tested, insulation resistance and discharge functions verified, and doors and locking arrangements examined, ensuring safe and reliable operation.
6. All actions under the Reliability Action Plan shall be implemented strictly in accordance with RDSO TC-142 or the latest applicable instructions.
 7. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

8. SMI/MS/TC for Panel section are as follows:

Sn	Description	SMI/TC No.
1	Fitting of Nuts, bolts screws	SMI-1
2	Method of evaluating crimped joint performance.	SMI-114
3	Operational, Maintenance and Trouble Shooting of 2x500 kVA, IGBT based Hotel Load Converter of WAP7 locomotives	SMI-297 (Rev-1)
4	Procedure of pneumatic tube connection to electro-pneumatic contactor of harmonic filter/hotel load converter in 3-ph locos.	SMI-313 & RAP TC-142
5	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various schedules for 3 phase electric locomotives.	SMI-332
Sn	Description	MS/TC No.
1	Provision of inspection window in filter cubicle.	MS-366
2	Provision of MCB (128.1) in Air Dryer circuit of 3-Phase electric locomotives	MS-375 Rev 1
3	Modification to voltage sensing circuit in WAP-5,WAP-7,WAG-9 & WAG-9H Locomotives	MS-377 & RAP TC-142
4	Paralleling of interlocks of EP contactors and relays of three phase locomotives to improve reliability.	MS-390 & RAP TC-142
5	Replacement of 10 mm ² cable type 4GKW-AX (Cable no. 1147,1148 and 1149) of oil cooling unit with 16 mm ² cable type 4GKW-AX to improve the reliability of three phase electric locomotives.	MS-395
6	Modification in 3-phase electric locomotive to record message of VCD isolation status.	MS-397
7	Modification sheet for shifting of the termination of 4GKW, 1.8 KV, 70 mm ² cable and 2 X 2.5 mm ² cables housed in lower portion of HB-2 panel and provision of Synthetic resin bonded glass fibre (SRBGF) sheet for three phase locomotives	MS-400 & RAP TC-142
8	Modification sheet for relaying of cables in HB-2 panel of three phase locomotives to avoid fire hazards.	MS-401
9	Auto switching off machine room/corridor lights to avoid draining of batteries in three phase electric locomotives.	MS-403 & RAP TC-142
10	Paralleling of interlocks of EP contactors and auxiliary contactors of three phase	MS-413 MS-413 Rev.'1' & RAP

		TC- 142
11	Modification sheet of Bogie Isolation rotary switch (Sch.Pos.154 cut out switch in 3Phase Electric Locomotive)	MS-426
12	Modification Sheet for re-location of earth fault relays for harmonic filter and hotel load along with its resistor in three phase locomotives	MS-428 & RAP TC-142
13	Removal of shorting link provided at c-d terminal of over current relay of 3 Phase locomotives	MS-432 & RAP TC-142
14	Modification in control circuit of 3phase locomotives to enable switching ON the Marker Light under locomotive dead condition.	MS-344 & RAP TC-142
15	Modification in Control Circuit of Flasher Light and Head Light of 3-phase electric locomotive.	MS-357 & RAP TC-142
16	Modification of mounting arrangement of MCB-100 (circuit breaker battery charger) fitted in aux. Converter (BUR 3/30x2) of 3 phase elect. Locos.	MS-367
17	Removal of interlocks of control circuit contactors No.126 from MCPA circuit in 3Ph. Loco.	MS-399
18	Modification in 3-phase electric locomotives provided with MICAS based VCUs to ensure complete redundancy FLG-1/2, HBB-1/2 and STB-1/2 of processor cards.	MS-459
19	Provision of auxiliary interlock for monitoring of A2-B- segment of harmonic filter ON (8.1)/adoption (8.2) contactor in GTO/IGBT locomotives.	MS-464
20	Modification in blocking diodes to improve reliability in three phase loco.	MS-467 & RAP TC-142
21	Modification in existing hotel load scheme by removing protections provided in WAP-7 locomotives.	MS-468
22	Conversion of GTO based locomotives into IGBT based 3-phase electric locomotives.	MS-473
23	Modification in existing Control Electronics (CE) resetting scheme of 3-phase electric locomotives.	MS-475
24	Modification in earth fault circuit for elimination of spurious message on account of earthing of control cables in 3-phase locomotives.	MS-480
25	Scheme for energy saving in three phase freight locomotives.	MS-482
26	Modification to ensure continuity of HOG Converters' feed to the train from working loco through dead loco in WAP5/WAP7 class of 3-phase HOG compliant electric locomotives.	MS-486
27	Provision of Blocking Diode in HOG control circuit (in series of MCB 129.2/1) of HOG compliant WAP7&WAP5 Three Phase Electric Locomotives.	MS-488
28	Modification to avoid Speedometer OFF & ON during running of train/locomotive due to VCU reset in three phase electric locomotives.	MS-490
	Modification Sheet for development of Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC type of Electric Locomotives.	MS-496
29	Modification Sheet for Power Supply to Real-Time Train Information System (RTIS) devices in Tap-changer based conventional Electric	MS-497

	Locomotives & 3-Phase Electric Locomotives	
30	Recording of Flasher light operation either due to fault or manually by Loco Pilot in case of emergency with time stamping in VCU of 3-phase Electric Locomotives.	MS-500
31	Unloader valve control circuit modification in three Phase Electric Locomotives.	MS-502
32	Paralleling interlocks of control circuit contactor to improve reliability of three phase electric locomotives.	MS-503
33	Isolation of Harmonic Filter from 3-phase locomotives fitted with M/s Alstom (BTIPL), CGPISL and Medha make IGBT based Propulsion Equipment.	MS-504
34	Removal of cables (3055 and 4236) leading to SPM to avoid failure of Locomotives.	MS-512
Sno	Description	TC No.
1	Instructions for regular implementation of different SMIs/TCs/Technical Reports issued by RDSO from time to time to improve the reliability of Electronics of 3-phase electric locomotives.	TC-137

9. Must Change Items for Panel section are as follows:

SN	Description
1	FB panel air supply pipe line set
2	ALL FB panel contactor insulating base
3	63 Amp MCB for OCB and TMB (Pos no 53.1/1,53.1/2, 59.1/1, 59.1/2)
4	40 amps mcb of CP 47.1/1 and 47.1/2
5	MRB contactor 54.2/1 and 54.2/2 with timer
6	Contactor 136.3,126.5, 136.4, 127.7/1, 130.1, 211, 126.6, 126.7/2
8	FB panel air supply pipe line
9	ALL HARDWARE (eg. Nut , Bolt , Washer, Screw , Pin etc.)
10	All Rubber item (eg Hose, Gasket , Seal , etc)

9) Driver Desk (DD) Section.

The PSU shall be responsible for complete inspection,overhauling, testing, rectification and certification of all Driver Desk panels and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The PSU shall carry out stripping and overhauling/replacement of Headlights, Marker Lights, Cab Heaters and Panel Locks as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest. Thermostats and blower motors shall be handed over to the respective specialized sections for repair/overhauling and reassembled after receipt.

2. Panels A, C and D:

The PSU shall inspect panel structural condition, rectify it if required. Replace all types of push button switches, desk meter, gauges, indication lamp, key etc and check operation of all these components. Control circuit cable to be checked for insulation resistance, lug and sleeve fitting and numbering on it.

3. TE/BE Master Controller:

The PSU shall carry out complete overhauling of the TE/BE master controller, including inspection of mechanical components and cam switches, gear mechanisms, main handle operation, auxiliary cam switches, reverser, MPJ operation for wear or damage, ensuring smooth movement, and check the continuity and insulation resistance to ensure reliable traction/brake control.

4. CAB AC :

- I. Overhauling of the cab AC shall be carried out by mechanical dismantling, cleaning, refrigerant charging, and internal servicing shall be carried out as per SMI-293 or latest and verify cooling effectiveness as per SMI-335 or latest.
 - II. During overhaul, compliance with electrical safety modifications shall be ensured, including complete AC circuit isolation in case of earth fault as per MS-394 or latest, correct provision and installation of cab AC as per MS-469 or latest, and verification of contactor stability where applicable as per MS-140 or latest.
5. Detailed All reliability-related actions shall be implemented strictly in accordance with RDSO TC-142 or the latest applicable instructions.
6. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
7. **SMI/MS/TC/STR for Driver Desk section are as follows:**

SN	Description	SMI/TC/MS/STR
1	Fitting of Nuts, bolts screws	SMI-1
2	Method of evaluating crimped joint performance.	SMI-114
3	Special Maintenance Instructions for roof mounted air conditioning system for cabs of Electric Locomotives.	SMI-293
4	Operational, Maintenance and Trouble Shooting of 2x500 kVA, IGBT based Hotel Load Converter of WAP7 locomotives	SMI-297
5	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipments in various schedules for 3 phase electric locomotives.	SMI-332
6	Modification in control circuit of 3phase locomotives to enable switching ON the Marker Light under locomotive dead condition.	MS-344
7	Standardization of power selection switch position in flasher units provided in three phase electric locomotives.	MS-407
8	Modification to avoid simultaneous switching ON of white & red marker light in 3 phase.	MS-0411 REV 1
9	Modification to provide rubber sealing gasket in master controller of 3 phase locomotives Loco.	MS-0419 REV 0
10	Deactivation of Vigilance Control Device (VCD) acknowledged from Asstt.Loco Pilot side on Electric Locomotives.	MS-450
11	Operations of WAP-5/WAP-7 in push pull.	MS-0477 (Rev 0)
12	Provision of HOG indication lamp in driver desk for HOG ON command from Power car.	MS-0489 (Rev 0)
13	Provision of additional BLDJ switch by utilization of BLHO/ZBAN switch as additional BLDJ in three-phase electric locomotives (WAG9/WAP7/WAP5).	MS-0495 (Rev 0)

14	Modification Sheet for development of Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC type of Electric Locomotives.	MS-0496 (Rev 0)
15	Modification for providing cab AC units in Electric Locomotives by Zonal Railways.	MS-469
16	Acknowledgment method of VCD through hand operated push button switch to eliminate possibility of rhythmic operation of foot operated switch.	MS-505
19	Brake System and EP Assisted Brake System for Three Phase Electric Locomotives	STR-76

8. Must Change Items for Driver desk section are as follows:

SN	Description
1	All driver desk Switches
2	ALL Hardware (eg. Nut , Bolt , Washer, Screw , Pin , push button etc.)
3	All Rubber item (eg Hose, Gasket , Seal , etc)
4	All Pedal Switches (Vigilance, Sander, PVEF etc.)
5	All switches BPFA, BLPR, ZPRD, BLDJ, ZPT, BPVR etc
6	All push button switches (BPVG etc.)
7	All indication Lamp
8	All program switches
9	All gauges
10	All desk meter, AI type of push button switches
11	Cab activation key
12	Angle transmitter
13	Panel mounting socket for hand lamp/charging

10) Light Room (LR) Section.

The PSU shall carry out stripping, overhauling, testing and re-installation of cab electrical equipment, lighting fittings and control devices, strictly in accordance with OEM manuals and applicable RDSO

1. Headlights, Marker Lights, Flasher Light

The PSU shall overhaul headlights including inspection and cleaning of body frame, glass, terminals , reflector and wiring for any crack, damage, loose fittings and replacement if required. All the light insulation-tested and functionally tested to ensure correct operation and check the illumination level. Replace all gaskets and other rubber items. Marker lights, Flasher light unit & lamp unit shall be replaced as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

2. Cab Heaters

The PSU shall strip and overhaul cab heaters, including cleaning and inspection of all components. Electrical and functional testing of the blower motor and heating element shall be carried out to verify proper operation, current draw and insulation resistance. Thermostats and blower motors shall be handed over to the respective sections, respectively, for specialized repair and testing, and refitted after overhaul.

3. All Tube light & Spot light

All the tube light, CFL lamps with fitting shall be replaced, insulation-tested and functionally tested to ensure correct operation and check the illumination level.

4. Battery MCBs

Battery MCBs shall be replaced and mechanical and electrical testing to ensure proper operation and protection functionality.

5. Panel Door Locks

Panel locks shall be cleaned, inspected and tested for smooth key operation. Locks shall be painted for corrosion protection and replaced in complete sets during overhauling, as specified in Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

6. Rotary Switches

All Rotary switches Contact integrity, continuity and insulation resistance shall be verified. Necessary modifications shall be carried out as required. Replacement shall be done in a complete set of rotary switches during POH to ensure reliability.

7. All switches and lights on control panels and the driver desk shall be checked for continuity and insulation and replaced, and tested to ensure correct operation.

8. All reliability-related activities shall be implemented strictly in accordance with RDSO TC-142 or the latest applicable instructions.

9. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

10. SMI/MS/TC/STR for Light Room section are as follow:

SN	Description	SMI/TC/MS/STR
1	Fitting nuts, bolts, screws.	SMI-1
2	Method of evaluating crimped joint performance.	SMI-114
3	Modification of terminal connection of heater cum blower assembly.	MS-0408 REV 0
4	Modification of bogie isolation (sch 154 cut out switches) in 3 phase electric locomotive.	MS-0426 REV 0
5	Provision of LED type light for exchanging signals with train passing staff.	MS-470
6	Twin Beam LED Head Light used on Electric Locomotives & EMUs.	STR/92

11. Must Change Items for Light Room section are as follows:

SN	Description
1	Head light lamp
2	LED Marker light, indication Lamps
3	Flesher light unit, Lamp light unit
4	All tube light & CFL lamps with fittings
5	Marker light rubber gasket and its o ring and flasher light gasket (Between flasher and roof)
6	Head light gasket, head light seals
7	Key switch simulation
8	Driver Desk illumination System
9	All door locks (during 2nd POH of WAP-7 and during POH of WAG-9)
10	All rotary switches
11	ALL HARDWARE (eg. Nut , Bolt , Washer, Screw , Pin , push button etc.)

12	All Rubber item (eg Hose, Gasket , Seal , etc)
13	All MCB's

11) Electro-Pneumatic Contactor (EPC) Section.

The PSU shall carry out complete inspection, overhauling, testing and certification of Electro-Pneumatic Contactors (EPCs) during POH, strictly in accordance with OEM manuals, approved check-sheets and applicable RDSO instructions.

1. The PSU shall overhaul the EPCs as per the OEM POH overhauling kit.
2. The PSU shall carry out pneumatic overhauling of EPCs, including Replacement of valve piston O-rings and other sealing elements, Checking the EPC for air leakage under both energized and de-energized coil conditions. Ensuring proper pneumatic operation in accordance with specified air pressure requirements as per OEM manuals and RDSO specification
3. The PSU shall perform electrical tests on EPCs, which shall include: Measurement of insulation resistance, coil resistance, Verification of operating pressure, Verification of rated voltage and pick-up voltage and Continuity and functional checking of auxiliary switches. All test results shall conform to the prescribed limits specified in the OEM manuals and RDSO specification.
4. The Reliability Action Plan for EPCs shall be implemented strictly in accordance with TC-142 or the latest applicable instructions, as issued from time to time.
5. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

6. SMI/MS/TC for EPC section are as follow:

SN	Description	SMI/TC/MS
1	Fitting of Nuts, bolts screws	SMI/1
2	Provision of auxiliary interlock for monitoring of A2-B2 system of Harmonic filter ON (8.1)/adoption (8.2) contactor in GTO/IGBT based locomotives.	MS/464

7. Must Change Items for EPC section are as follow:

SN	Description
1	POH Overhaul kit of the EP contactor (include rubber part of servo motor and main cylinder, contact tip etc.)
2	Overhaul of EM and EP contactor in different module
3	Set of contacts (fixed and mobile) for contactor.
4	Set of contact auxiliary type f (faston).
5	All pneumatic panel solenoid valves to be replaced with modified ones (if not done earlier).
6	All auxiliary switches of EPC contactor and pre charging contractor
7	Main contractor EPC of SR.
8	FB panel copper contact tips.
9	Rubber parts of servo motor and main cylinder of EPC in cubical.
10	Contact tips of EP conductors.

12) Transformer Section.

The PSU shall carry out complete overhauling of the transformer, including oil analysis, draining, cleaning, reconditioning, refilling, reassembly and electrical testing, to ensure safe, reliable and efficient operation of the transformer during the service period.

1. Incoming transformer oil shall be treated as a mandatory replacement item under the scope of work. Reuse or refilling of existing oil shall not be permitted. Fresh transformer oil shall be supplied and filled by the PSU.
2. The old transformer oil shall be completely drained, with the main tank and chokes drained separately. Incoming Oil test to be performed for fault detection. Incoming electrical testing of IR, Voltage rating, Inductance , winding resistance etc to be performed.
3. The new transformer oil shall conform strictly to the prescribed limits and requirements of the relevant RDSO specifications SMI-158 & SMI-159 or latest. Prior to filling, the oil shall be subjected to Dissolved Gas Analysis (DGA) (SMI- 138 or latest), Dielectric Breakdown Voltage (BDV) testing, acidity measurement, and visual inspection for colour, contamination, and water content, as applicable, to ensure full compliance with the specified standards. Only transformer oil meeting all prescribed RDSO limits shall be accepted for use.
4. The transformer shall be thoroughly cleaned to remove sludge, contaminants and residual moisture. Transformer tank inspected for damage. Visual inspection, MPT/DPT and other tests should be done to check transformer tank intactness. Core Tightening to be done by checking the torque values of core bolts.
5. The transformer tank and all winding should be under the hose heating and vacuum drying cycle in the vacuum drying plant for a specific time. After that new oil should be filled.
6. The PSU shall carry out overhaul and maintenance of all transformer sub-assemblies, including radiators, bushings, conservator and breather system, to ensure safe and reliable transformer operation.
7. High voltage and transformer bushing to be cleaned and checked for any flashing, damage , crack etc and electrical testing to be done. Check the high voltage and transformer bushing for flashing, damage, or cracks, and perform necessary testing.
8. Radiators shall be thoroughly cleaned and inspected for damage. Radiators shall be pressure-tested for leakage and defective radiators or gaskets shall be repaired or replaced as required. (As per SMI/287 Rev1 or latest)
9. High-voltage bushings shall be inspected for cracks, contamination and physical damage. Electrical testing shall be carried out and defective bushings, seals and gaskets shall be replaced (As per TC-76 or latest).
10. The conservator shall be inspected for structural integrity and proper oil level. Also pressure tested for any leakage. Gaskets shall be replaced and any accumulated water shall be drained and purged. Silica gel breathers shall be checked for damage and saturation, and the silica gel shall be replaced to ensure effective moisture control.
11. All oil circulating pipes should be thoroughly cleaned and checked for any damage and leakage.
12. The pressure relief valve must be examined, and tested to ensure its operation at specified pressure.

13. During reassembly of the Oil Cooling Unit, all components shall be fitted with new seals and appropriate locking compounds. Oil circuits shall be refilled and properly bled, and correct rotation, airflow and leak-tightness shall be verified to ensure satisfactory operation.
14. After reassembly, the PSU shall carry out electrical tests including insulation resistance (IR) measurement of primary, filter, auxiliary and traction windings and chokes, winding resistance measurement, voltage ratio verification and BDV testing of the filtered oil. All results shall be within limit as per the RDSO specification.
15. All must change items strictly in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
16. The Reliability Action Plan shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
17. **SMI/MS/TC for Transformer section are as follow:**

Sr. No	Description	SMI/TC/MS
1	Fitting of Nuts, bolts screws	SMI-1
2	Maintenance of main transformer oil in service	SMI-120
3	Revised characteristics for new insulation oil for locomotive/EMU transformer and additional tests for maintenance of oil in service	SMI-121
4	I. Procurement specification for insulating oil II. Condition monitoring of insulating oil (for loco and EMU Tr. Only)	SMI-127
5	Condition monitoring of traction transformers by dissolved gas analysis	SMI-138
6	Code of practice for maintenance of transformer oil in service	SMI-158
7	Inhibited transformer oil	SMI-159
8	Code of practice for maintenance of loco transformer	SMI-164
9	Check point during commissioning of TFP fitted with M/s BSES bushing (A33).	SMI-179
10	Engineering practices for improving reliability of cable head termination system for 25 KV AC Locos/EMUs	SMI-193
11	Assembly of electrical terminations of traction winding bushings 2u1_2v1,2u2_2v2,2u2_2v3,2u4_2v4 in indigenously manufactured transformers type lot_6500/lot_7500 used in 3phase drive locomotives type WAG9/WAP5	SMI-228
12	Test procedure, Lower limit and process of adding inhibitor in transformer oil of inservice traction transformer	SMI-249
13	Removal of orifice ring provided in the inlet & outlet flanges of Converter Oil (COC) and Transformer Oil Cooler (TOC) of 3 phase oil cooler assembly manufactured and supplied by M/s.Apollo	SMI-279
14	Special Maintenance Instruction for maintenance of Radiators of Oil Cooling Unit of 3-phase Electric Locomotives	SMI-287
15	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipments in various schedules for 3	SMI-332
16	Replacement of critical subassemblies and components in every POH/2 nd POH of AC Electric locomotives.	TC-21 Amendme nt '2'
17	Oil leakage from the transformer bushings and covers in 3 phase locomotive	TC-76

18	Technical circular for storage & handling of lubricant/greases used in Electric locomotives /MEMUs/EMUs	TC-104
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18. Must Change Items of Transformer section are as follow:

SN	Description
1	Transformer oil
2.	Silica gel in breather assembly
3.	OIL cooling radiator complete (During 2nd POH of WAP-7 and during 1st POH of WAG-9)
4.	TFP Pressure Sensor & Temperature sensor (Both during 2nd POH of WAP-7 and during 1st POH of WAG-9)
5.	All sealing gasket including tank cover gasket of TFP
6.	Transformer conservator gauge glass gasket, rubber part
7.	TFP conservator gauge glass gasket, rubber parts
8.	All O rings of oil cooling piping.
9.	TFP bearing and o ring
10.	Main transformer drain oil cock rubber parts
11.	Oil hose (vent tube) from main transformer to conservator, equalizing pipe along with accessories
12	All transformer foundation bolts & bushing lock nuts
13	All TFP bushing rubber seals (as per TC 0076 or latest)
14	All rubberized cork sheets, washers, nuts, gaskets, bolts
15	ALL hardware (eg. Nut , Bolt , Washer, Screw , Pin etc.)
16	All Rubber item (eg Hose, Gasket , Seal, O rings etc)

13) Switch Gear Section.

The PSU shall carry out complete maintenance and overhaul of the Switch Gear system, including Vacuum Circuit Breakers (VCBs), Contactors, Protection devices and associated electronic components, covering mechanical, pneumatic, lubrication and electrical aspects, strictly in accordance with OEM manuals and applicable RDSO TCs/, SMIs/MS.

1. Vacuum Circuit Breaker (VCB) Maintenance

- I. Vacuum Circuit Breakers shall be overhauled in accordance with the SMI- 236 (REV-1) or latest.
- II. Pneumatic overhaul of VCBs shall be done by dismantling and replacement of magnet valves, relay valves, cylinder piston assemblies, and all sealing elements including O-rings, PTFE valve discs, piston seals and poppet valves as per SMI-236.
- III. Air dryers associated with VCBs shall be serviced and molecular sieves replaced.
- IV. Lubrication shall be carried out for pistons, valves, relay assemblies and associated components using approved lubricants, ensuring smooth and reliable operation.
- V. After reassembly, post-maintenance testing shall include air leakage checks, sequence tests, pressure switch verification, contact resistance measurement and contact travel checks, strictly as per RDSO specification.

2. Contactor Maintenance

- I. Maintenance of switchgear components such as contactors (10 & 20 Amp) contactor, and relays shall include detailed electrical measurements, mechanical inspection and

mandatory replacement of worn or life-expired components or as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest, to ensure safe and reliable operation.

- II. Contactors of different current ratings shall undergo visual inspection, measurement of coil resistance and insulation resistance, verification of pick-up voltage and drop-out voltage, and checking of main contact pressure, contact timing, and continuity in accordance with OEM manuals and RDSO TC/SMI/MS.
- III. For HSM type contactors, additional checks shall include continuity of auxiliary switches, verification of contact pressure and continuity after closing, as specified in the OEM manuals and RDSO TC/SMI/MS.
- IV. Solenoids shall be monitored and assessed using the surge comparison method to detect winding or insulation defects.

3. Protection and other Electronic Equipment

- I. Maintenance of protection and electronic components, including surge arresters, current transformers (CT), potential transformers (PT), battery chargers, high voltage bushing insulator and flasher units, shall be carried out through cleaning, detailed inspection, electrical testing and mandatory replacement of defective components.
- II. Surge arresters shall be visually inspected for cracks, dents or damage. Terminals shall be cleaned, high-voltage testing shall be carried out, and insulation resistance shall be measured as per RDSO guidelines.
- III. Potential transformers and current transformers shall be cleaned, inspected and electrically tested for transformation ratio, coil resistance and insulation resistance. Anti-tracking varnish shall be applied wherever required.
- IV. Battery chargers and associated components shall be inspected for cracks and damage, tightness of connections verified, diode polarity checked, input and output voltage measured, and insulation resistance tested. Charger transformers shall be varnished, baked and high-voltage tested.
- V. Thermostats shall be inspected for cracks and damage. Regulator knob and dial condition shall be checked. Proper crimping of electrical leads shall be ensured/ replaced if required.
- VI. The SON(buzzer) shall be replaced . After replacement proper audible alarm output shall be ensured.
- VII. The PSU shall carry out complete Replacement of the DC–DC Converter and overhauling of Smoke Detector Unit, Alarm Unit, FDSS (If applicable) by replacing the sensors followed by reassembly of all components.. After assembly, Alarm Unit, FDSS (If applicable) and Smoke Detector Unit shall be tested thoroughly to check proper working.
- VIII. Refilling of CO2 gas cylinder and if expired to be provided new.

4. The Reliability Action Plan for the Switch Gear Section shall be implemented strictly in accordance with TC-142 or the latest applicable instructions.

5. All the must changed items strictly replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

6. SMI/MS/TC for switch gear section are as follows:

SN	Description	SMI/MS/TC No.
1	Fitting of Nuts, bolts screws	SMI/1
2	Method of evaluating crimped joint performance.	SMI-114
3	Condition monitoring of solenoids by surge comparison method	SMI-157
4	Lubrication to air relay valve and main piston Of VCB	SMI-162 R1
5	Overhauling kits for AOH/IOH/POH of single bottle VCBs.	SMI 236 Rev 1
6	Use of loctite in place of RTV 1080 to seal upper and lower insulators of Schnider make single bottle VCBs type 22cb	SMI-281
7	Re-application of RTV 1080 sealant in Schneider Make VCBs fitted in conventional and 3 Phase loco.	SMI-285
8	Operational, Maintenance and Trouble Shooting of 2x500 kVA, IGBT based Hotel Load Converter of WAP7 locomotives	SMI-297(Rev.)
9	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various schedules for 3 phase electric locomotives.	SMI-332
10	Overhauling kit of AOH/IOH/POH of single bottle VCBs of different make	SMI-236 Rev-1
11	Repair and Maintenance of Motorized Line Contactors provided in IGBT based Traction Converter of 3-phase electric locomotives.	SMI-338
12	Standardization of earthing switch arrangement on 3phase locomotives to make interchangeable of various makes VCB between single & 3phase locomotives (Material)	MS-345
13	Standardization of power selection switch position in flasher units provided in three phase electric locomotives.	MS-407
14	Modification in the bottom plate of M/s Schneider make Single bottle VCBs	MS-471
15	Technical circular for storage & handling of lubricant/greases used in Electric locomotives /MEMUs/EMUs	TC-104
16	Condition Monitoring of Lightening Arrestor of Electric Locomotives and EMUs	TC-136

7. Must Change Items of switch gear section are as follows:

SN	Description
1	All Item in POH Overhauling kit of VCB (as per SMI-236)
2	Pre charging conductor, FB panel copper contact tips
3	80 amp contactor, 150 amp contactor (7 nos) to be replaced with contactor along with snubber & auxiliary switches (during 2nd POH of WAP-7 and during POH of WAG-9)
4	Overhaul the EMC IN different Module
5	All auxiliary switches of pre charging contactor
6	MRB contactor 54.2/1 and 54.2/2 with timer
7	Contactor 136.3,126.5, 136.4, 126.7/1, 130.1, 211, 126.6, 126.7/2
8	ALL hardware (eg. Nut , Bolt , Washer, Screw , Pin etc.)
9	All Rubber item (eg Hose, Gasket , Seal etc)
10	Filter of fire detection unit
11	BUZZER vigilance / fire alarm
12	DC-DC converter
13	Primary Voltage transformer rubber cable conduit between transducer & terminal box and roof cable duct

14	High voltage bushing seal,cork gasket
15	Complete 25 KV vertical cable head bushing (during 2nd POH of WAP-7 and during POH of WAG-9)
16	LED based locomotive warning light system for electric. Locos type'E'as per RDSO SPECIFICATION
17	Contactor for Time delay relay of MR blower.
18	Relay for control Electronic OFF/ Safety relay control electronics ON / relay Temp control Electronics
19	Contactor for Time relay VCB and power supply to cab and accessories
20	A set of snap action micro switches for locomotives pre-charging contactors.
21	Snubber circuit
22	Contactor for Head light, Auxiliaries Compressor and GUSP AND Auxiliary contactor for Contactor Auxiliaries
23	Contactor auxiliaries with Auxiliaries contact block .
24	Auxiliary contactor pantograph and VCB (Pos no 130.1, 136.4)

14) Relay Section.

The PSU shall carry out complete maintenance, overhaul/replace and calibration of all meters, gauges, relays, switches, electronic equipment and sensors provided in the locomotive, combining electrical testing, mechanical inspection and calibration checks, in accordance with applicable OEM manuals and RDSO SMLs, TCs and MS.

1. Cab Meters and Gauges

PSU shall carry out the calibration of moving coil meters, including TE/BE meter , catenary voltmeters and battery voltmeters(UBa), KV meter shall include insulation resistance testing, zero adjustment and verification of full-scale deflection at specified voltages, as per prescribed standards on test bench. Proper functioning of dial lamps and compliance with technical measurement ranges shall be ensured. All new meters should be provided.

2. Pressure Gauges

Pressure gauges, including single and duplex pressure gauges, air flow gauges shall be mechanically inspected for pointer straightness, smooth movement, zero adjustment and thread condition. Electrical insulation resistance shall be measured, and gauges shall be calibrated against a master gauge. For duplex gauges, the difference between pointer readings shall remain within limits.

3. Pressure Switches

PSU shall carry out the calibration of pressure switches shall include inspection of thread condition and ply spread, insulation resistance measurement, functional verification and calibration of cut in and cut out pressure. All testing to be done as per SMI-327 or latest.

4. Relays overhauling & calibration

The PSU is responsible for the inspection, overhauling, and calibration of all critical relays during the Loco POH. This work includes the overhauling and calibration of relays such as the Over current relay, Auxiliary Converter relay, Earth fault relay, Minimum voltage relay, and Auto flasher relay etc. The inspection points include checking for proper contact pressure, contact gap, and the tripping setting, along with electrical checks i.e. measure coil resistance and Insulation Resistance etc. Calibration checks

involve determining and adjusting the Pick up Voltage or Pick up Current, and the Drop out Voltage or Drop out Current.

5. Electronics and Sensors

Maintenance, testing, replacement and overhaul of electronic equipment and sensors including TM speed sensor, pressure sensor (TFP & SR), temperature sensors (TM, CE, Cab heater etc) shall include mechanical inspection, electrical testing and calibration for signal accuracy, correct air gaps and component wear strictly as per OEM manuals and RDSO SMIs/TCs/MS, to ensure mechanical integrity, electrical safety, measurement accuracy and reliable operation for full range.

6. Speedo Meter and Pulse generator

Pulse generators (speed sensors) shall be inspected for bearing condition and spindle wear. All gaskets shall be replaced, and insulation resistance shall be measured to confirm electrical integrity. Speedometers and tachometers shall be calibrated against standard reference values. Proper functioning of over-speed indication, dial lamp operation and locking arrangement shall be verified.

7. HMI

The PSU shall carry out overhauling and inspection of all cab HMI including Driver Display Unit (DDU) , Real-Time Train Information System (RTIS) and check tightness of all Sub-D connectors, and verify proper working after overhauling . The PSU shall inspect and carry out the overhauling of the all display body and D-couplers. Input supply of 110 V DC shall be applied and all buttons, indications and display brightness shall be checked for proper functioning.

8. The Reliability Action Plan for the Relay Section shall be implemented strictly in accordance with TC-142 or the latest applicable instructions.

9. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

10. SMI/MS/TC/STR for Relay section are as follows:

SN	Description	SMI/MS/TC/STR
1	Fitting of Nuts, bolts screws	SMI-1
2	Method of evaluating crimped joint performance.	SMI-114
3	Technical scope of works for Annual Maintenance Contract (AMC) of Microprocessor based Electronic Speed cum Energy Monitoring System (ESMON) fitted in Electric Locomotives and EMUs/MEMUs.	SMI-289
4	Special Maintenance Instruction for time setting in ESMON fitted in conventional & 3-phase Electric Locomotives.	SMI-302
5	Procedure for testing & setting of Pressure Switches in E-70 & CCB brake System.	SMI-327
6	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various schedules for 3 phase electric locomotives.	SMI-332
7	Reliability improvements in relays	MS-232
8	Modification sheet to provide mechanical locking function in primary over current relay of 3 phase loco (RDSO/2013/ELMS/0420 REV.0 dated 23/01/2013	MS-420
9	Modification Sheet for MCP control circuit in three phase electric locomotives	MS-427
10	Removal of shorting link provided at c-d terminal of over current relay of 3-ph	MS-432

	locomotives.	
11	Adoption of IGBT type speed sensor in locomotive with GTO traction converter RDSO/2017/EL/MS/458 REV.0 dt. 7/02/2014	MS-458
12	Modification in the existing Control Electronics (CE) resetting scheme to reset the control electronics (VCU) in Multiple unit locos.	MS-475
13	Modification Sheet for Power Supply to Real-Time Train Information System (RTIS) devices in Tap-changer based conventional Electric Locomotives & 3-Phase Electric Locomotives	MS-497
14	Standardization of drawings for self illuminated pressure and vacuum gauges for electric locomotive application	TC-56
15	Technical Circular for Interchangeability and Maintainability of Hall Effect Speed Sensors provided in IGBT based 3-phase electric locomotives.	TC-145
16	Microprocessor based Electronic Speed-cum-Energy Monitoring System AC Electric Locomotives.	STR/11
17	Brake System and EP Assisted Brake System for Three Phase Electric Locomotives	STR-76

11. Must Change Items of Relay section are as follows:

SN	Description
1	All desk Meters for 3 phase loco (TE/BE, Volt, Battery Volt etc..)
2	All pressure gauge for 3 phase locos (FP, BP, AFI, BC etc.)
3	POH maintenance kit for SPM + PG
4	PVC Flexible Pipe
5	All hardware (eg. Nut , Bolt , Washer, Screw , Pin etc.)
6	All Rubber item (eg Hose, Gasket , Seal etc)
7	Push button switches
8	63 amp MCB of OCB , TMB 59.1/1, 59.½, 53.1/1, and 53.1/2
9	40 amp MCB of CP 47.1/1 and 47.1/2
10	ALL program switches
11	Relays
12	Temperature & pressure Sensor of Transformer and Traction Converter, Temperature & Speed sensor of Traction Motor (2nd POH of WAP7 and 1st POH of WAG9)

15) Pneumatic Section.

The PSU shall carry out complete maintenance, overhaul and testing of all pneumatic systems and equipment, including not limited to wipers, air dryers, pneumatic valves, and wheel flange lubrication systems, strictly in accordance with OEM manuals, RDSO SMLs/TCs/MS and approved test specifications.

1. Wipers / Wind Shield Washers

- a. Overhauling of the wiper and washer system shall include inspection of the Wiper Motor, Wiper Switch, Wiper Pump and its component for damage, cleaning and overhauling. For a wiper motor, Wiper arms and Wiper blades should be replaced. The water tank should be cleaned and filled with DM water. The washer jet nozzle should be cleaned.
- b. The wiper motor shall be overhauled, ensuring grease passages in the spindle are clear, mandatory replacement of the POH maintenance kit and tested for correct operation, air duct clearance and performance at different operating speeds. Proper functioning of the

complete wiper/washer system shall be ensured and deficiencies rectified. All plastic nozzles should be replaced.

2. Air Dryers

Air dryers shall be maintained by replacing the complete overhaul kit and refilling with regenerated or new silica gel. The humidity indicator shall be checked to confirm correct dryer performance. Functional testing shall include verification of purge valve, pressure switch, solenoid valve and drain valve operation, and leakage checks, dryer body and pneumatic pipe connections.

3. Pneumatic Valves, Coke and Control Equipment

- a. PSU shall carry out Complete Overhauling of E-70 / CCB pneumatic brake system in locomotives.
- b. All pneumatic valves, including pressure control valves, E-70 (Alteration-17 covering KAVACH or latest) control units sling with card, CCB control unit along with card, non-return valves (NRVs), isolating valves, unloader valves, all safety valves, angle cock, isolating coke, A9, SA9, DAB valve, limiting Valve, Drain Valve, Double check valve, Drip Cup, Sand injector, Horn switch and associated brake equipment, shall be dismantled, cleaned and overhauled. All as per POH maintenance kit of OEM to be changed. All rubber parts should be changed.
- c. Defective components shall be repaired or replaced. Valves and assemblies shall be tested on approved test rigs strictly as per specified test procedures and OEM/RDSO standards.
- d. Horn to be cleaned, dismantled, overhauled and tested.

4. Wheel Flange Lubrication (WFL) System

- a. Overhauling and Maintenance of the Wheel Flange Lubrication (WFL) system shall cover the bogie-mounted reservoir, distributor valve, nozzles and brackets, brake frame pneumatic equipment, interface manifold and auxiliary piping.
 - b. The PSU shall inspect the reservoir, distributor valve O-ring seats, nozzle brackets and all pneumatic/hydraulic pipelines for damage, looseness or leakage. Correct nozzle alignment shall be ensured for effective lubrication.
5. The Reliability Action Plan applicable to the Pneumatic Section shall be implemented strictly in accordance with TC-142 or the latest instructions issued by the competent authority.
6. All must changed items shall be in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

7. SMI/MS/TC for Pneumatic section are as follows:

SN	Description	SMI/MS/TC/STR No.
1	Fitting of Nuts, bolts screws	SMI-1
2	Technical Scope of Work for annual maintenance contract of brake system fitted in 3 phase electric locomotive	SMI-298
3	Special Maintenance Instruction for Heatless regenerative twin tower type compressed air dryer for electric locomotives application	SMI-305
4	Comprehensive Maintenance Instructions for the maintenance of Wiper Assembly in workshops, loco-sheds, trip-sheds / pooling points and on-line to improve their effectiveness.	SMI-333
5	Special maintenance instruction for Sander used in Electric locomotives.	SMI-334
6	Provision of ½" air strainer in the common pipe line connected to port No. 30 of	MS-291

	A9 and SA9 pneumatic valves.	
7	Provision of isolating cock for unloader valves (12) in E-70 brake system of 3-phase electric locomotives.	MS-412
8	Removal of Anti-spin valve on E-70 & CCB and Flange lubrication manifold of E-70 from 3-phase electric locomotives.	MS-447
9	b. Replacing KBIL make 'NB-11 valve' (size 01") of CCB 2.0 system with FTRTIL make 'Emergency Exhaust valve' (size 1 1/4") of E-70 system or similar design Emergency exhaust valve.	MS-465
10	Relocation of RS valve/Emergency Cock for ease of operation by Assistant Loco Pilot (ALP) in 3-Phase Electric Locomotives.	MS-491
11	Indigenization of lubricants for WAP5/WAG9 Locomotives.	TC-34
12	RDSO's recommendation for import of critical rubber components for pneumatic brake valves.	TC-52
13	Modification in the list of critical component of pneumatic brake valve	TC-53
14	Test procedure for Testing of Air Dryers and its efficacy on Electric Locomotives in Electric Loco Sheds/ Workshops. Rev.'0'	TC-108
15	Pneumatic testing of Three Phase Electric Locomotives in Electric Loco Sheds Workshops	TC-113
16	Testing of feed pipe circulation twin air brake system Locomotive.	TC-122
17	Procedure for Dew point Depression temperature measurement of compressed air passing through heat less regenerative twin tower type air dryer being used in electric locomotives.	TC-139
18	Brake System and EP Assisted Brake System for Three Phase Electric Locomotives	STR/76

8. Must Change Items of Pneumatic section are as follows:

SN	Description
1.	Wiper blade assembly, Wiper arm assembly, Wiper motor driver shaft seal, wiper idler shaft seal, pneumatic and water hoses
2.	Overhauling KIT OF AIR DRYER(As per OEM manual, make wise)
3.	All pneumatic valve, cocks and filter : All rubber components
4.	AIR DRYER body connector male & female
5.	Overhauling kit of Complete E-70/CCB break system (as per OEM instruction)
6.	Overhauling kit of Driver break controller and automatic break controller (as per OEM)
7.	TBU and PBU kit (If applicable)
8.	Break activating mechanism (main cylinder & parking brake cylinder)
9.	Horn gasket and other rubber parts of Horn
10.	ALL rubber component, and all hardware
11	Overhauling kit of wiper motor
12	Set of overhauling kit for all pneumatic valve including unloader exhaust valve, drip cup & auto drain valve, drivers brake controller, emergency exhaust valve ,isolating cocks, e-70 brake control, miscellaneous valves of on c3w manifold, c3w distributor valve , ep relay valve , d2 relay valve, pressure control valve, manifold assembly, aux equipment , solenoid ep valve , wiper motor operating valve, latched solenoid valve & double check valve, 1 1/4" check valve

	(rs), driver brake valve and horn valve, safety valve, braking manifold, cut out coke, angle coke of BP and FP pipe, end coke, isolating coke etc
13	Molykote 55M lubricant for lubrication of rubber components pneumatic valve

16) Loco Body Overhauling Section (Loco Body, Roof, CBC, Buffer, Cattle guard, Pneumatic Pipe & tank,WLU)

The PSU shall carry out complete overhaul, inspection, testing and repair/replacement of the locomotive body and its associated structural and safety components, including Center Buffer Coupler (CBC), side buffers, cattle guard and draft gear, strictly in accordance with RDSO guidelines, applicable SMIs, TCs, Maintenance Schedules and approved drawings, to ensure structural integrity and operational safety.

1. Center Buffer Coupler (CBC) and Draft Gear

- a. The complete CBC along with draft gear assembly shall be Must Change Item during POH.
- b. RDSO approved Go/No-Go gauges are used for checking contour, coupler head, knuckle and complete assembly. Mandatory Dye Penetrant Testing (DPT) shall be carried out on the knuckle, shackle and other critical components.
- c. All CBC components shall be assembled without application of paint or lubrication.
- d. Draft gears shall undergo Radiographic Dye Penetrant Testing (RDPT) / Magnetic Particle Testing (MPT) at all critical stress locations for cracks, fractures and wear on wedges, shoes and followers. Handling shall be carried out as spring-fit assemblies, ensuring correct compression, locking arrangements and safety precautions during removal and installation. Pocket correction and fitment of pre-loaded draft gears shall be carried out wherever required.
- e. H-type Buffer Modification to be done if applicable.

2. Side Buffers

- a. Side buffers shall undergo Radiographic Dye Penetrant Testing (RDPT) / Magnetic Particle Testing (MPT) at all critical stress locations. Side buffers should be dismantled and detailed inspection shall be carried out for plungers, spindles, casings, bolt holes, check sleeves and buffer bases.
- b. Correct installation length and free length of buffers after assembly shall be ensured. All overhauled activities shall be carried out strictly as per applicable RDSO TC/SMI/MS or drawings.

3. Cattle guard

- a. Cattle shall be visually examined for cracks, fractures and wear etc. All its fasteners to be changed. Whole cattle guard to be changed in 2nd POH of WAP7 and POH of WAG9. After overhauling Painting should be done.

4. Hand Brake:

Hand Brake shall be visually examined for cracks, fractures and wear etc. All its fasteners and bearing to be changed. After overhauling Painting should be done.

5. Loco Body and Roof – Structural Repairs and Painting

- a. The locomotive body and roof shall be thoroughly inspected for damage, corrosion, cracks and deformation. Identified defects shall be repaired prior to painting.
- b. Surface preparation shall include thorough cleaning, removal of burrs and weld slag, masking of threads and machined surfaces, followed by blast cleaning or sanding and complete degreasing.
- c. Painting shall be carried out using approved primers and paints strictly as per RDSO Specification No. M&C/PCN/100/20218 or latest. After painting, all mandatory identification

markings, safety labels, logos and stickers shall be applied or painted as per prescribed standards.

6. Loco Body Fittings and Assemblies

- a. All loco body sub-assemblies and fittings, including windscreen guard grilles, windscreens, side windows, quarter windows, lookout glass, All door locks, hinges and related hardware, Filters shall be systematically inspected and changed as per the TC 123.
- b. These items shall be checked for proper operation, deformation, cracks, corrosion and paint damage. Necessary repair or replacement shall be carried out, followed by repainting wherever required.

7. Waterless Urinal (WLU)

- a. For a periodic overhaul of the urinal system, isolate the power supply to safely inspect and calibrate the occupancy sensors, ensuring they correctly trigger the UV sanitization cycle, exhaust fan, and indicator lamps.
 - b. Thoroughly deep-clean the nano-coated stainless steel bowl and clear all floor drainage paths of debris, while replacing membrane traps and liquid sealant cartridges to maintain odor control.
 - c. Lubricate the spring-loaded seat mechanism and auto-door closer, and verify the structural integrity of the internal door latch and emergency push button to ensure the system remains safe and fully operational.
8. All applicable Reliability Action Plan (RAP) measures related to the locomotive body, CBC, buffers, draft gear and pneumatic equipment shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
9. All must changed items shall be in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.

10. SMI/MS/TC for Manufacturing section are as follows:

SN	Description	SMI/MS/TC No.
1	Guidelines on maintenance procedure and schedule to be followed for CBC and draft gear assembly	SMI-213
2	Procedure for fitment of M/s Frontier Alloy Steel Ltd make pre-load draft gear and procedure for correction of pocket size for draft gear in existing locomotives.	SMI-328
3	Modification from conventional hand brake to modified hand brake (Gear type) arrangement for WAP-4, WAP-7, WAG-5 and WAG-7 electric locomotives applications.	MS-440 (Rev.1)
4	Provision of Top operated handle for CBC in place of bottom operated	MS-454
5	Implementation of Technical circular No.38 for Buffer maintenance.	TC-38 and MPMI-116
6	CBC-Buffer General purpose grease	TC-34
7	For detection of service cracks in loco side buffer assembly by means of DPT	RDSO Instruction Bulletin No. MP.IB.L.D.01.01.23 Rev.(00)
8	Provision of Waterless Urinal in WAP-7 Three Phase Electric Locomotives.	MS-0508
9	Provision of Waterless Urinal in WAG9/9H/9C Three Phase Electric Locomotives.	MS-0507

11. Must Change Items of Manufacturing section are as follows:

SN	Description
1	Complete painting of loco body and body decals (stickers) (exterior, interior along with surface finish).
2	Complete cbc assembly with draft gear.
3	Modified transition screw coupling. (WAP7/WAG9/9H)
4	Knuckle, clevis, devis pin and yoke pin (Draft gear & coupler)
5	Striker block wear plate.
6	Complete side buffer assembly (during 2nd poh of wap-7 and during poh of wag-9)
7	All Rubber buffing element, fastener (for Buffer)
8	Cattle guard along with its hardware (during 2nd poh of wap-7 and during poh of wag-9)
9	Fiber body above buffer and cbc coupler(wap-7 only),
10	Cab/machine room window seals, foot steps
11	Cab/machine room door seals,door window seal, foot steps hardware
12	Front lookout glass and side glass(WAG9), Front lookout glass(WAP7), Side glass (WAG9), Side glass(During 2nd POH of wap-7)
13	Seal of cab window, Sliding window, Splashed shield, windscreen shield and rubber flap on the cab side window drainage channel outlet.
14	All door lock (during 2nd poh of wap-7 and during poh of wag-9)
15	All hardware (eg. nut , bolt , washer, screw , pin , o ring etc.)
16	All rubber item (eg o ring, hose, gasket , seal , etc)

17) Erection Section - Loco Lowering & Assembly

1. Roof Line System – Overhaul and Maintenance

The PSU shall carry out complete overhauling and maintenance of the locomotive roof line system through thorough cleaning, detailed inspection, proper lubrication and strict adherence to applicable RDSO SMLs, to ensure reliable high-voltage performance, prevent flashover, maintain insulation integrity and ensure long-term roof line reliability.

2. Inspection and Treatment of Roof Line Insulators and HV Equipment

Roof line components including contact springs, high-voltage bushings, primary current transformers, pin insulators, surge arresters, pantograph base insulators and roof-line insulators shall be cleaned and inspected for cracks, chips, arcing marks and seal condition. Silicon grease shall be applied as specified, and effectiveness shall be verified by the water-beading test and other prescribed tests. Defective components shall be replaced as complete units.

3. Roof Conductors and HV Cables

Roof conductors, clamps, jumper cables and isolator switches shall be inspected for bends, wear, arcing, damaged spacers and contact spring condition. Electrical contact surfaces shall be cleaned, and grease shall be applied to contact springs during installation. High-voltage cables and plugs shall be inspected for sheath damage, cleaned, lubricated and installed using an air-venting nylon thread to prevent trapped air.

4. Loco Body Repairs and Painting

Based on detailed condition monitoring and inspection, any identified defects in the locomotive body structure or equipment foundations shall be rectified by machining, roof fiwelding, grinding, boring, tapping or other suitable mechanical processes, ensuring dimensional accuracy and structural integrity. After thorough cleaning of the complete locomotive body area (exterior, interior along with surface finish), internal surfaces of the

loco body and all equipment foundation areas shall be PU painted using approved primers and paints, strictly as per RDSO Specification no M&C/PCN/100/20218 or latest, to ensure corrosion protection and long-term durability.

5. Safety Checks and Measurements

Critical measurements of the underframe, including pivot head inner diameter and cattle guard clearance, shall be taken. Safety provisions such as slings for compressors and traction links shall be ensured.

Traction link mounting shall be attended to by checking M20 bolts and replacing all interlock washers and lock nuts.

6. Re-assembly of Equipment and Sub-Assemblies

All equipment, sub-assemblies and components that have been inspected, repaired or overhauled shall be systematically re-assembled on the locomotive body, using the prior identification, tagging and documentation records to ensure correct placement and traceability.

All roof filter and side body filter to be fitted as per standard practise. Specialized sealing, including the application of RTV gaskets and insulators, is used to ensure the unit is weather-tight, dust-proof and water leakage-proof.

7. UIC and IV Coupler

Comprehensive visual inspection for damage, flash marks, or overheating, alongside the verification of all mechanical hardware like Hex bolts and the ratchet assembly. Moving parts and contact pins must be cleaned and lubricated to ensure free movement, proper cover tension, integrity of locking mechanism while electrical integrity is confirmed through phase sequence checks and insulation resistance tests for high voltage pins. O-rings and specific control pins are replaced as needed, and the assembly is kept closed to prevent dust and water ingress. Functional checks of the pins are conducted during HLC testing, and specific components like Pin No. 11 and 12 are replaced to maintain reliable connectivity. Similar to the IV units, these couplers must remain in a closed condition when not in use to protect against environmental contamination.

8. Loco Lowering on Bogies

The overhauled bogies shall be brought from the Bogie Section and correctly positioned for re-assembly.

The locomotive body shall be lifted from stands using approved lifting arrangements, cranes, tools and tackles, and securely lowered onto the bogies strictly as per approved lifting plans and safety procedures and maintain necessary clearances as per RDSO.

9. Reconnection of Systems

Transformer oil and traction converter coolant shall be safely filled, wherever required, strictly as per OEM instructions, environmental guidelines and Railway safety standards.

All electrical, pneumatic and mechanical connections between the locomotive body and bogies including cables, hoses, pipes, linkages and associated fittings shall be reconnected and secured in accordance with prescribed safety procedures. All new E/shunt should be provided.

10. Functional Testing of Pneumatic and Mechanical Systems

The PSU shall test compressor performance (pressure build-up and unloader valve operation) and verify brake system integrity and functionality, including MR, BP, pantograph leakage, auto brake capacity and parking brake operation. Functionality of horns, wipers and sanding gear shall also be checked.

11. Final Cleaning and Cab Equipment Inspection

Roof insulators, pantographs and OCU filters shall be thoroughly cleaned. Condition of cab doors, locks, seats, spare BP/FP pipes, 2 Nos sand bag, U Clamp , 4 Nos wooden wedge and CO₂ cylinder shall be inspected and rectified wherever required.

12. LT/HT and Functional Testing

Low-tension and high-tension testing shall be carried out, including functional verification of safety and control systems such as Emergency Stop, contactor sequences, earth fault protection and fire detection. Air velocity shall be measured to ensure adequate cooling, and dB loss of fiber optic cables shall be checked.

13. Static Rain / Water Leakage Test

After completion of maintenance and assembly, each locomotive shall undergo a mandatory static rain / water leakage test on the designated line to ensure water tightness and prevent electrical or corrosion damage. The locomotive shall be fully operational, with all equipment installed, sealants cured and blowers running.

Any leakage detected during the rain test shall be immediately rectified, and the test shall be repeated until a completely leak-proof condition is achieved, strictly as per SMI-315.

14. Joint Inspection and Handing Over

A joint inspection shall be carried out by the PSU and the owning Railway staff after completion of POH. The locomotive shall be handed over to owning railway shed only after testing and documentation formalities as per the Tender Document/Agreement clause 17.6.

15. SMI/MS/TC for Erection section are as follows:

SN	Description	SMI No
1	Silicon grease treatment on roof line, panto mounting and pantograph insulators.	SMI-110A
2	Use of cork sheet gasket in place of rubber	SMI-178
3	Burning of PCB on Air Dryer	SMI-219
4	Provision of Modified traction link flange mounting bolts in WAG9& WAP7 phase locomotives.	SMI-241
5	Maintenance Practices of Under slung Compressor mounted on WAP-5, WAP-7 & WAG-9/WAG-9H/HC class of Electric Locomotive to avoid falling down of the compressor unit on line. Standardization of safety wire rope arrangement of under slung compressor mounted on WAP-5, WAP-7 & WAG-9/WAG-9H/HC class of Electric Locomotives	SMI-0242 (REV'3')
6	Maintenance of Earthing System in 3-phase electric locomotives type WAP5, WAP7 & WAG9.	SMI-248
7	Air delivery measurement in 3-phase locomotives to ascertain proper cooling and pressurization of the machine room.	SMI-255 & TC-142
8	Maintenance & use of materials for traction link & housing for 3phase electric locomotives.	SMI-259
9	Preventive measures to check flash over of roof insulators and roof line fittings of electrical locomotives,	SMI-274
10	Special maintenance Instruction for measurement of milli volt drop of Contactor numbers 218,126, 136.4 & 130.1.	SMI-275
11	Special Maintenance Instruction for maintenance of filters of Oil Cooling Blower (OCB), Machine Room Blower (MRB) and Traction Motor Blower	SMI-286

	(TMB) for 3-phase Electric Locomotives.	
12	Special Maintenance Instructions for roof mounted air conditioning system for cabs of Electric Locomotives.	SMI-293
13	Special Maintenance Instruction for maintenance of Distributed Power Wireless Control System (DPWCS) for AC Tap-changer & 3-Phase Electric Locomotives.	SMI-295
14	Operational, Maintenance and Trouble Shooting of 2x500 kVA, IGBT based Hotel Load Converter of WAP7 locomotives	SMI-297 (Rev-1)
15	Special Maintenance Instruction for water jet test facility in Electric loco sheds / Workshops.	SMI-315
16	Fitment procedure/replacement schedule of Elastic ring for Three phase Electric Locomotive.	SMI-316
17	Maintenance Practice for improving reliability of cable head Termination system with Vertical Receptacle for 25 KV AC loco/EMUs and High Voltage cable with Plug for Three Phase electric Locomotive.	SMI-317
18	Burning of PCB on Air Dryer	SMI-219
19	Procedure for fitment of M/s Frontier Alloy Steel Ltd make pre-load draft gear and procedure for correction of pocket size for draft gear in existing locomotives.	SMI-328
20	Procedure of checking the Effectiveness of hand brake in 3-phase Electric locomotives.	SMI-331
21	Check sheet for various activities, parts replacements and parameters to be tested during post inspection testing for IGBT based propulsion equipment in various schedules for 3 phase electric locomotives.	SMI-332
22	Comprehensive Maintenance Instructions for the maintenance of Wiper Assembly in workshops, loco-sheds, trip-sheds / pooling points and on-line to improve their effectiveness.	SMI-333
23	Special maintenance instruction for Sander used in Electric locomotives.	SMI-334
Sr No	Description	MS No
1	Rising of height of battery box from rail level on WAP5 and WAP7/locomotives	MS-320
2	Replacement of metallic corrugated steel pipe/outside steel braided flexible pipe by flexible reinforced rubber pipe connected in between VCB/Air blast circuit breaker & Air drier and main air pipe line to air drier.	MS 340
3	Modification in control circuit of 3phase locomotives to enable switching ON the Marker Light under locomotive dead condition.	MS 344
4	Modi. Of Earthing Switch arrangement for type interchangeability of VCB.	MS-0345 Rev-0/1
5	Modification in Control Circuit of Flasher Light and Head Light of 3-phase electric locomotive.	MS-357
6	Modification sheet on shifting of transformer conservators location from OCB duct to an independent stand provided in between SR and Oil Cooling blower in 3 phase drive locomotives.	MS-360
7	Improved Grounding of ALG rack in TRACTION CONVERTER of 3φ electric locomotives.	MS-365

8	Modification of mounting arrangement of MCB-100 (circuit breaker battery charger) fitted in aux. Converter (BUR 3/30x2) of 3 phase elect. Locos.	MS-367
9	Provision of change over switch in Traction Converter for speed sensor of Traction Motor	MS-371
10	Modification of Bellows and its Mounting arrangement of existing Traction Motors type 6FRA 6068 used in WAG9/WAP7 class of locomotives (retro fitment).	MS-373 (Rev.'1') Amendme nt '1' / MS-476.
11	Modification in Air Dryer Ckt. With MCB (128.1) provision.	MS-375
12	Modification to voltage sensing circuit in WAP-5,WAP-7,WAG-9 & WAG-9H Locomotives	MS 377
13	Closure of two central ventilators in WAP-7, WAG-9 and WAG-9H locomotives.	MS-380
14	Partial blocking of opening duct of back side of auxiliary converter of three phase electric locomotives	MS-385
15	Replacement of OCB cable's 10mm sq. to 16mm sq.	MS-395
16	Removal of interlocks of control circuit contactors No.126 from MCPA circuit in 3Ph. loco.	MS-399
17	Auto switching of Machine Room /Cab lights to avoid draining of batteries.	MS-403
18	Standardization of power selection switch position in flasher units provided in three phase electric loco.(Loop cable provided between terminals 110v+ve input and AFL.)	MS-407 & TC 142
19	Modification of terminal connection of heater cum blower assembly	MS-408
20	Modification to avoid simultaneous switching ON White & Red marker light.	MS-411
21	Provision of ¾" vent type isolating cock for unloader valves (1, 2) in E-70 brake system of 3-phase electric locomotives.	MS-412 & TC-142
22	Modification of illumination of Head Light in dimmer mode in 3 phase electric loco (Provide dimmer resistance 10Ω instead of 47Ω at both cab F panel).	MS-425
23	Modification sheet of bogie isolation rotary switch(POS 154 CUT OUT) in three phase locomotives.	MS-426
24	Modification Sheet for MCP control circuit (Pr.Sw.Parallaling) in three phase locomotives	MS-427 & TC-142
25	Modification for avoiding necessity of cab changing in case of failure of processor cards of VCU in WAG9 & WAG9H Loco.	MS-429/4 59
26	Removal shorting link provided at c-d terminal of over current relay base of 3 Phase locomotives	MS-432
27	Modification to create low pressure zone above hood ventilator in order to make machine room pressurized and free from dust to avoid failure of electronic cards in 3 Phase Loco	MS-434
28	Modification sheet to avoid failure of TM temperature sensor due to increase in resistance value of temperature sensor cable shielding.	MS-437
29	Modification from conventional hand brake to modified hand brake (Gear type) arrangement for WAP-4, WAP-7, WAG-5 and WAG-7 electric locomotives applications.	MS-440
30	Removal of anti slip valve on E-70 & CCB and flange lubrication manifold of	MS-447

	E- 70 from 3-Phase electric locomotives.	
31	Deactivation Vigilance Control Device (VCD) acknowledge from Asstt.Loco Pilot side on Electric Locomotives	MS-450
32	Provision of top operated CBC.	MS-454
33	Adoption of IGBT type TM RPM sensor in loco with GTO based SR.	MS-458
34	Modification of providing dummy plate on Cab roof in place of Air Conditioning unit.	MS-461
35	Provision of Trap Chamber in BP train pipe.	MS-465 & TC-142
36	Modification in existing hotel load scheme by removing irrelevant protections provided in WAP-7 loco.	MS-468
37	Cab Air Conditioner Provision.	MS-469
38	Signal Exchange LED Lamp provision.	MS-470
39	Conversion of GTO based loco to IGBT base.	MS-473
40	Provision of Control Ckt. Reset push button with ckt.	MS-475
41	Modification in Mounting arrangement of Leather Bellows of Traction Motors type 6FRA6068.	MS-476
42	Ele. Ckt. Modi. For push pull operation for multiple in P-5 & P-7.	MS-477
43	Provide additional resistance 90.7/3 parallel to resistance 90.7/2 in control Ckt. Earth fault detection ckt.	MS-480
44	Scheme for energy saving in three phase freight locomotives.	MS-482
45	Modification in vertical damper fixing Arrangement of WAP-7/WAG-9 locomotives.	MS-483
46	Modification in underslung compressor mounting legs at Electric Locomotives.	MS-484
47	Modification to ensure continuity of HOG Converters' feed to the train from working loco through dead loco in WAP5/WAP7 class of 3-phase HOG compliant electric locomotives.	MS-486
48	Provision of Blocking Diode in HOG control circuit (in series of MCB 129.2/1) of HOG compliant WAP7&WAP5 Three Phase Electric Locomotives.	MS-488
49	Provision of HOG indication lamp in driver desk for HOG ON command from Power car.	MS-489
50	Modification to avoid Speedometer OFF & ON during running of train/locomotive due to VCU reset in three phase electric locomotives.	MS-490
51	Relocation of RS valve/Emergency Cock for ease of operation by Assistant Loco Pilot (ALP) in 3-Phase Electric Locomotives.	MS-491
52	Provision of Additional safety sling for Traction Link of WAP5/WAP7/WAG9 Locomotives.	MS-493
53	Provision of seats for inspecting officials in Electric locomotives.	MS-494
54	Provision of additional BLDJ switch by utilization of BLHO/ZBAN switch as additional BLDJ in three-phase electric locomotives (WAG9 /WAP7 / WAP5).	MS-495
55	Modification Sheet for development of Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC type of Electric Locomotives.	MS-496
56	Modification Sheet for Power Supply to Real-Time Train Information System (RTIS) devices in Tap-changer based conventional Electric Locomotives & 3-Phase Electric Locomotives	MS-497

57	Recording of Flasher light operation either due to fault or manually by Loco Pilot in case of emergency with time stamping in VCU of 3-phase Electric Locomotives.	MS-500
58	Unloader valve control circuit modification in three Phase Electric Locomotives.	MS-502
59	Isolation of Harmonic Filter from 3-phase locomotives fitted with M/s Alstom (BTIPL), CGPISL and Medha make IGBT based Propulsion Equipment.	MS-504
60	Acknowledgment method of VCD through hand operated push button switch to eliminate possibility of rhythmic operation of foot operated switch.	MS-505
61	Provision of Waterless Urinal in WAG-9/9H/9HC 3-phase electric locomotives.	MS-507
62	Modification sheet no. RDSO/2025/EL/MS/0508, Rev. '0' dated 23.04.2025 for provision of Waterless Urinal in WAP-7 Three Phase Electric Locomotives.	MS-508
63	Removal of cables (3055 and 4236) leading to SPM to avoid failure of Locomotives.	MS-512
SN	Description	TC No
1	Provision of Audio visual indication in case of train parting or alarm chain pulling in air brake trains.	TC-20
2	Replacement of critical subassemblies and components in every POH/2 nd POH of AC Electric locomotives.	TC-21 Amendment '2'
3	Testing of feed pipe circuit on twin pipe air brake system locomotive	TC-122
4	Instruction to form Multiple unit of 3-phase electric locomotives	TC-133
5	Trouble shooting of different make 2x500 kVA, IGBT based Hotel Load Converter of WAP-7 Locomotives	TC-141
6	Pneumatic testing of Three Phase Electric Locomotives in Electric Loco Sheds /Workshops	TC-113

16. Must Change Items of Erection section are as follows:

SN	Description
1	Set of mod.sunvisor assembly (RH & LH)
2	The pantograph, converter roof hatch gasket and rubber seals around the pantograph and converter
3	Decals (Sticker) on Body
4	Seals involved in fitment of side body and roof filters
5	Push pull rod for wap7/wag9 as per clw drg.no.1209.01.113.006 alt-2 or latest.
6	Set of lock asly.consist of cab door lock (Replace in 2nd poh of wap7 and poh of wag9)
7	Seal for machine room door of 3-phase loco
8	Set of clip for hoses of 3 phase
9	Set of hoses as per slpec.no.clw/es/3/0099 alt-e consisting 6 items
a	Set of neoprene hose as per specn.no.clw/es/3/0094 alt-e or latest consist of 12 items
11	Set of hoses for CP and CPA for 3 phase locos
12	Set of hoses for wag-9 locomotive comprising of 08 items and 28 nos.
13	Set of ventilation hoses for 3ph locos
14	Set of gasket for transformer oil cooling system

15	Set of gasket [non metallic] for wag9/wap7 locos
16	Set of elastomeric sealing rubber for all type of 3 phase locos
17	Hose for cab heater
18	Set of rubber items
19	set of gaskets for main door glasses of 3 phase loco.
20	Modified traction link bolt
21	Set of lock nut f.s. all- steel for 3 phase loco
22	Set of tfp fixing bolt & plate assembly
23	Window assembly
24	Filter assembly for traction motor ventilation, oil cooler ventilation, machine room ventilation (Replace in 2nd POH of WAP7 and POH of WAG9)
25	Single core cable 9 gkw- ax120, 4000 v, bk, (Replace in 2nd poh of wap7 and poh of wag9)
26	Single core cable (conditional) 150 sq mm 9 gkw 4000 volt gr.
27	Set of spares (gto loco) for 3- phase transformer to conservator tank & traction converter's oil draining & filling.
28	Set of flame retardant and quick release coupling hose assembly for 3 phase loco transformer set.
29	Set of single duct leather bellows with top and bottom plates,
30	Air brake hose coupling for feed pipe
31	Set of safety wire rope sling of 8mm dia meter as per is:2762(2009)and wire rope as per is:2415(2004)gr.1770.
32	Neoprene rubber sheets width 1 meter [one meter] x thickness 1.5 mm, running length
33	Flexible polyvinyl chloride [pvc] flooring sheet
34	Set of earthing cable
35	Cable lug & cable gland
36	Seal for battery box
37	Gasket for reservoir inspection cover
38	Set of hardware for 3 phase loco
39	Silicone rubber compound
40	High strength RTV general purpose liquid gasket sealant
41	Complete driver seat (during 2nd POH of WAP-7 and During POH of WAG-9)
42	Antiskid Floor cover in CAB
43	Cab heater flexible duct
44	Cab and Machine room Door seals and door window seals
45	Co2 gas cylinder refill
46	All hardware (eg. nut , bolt , washer, screw , pin , o ring etc.)
47	All rubber item (eg o ring, hose, gasket , seal , etc)

C. SCOPE OF WORK for IOH of Motorized Bogie (Co-Co Type)

Bogie Frame Overhauling

The PSU shall be responsible for complete inspection,overhauling, testing, rectification, replacement and certification of Bogie and associated equipment during IOH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The motorized bogie (Co-Co type) is systematically decoupled from the locomotive car body. The primary electrical connections, traction motor (TM) bellows, pneumatic brake hoses, and sanding pipes are disconnected and sealed to prevent foreign material ingress. The bogie frame is lifted, and components including the Traction Motor, wheelsets, gear cases, suspension systems (primary and secondary springs/dampers), and brake rigging are completely dismantled.
2. After cleaning, Magnetic Particle Testing (MPT) and Dye Penetrant Testing (DPT) must be performed on critical stress zones. Traction link pivot post welding (both body and bogie side), axle guide fixing posts, all brake hanger fixing brackets, damper fixing brackets, and TM support/torque arm brackets. Ensure Motor Support on Bogie Transom has a modified fillet radius of 15R to prevent cracks (as per RDSO MS-443 and SMI-269).
3. The structural integrity of the bogie frame and pivot head is strictly measured. The variation in diagonal dimensions of the bogie frame must not exceed 3 mm as per MP.IB.BD.02.16.01 (Rev.01). Deviations require rectification as per standard procedure. Verify Pivot Post Critical Dimensions according to standard specification. The Aclathan / Vulkollan ring is a mandatory replacement item (RDSO Spec 0053). A new modified housing for the Aclathan ring must be provided and critical dimensions checked before insertion.
4. For high-speed reliability, the existing Tread Brake Units (TBU) or Parking Brake Units (PBU) must be completely replaced by a Conventional Brake Rigging System in accordance with RDSO Mod. No. 381 (Rev '0').
5. All pins, bushes, and pads of the brake rigging are replaced. Brake levers and hangers must be checked for cracks using DPT as per SMI-244. Provision of an additional safety sling on brake hangers/levers must be ensured to prevent falling on the line, as per SMI-244 and SMI-282. Use modified bottom slack adjuster pins with split pins and nuts to prevent dropping (MS-441).
6. Complete overhauling of the sanding equipment. Ensure the sand box is free of corrosion, replace all seals, gaskets, and hoses. Adjust the sander nozzles to exhaust just ahead of the wheel contact point (SMI-334). The Traction Motor Dropping Detection System (TMDDS) must be comprehensively overhauled and tested to ensure reliable and safe operation as per MS-496.
7. All primary and secondary helical springs are replaced during POH. Springs are tested on a load testing machine. Springs must be grouped by height bands (1 band or 2 bands) and colour-coded. Required liners to be placed on end axle boxes and middle axle boxes. All vertical, lateral, and yaw hydraulic dampers are replaced and tested on a damper testing machine.
8. The Axle Guide Rod and its spheriblocs, as well as Torque Arm spheriblocs, are replaced. Mounting/dismounting of spheriblocs must strictly follow SMI-330 and SMI-270.
9. Thoroughly inspect the gear case for cracks using MPT. Ensure all flange holes are correctly tapped. Check and repair/replace all sub-assemblies including the oil filling cap,

spy glass, and breather assembly. Ensure tightening of suspension tube bolts (M30x140) at the specified torque. Check mechanical integrity and rotational clearances, verifying backlash between the main gear and pinion. Trial run for 5 minutes of motorised wheelset to be done before fitting of gear case for identification of any defects before gear case mounting.

10. Final check is conducted to ensure there is no leakage. Seal the gear case hermetically, ensuring zero leakage, and fill with the prescribed quantity of Servosyn gear 460 RR.
11. Run the assembled wheelset, TM, and gear case minimum 20 minutes in each direction. Monitor for abnormal bearing noise, unusual gear box sounds, and record the operating temperatures of the A/box Bearing, TM Bearing, MSU bearing and Gear case within prescribed range .
12. After lowering the bogie frame onto the wheelsets, the primary lateral clearance between the axle box and bogie frame must be strictly maintained between 15 mm to 22 mm as per TC-83. All Earthing Shunts must be provided between the bogie and the axle boxes (6 numbers per bogie) to ensure a proper earth return path, adhering to SMI-248. After all overhauling, inspections, and part replacements are complete, the bogie frame and its sub-assemblies undergo complete painting. This is done using approved primers and paints strictly in accordance with RDSO Specification No. M&C/PCN/100/20218 to guarantee long-term corrosion protection.
13. All applicable Reliability Action Plan measures shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
14. ALL the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
15. **SMI/MS/TC/STR for Bogie Section** are as follows:

SN	Description	SMI/MS/TC /STR
1	Fitting of Nuts, bolts screws	SMI-01
2	Special Maintenance Instruction to prevent failing of brake hanger in middle axles of WAP-7 Locomotives	SMI-282
3	Provision of additional safety sling on brake lever of WAP 7/WAG 9 Locos.	SMI- 244
4	Maintenance of earthing system in 3 phase electric locomotive type WAP5/WAP7/WAG9 Locos.	SMI- 0248
5	Maintenance instructions of brake hanger for WAP 7 /WAG 9 locos	SMI- 251
6	Maintenance & use of materials for traction link housing for 3phase electric locomotives.	SMI-259
7	Maintenance of Traction Motor support plate and Bogie nose to prevent crack/ breakage of Traction Motor support plate (Holder for Traction Motor suspension).	SMI-269
8	Special Maintenance Instruction for Axial Wear of serviceable Spheriblocs used in WAP5/WAP7/WAG9 Locomotives	SMI-270
9	SMI for Magnetic Particle Testing (MPT) of Traction Motor nose stay in conventional locomotives/EMUs/MEMUs/Metro Railways, TM suspension holder support and motor support in WAG9/WAP7 locomotives and Traction Motor support arm in WAP5 locomotives.	SMI-311
10	Special maintenance instruction for Mounting/dismounting of spheri	SMI-330

	blocs on components used in three phase Electric Locomotives.	
11	Modification in Brake Assembly of WAP7 Electric Locos	MS-369
12	Provision of conventional brake rigging in WAP7 Locomotive	MS -381
13	Modification in Brake hanger mounting brackets (Holder and Support) of WAP- 7/WAG-9 Electric locomotives to prevent crack/breakage of bracket.	MS-396
14	Modification to avoid dropping of slack adjuster assembly (Bottom) in case of breakage of its split cotter pin in 3-phase WAP-7 loco.	MS-411 Rev-1
15	Modification to avoid dropping of slack adjuster assembly (Bottom) in case of breakage of its split cotter pin in 3-phase WAP-7 loco.	MS-441
16	Modification Sheet for development of Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC type of Electric Locomotives.	MS-496
17	Modification in Vertical damper fixing Arrangement of WAP-7/WAG-9 locomotives.	MS-483
18	Traction Motor Dropping Detection System (TMDDS) in WAP-7/ WAG-9 / 9H / 9HC	MS-496
19	Modification in Tie-bar for all axle locations & its safety sling bracket for axle no.2, 3, 4 & 5 of conventional brake rigging arrangement equipped in WAP-7 and WAG-9HC three phase electric locomotives.	MS-513
20	Repair method of bogie frame	TC-01
21	Indigenization of lubricants for WAP5/WAP7/WAG9 Locomotives.	TC-34
22	Specification of welding electrode as well as welding procedure for welding of manganese liner on axle box as well as bogie horn pedestal of electric locomotives.	TC-45 Rev-2
23	Change in the material of brake blocks for Electric Locomotives	TC-49
24	Bogie clearances on WAG9 & WAP7 3-phase Electric locomotives.	TC-82
25	Norms for repair rehabilitations & replacement of cracked it mount cast steel bogie frames of Electric locomotive	TC-84
26	Limits for wheel set dimension variations and wheel wear of WAP5, WAP7, & WAG9 3 phase Electric locomotives.	TC-83
27	Technical Circular for repair of crack in welding of plate (Drg. No. 1209-01-312- 145) of Pivot Transom sub assembly of bogie frames for WAP7/WAG9 locomotives.	TC-149
28	Technical Circular for measurement of 'C' Clearance in MSU assembly of 6FRA-6068 Traction motors in WAG/WAP7 class Locomotives.	TC-151
29	Repair, rehabilitation of motorised bogie frames	STR-81
30	Elastic Ring used on Three Phase Electric Locomotives (WAP5, WAP9 & WAG9).	STR-96
31	Spheriblocs on 3 phase Electric Locomotives.	STR-50

16. Must Change Items for Bogie Section (Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest follows) :

SN	Description
1	Aclathan / ELASTIC / Vukollan ring and all its hardware FOR WAG-9/WAP7

	LOCOMOTIVE. MATERIAL ACLATHAN-2300H, as per Amendment. No.1 to RDSO SPECN. NO. RDSO/2007/EL/SPEC/0053 [Rev.0]
2	GEAR CASE OIL as per TC-34
3	Brake hanger
4	Safety Sling of brake hanger, traction link etc, pin & R-clip
5	SPHERI BLOC for axle guide rod/tm support arm and all types of dampers for wag-9/wap-7 locos
6	TM Fixing bolts
7	Houses between bogie frame to brake cylinder, Bogie - Body hose connection
8	Insulating Base of primary springs
9	All pin & pad and bushes of brake rigging
10	Spheriblocs of the all axle guide rod.
11	Spheriblocs of TM support Arm.
12	Spheriblocs of all types of damper
13	Gearbox Oil Seal / O rings
14	Gear case gauge glass seal
15	Gearcase Drain plug washer and oil filling plug washer
16	All rubber components, hoses and fasteners on the bogie
17	ALL HARDWARE (eg. Nut , Bolt , Washer, Screw , Pin , O ring etc.)
18	All Rubber item (eg. O ring, Hose, Gasket , Seal , bushes, hoses etc)
19	Sand in all sand box, Sander hose pipe, seal in the sand box lids, sanding equipment fasteners

Wheel Set Overhauling:

The PSU shall be responsible for complete inspection, testing, overhauling, rectification, replacement and certification of wheel section and associated equipment during IOH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The axle box overhauling must be executed systematically as per SMI-246 and TC-129 guidelines. In axle box dismantling, remove the front cover and axle end cap. Withdraw the bearing loose lip, carefully pulling axle box housing straight off the bearing using a crane, and place it on a rubber mat to protect the surfaces. Remove rear cover and extract the bearing outer race and roller set from the axle box housing. Remove the inner race by pulling it through the thrower with a hydraulic bearing extractor machine. Strictly avoiding the use of flame heating or welding torches on reusable components.
2. The wheel discs, MSU and bull gear (if required) are floated off using the hydraulic oil injection method. Pressure must be strictly controlled as per critical value. Axle push to press off wheel discs, MSU and Bull gear by using hydraulic wheel press. All these processes to be done as per the maintenance manual of locomotives.
Before further processing, the rough/bare axle must undergo a strict Ultrasonic Flaw Detection test in accordance with TC-47 to detect any internal, sub-surface flaws, or micro-cracks.
Check Axle journals for fretting corrosion, pitting, ovality, or taper. Also check Axle journal diameter, Taper and out-of-roundness. Check journal surface waviness using a metal ruler coated with marking blue in two planes at 90°. The combined width of valleys must be $\leq 2/3$ of the journal length. A new axle to be provided if necessary to maintain reliability of

- the locomotive.
3. MSU to be overhauled as per maintenance manual procedure.
 - a. All parts of the Motor Suspension Unit like Bearing of DE and NDE side and All labyrinth to be removed by use of induction heater must be cleaned with Kerosene/approved solvents, and overhauled. Check all labyrinths/Bearing visually for any dent, scratch and repair / reject if out of dimension as per drawing. Clean MSU tube and DPT/ MPT to be done on critical dimension before further process. Measure the bore diameter of the bearing seats of DE & NDE side and other critical dimensions. All dimensions should be within range.
 - b. DE and NDE bearings must be installed using an induction heater. Heat the inner racers using an induction heater to 100-110 °C and shrink-fit them onto the gear hub and axle respectively. Installed bearing using flexi coil induction heater and Assemble labyrinths using Loctite and specific torque as per maintenance manual.
 - c. Maintain the 'C' clearance and 'X' clearance as per TC-151 and MS-456 using modified supporting rings to prevent premature MSU failures. After final fitting lateral play of the MSU must be maintained within range as per RDSO guide line.
 4. The new wheel disc must be bored to precisely match the axle dimensions. The axle itself is turned and finished as per CLW Drg. No. 1209-01.011-002 Alt-2. Critical Values like wheel bore diameter, Surface roughness and seat length as per drawing. Interference between wheel and axle strictly maintained as per TC-132. Press new bull gear (If required) according to TC-132 and
 5. Wheel disc Pressing Procedure Must follow TC-132 or latest.
 - a. Apply Paste on wheel disc and axle seat as per requirement to prevent scoring . The wheel is cold-pressed onto the axle using a highly calibrated hydraulic wheel press. The press-in contact force must strictly fall between as per drawing / TC-132. The outer wheel flange must sit at a specific distance from the outer edge of the axle hub flange. The distance between the hubs of the two wheel discs (Drive End to Non-Drive End) must be exactly 1596 ± 0.5 mm.
 - b. After the wheel press operation, a final Ultrasonic Test (UST) of the assembled axle must be conducted per TC-47 to ensure structural integrity was not compromised during pressing. Also Dynamic Balancing wheelset must be ensured.
 - c. The wheelset must be subjected to wheel profiling on surface wheel lathe (wear - adapted profile) to match the profile dimensions, followed by journal burnishing on Axle journal turning and burnishing machine to ensure the proper finish, ovality and runout as drawing .
 6. Axle box fitment procedure should be in accordance with TC 129 & SMI 246 or latest and RDSO guideline.
 - a. Measure Thrower seat OD and Bearing Journal OD. Also measure the ID of the inner race to calculate critical interference. Shrink-fit the thrower onto the axle by heating it up to 150°C. After that, apply a thin layer of SAE 30/40 heavy mineral oil to the journal.
 - b. Cold press the new CRU-150 Roller Bearing Unit onto the journal applying a minimum force using a hydraulic puller/pusher. Conduct Ultrasonic Testing (UST) on inner racers in the mounted position to detect deep-seated cracks.
 - c. Clean the axle box bore and ensure bore ID and bearing OD should be maintained and per drawing. Also maintain interference as per TC 129 & SMI 246. Insert bearing into the Axle box and mount the Axle box Unit on the inner race. Critical radial play and

axial play of bearing to be verified. Inject the exact quantity of Servoplex SHC-120 grease based on the bearing made using a calibrated digital meter. Never over-grease or mix greases.

- d. For axle boxes 1, 6, 7, and 12, install the earth return carbon brush contact plate. Ensure the continuity and integrity of the earth return path by verifying the carbon brush length and measuring earth resistance. Torque front cover bolts.
7. Once the wheelset is completely assembled, verified, and sealed, the exterior surfaces of the Wheel discs, Axle Box housing, and the MSU tube must undergo painting to prevent rust, corrosion, and environmental degradation, conforming to prescribed visual and protective standards.
8. During run test monitor bearing temperatures rigorously; the temperature rise must be below 25°C above ambient. Check for any mis alignment, vibration or sound from the axle box during the run test.
9. During the Intermediate Overhaul (IOH) of motorized bogies, if replacement of wheel discs is required, the same shall be identified during the pre-inspection of the motorized bogie at the premises of the Owning Shed and the Railway/Owning Shed shall arrange the required wheel discs(at its own cost).

The PSU shall carry out the replacement accordingly and shall hand over the released wheel discs to the Railway in accordance with prescribed procedures.

10. All applicable Reliability Action Plan measures shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
11. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
12. **SMI/MS/TC/STR for Wheel-shop Section** are as follows:

SN	Description	SMI/TC/MS/STR
1	Wheel wear and application management	MP.IB.BD.02.16.01
2	Standardization of the gauge & instructions for measuring loco wheel diameter. (B.G)	SMI-214
3	Maintenance of Axle Box bearing for WAP7 & WAG 9 for Electric locomotive	SMI 246 Rev -2
4	Maintenance of Earthing System in 3-phase electric locomotives type WAP5, WAP7 & WAG9.	SMI-248
5	Defining Periodicity of overhauling schedule of MSU of WAG9/WAG9H/WAP7 locomotives to prevent premature MSU failure	SMI-300
6	Use of Induction Heater for heating of Bearing seating area of Suspension tube instead of flame heating for fitment of MSU Bearings in WAG-9/WAP-7 locomotives.	SMI 306
7	Modification in drawing of supporting ring to achieve adequate 'C' Clearance in MSU assembly of 6FRA-6068 TM in WAG9/ WAP7 class of locomotives	MS 456 & TC 151
8	Approved Lubricants for 3-phase Locos	TC 34 Rev 4
9	Ultrasonic testing proceeding for axles of electric locomotives.	TC 47, Rev 2

10	Limits for wheel set dimension variations and wheel wear of WAP5, WAP7, & WAG9 3 phase Electric locomotives.	TC 83
11	Guide-lines for mounting, dis-mounting, inspection and maintenance practices of axle box bearing units for WAG-9/WAP-7 Locomotives.	TC 129
12	Procedure of pressing-in of wheels on axles in Electric Locomotives.	TC 132
13	Technical Circular for measurement of 'C' Clearance in MSU assembly of 6FRA-6068 Traction motors in WAG/WAP7 class Locomotives.	TC-151
14	Repair, rehabilitation of motorised bogie frames	STR-81
15	Gears and Pinions of Electric Locomotives	STR/22

13. Must Change Items for Wheel-shop Section are as follows:

SN	Description
1	Set Of Hardware For Axle Box
2	O-Ring For Axle Box
3	Earthing Carbon Brush
4	Servoplex SHC-120 (IOCL) Grease For Suspension Tube Bearing as per TC - 34
5	Lubricant For Pressing In Of Wheels as per TC-132
6	Set Of Hardware For WAG9/WAP7 Locos Suspension Tubes(One Set Consists Of 5 Items 100 Nos) Item Reserved For Clw Approved Sources Only
7	Set Of "O" Ring For MSU
8	All Hardware (eg. Nut , Bolt , Washer, Fasteners,Screw , Pin , O ring etc.)
9	All Rubber item (eg O ring, Hose, Gasket , Seal , etc)

Traction Motor Section :

The PSU shall be responsible for complete inspection, overhauling, testing, rectification, replacement and certification of Traction Motor and associated equipment during POH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The PSU shall carry out incoming inspection and electrical tests on the traction motor including Insulation Resistance (IR) test of stator windings. Inductance measurement between phases shall be conducted at the TM terminal box using an LCR meter as per SMI-262 or latest, ensuring the phase difference is within prescribed limits. Incoming radial and axial play shall also be measured using dial gauges and recorded.
2. The PSU shall undertake complete dismantling of the traction motor including removal of speed sensor, probe housing, pulse generator ring (PGR), clamp plate, angle ring, NDE bearing cap and other associated components using approved tools. The pinion shall be extracted using a hydraulic extraction system, and inner races and rotor labyrinths shall be removed using induction heating while maintaining prescribed temperature limits. Drive End (DE) and Non-Drive End (NDE) end shields and bearings shall be removed.
3. Detailed visual, dimensional and mechanical inspection of the stator, rotor, end frames and other components shall be carried out. Specialized tests such as Inductance Test, Growler Test, Dye Penetrant Test (RDPT), Ultrasonic Testing (UST) and Magnetic Particle Testing (MPT) shall be performed wherever applicable. Necessary repairs or replacement of

defective components shall be carried out in accordance with applicable SMIs, Technical Circulars (TCs) and Modification Sheets (MS).

4. The stator, rotor and end frames shall be thoroughly cleaned using dry compressed air, vacuum cleaners, and approved halogen-free solvent cleaning agents like White Spirit or Xylol-CHR (chemically pure) to remove oil, grease, and contaminants from the stator and rotor. The stator and rotor shall be baked in a temperature-controlled oven to remove moisture. The stator shall then be varnished with approved anti-tracking varnish and allowed to dry to restore insulation strength.
5. All bearings, pinion, O-ring, Gasket and other associated accessories shall be replaced as per IOH schedule. The bearing inner race shall be fitted on the rotor in accordance with RDSO Modification Sheet MS-415 or latest applicable standard.
6. The rotor shall be thoroughly cleaned and dynamically balanced. A surge comparison test (approximately 5 kV) shall be conducted on the stator winding to detect inter-turn faults, and a Growler Test (SMI-163 or latest) shall be carried out on rotor bars and end rings. UST and RDPT shall be performed on the rotor shaft, particularly at pinion and bearing seating areas, to detect internal or surface defects. Magnetic Particle Testing (MPT) as per SMI-311 or latest shall also be carried out at critical stress locations where required.
7. A new pinion shall be fitted in accordance with the procedure specified in RDSO SMI-278 or latest instructions. Prior to fitment, the taperness of the shaft and pinion shall be verified using approved gauges (RDSO Drawing No. SKEL-5032 and SKEL-5043 or latest). Dye transfer (colour matching) test shall be conducted to ensure proper contact between the pinion and shaft taper with minimum 90% contact area. The pinion shall be mounted using a hydraulic press arrangement with controlled pressure (approximately 1700–1900 bar and not exceeding 2000 bar) ensuring the specified travel of the pinion within the shaft.
8. Bearings and labyrinth rings shall be fitted on the rotor and end frames after verification of all critical dimensions in accordance with MS-415 or latest. Precision measuring instruments such as Dial Snap Gauges (SMI-314 or latest) and Bore Gauges (SMI-318 or latest) shall be used for measurement. Heating for shrink fitment shall be carried out using induction heating equipment as per SMI-301 or latest, ensuring temperature does not exceed 120°C. Proper lubrication using approved grease shall be carried out during assembly.
9. The PSU shall inspect, modify and standardize the traction motor speed and temperature sensor systems including associated cabling and connectors. Temperature sensor mounting shall comply with MS-350 or latest, with proper earthing of shielding as per MS-437 or latest. The gap between the speed sensing probe and the Pulse Generator Ring (PGR) shall be maintained between 0.5 mm and 1.0 mm as per TC-145 or latest. Adoption of IGBT type speed sensors shall be carried out where applicable in accordance with MS-458 or latest.
10. After completion of overhaul activities, the traction motor shall be assembled as per applicable SMIs, MS and TCs. Greasing shall be carried out as per SMI-307 or latest, and modified bellows arrangements shall be provided where applicable as per MS-476 / MS-472 or latest. Radial play shall be verified as per SMI-278 / SMI-336 or latest, and axial play shall also be measured to ensure compliance with prescribed limits before testing.
11. After assembly, the traction motor shall undergo a mandatory no-load run test on a VVVF test plant. The motor shall be run up to rated voltage and frequency (approximately 400 V, 50 Hz) and operated for about one hour in each direction. Bearing temperature rise, vibration and noise levels shall be monitored. The bearing temperature rise shall not exceed 40°C above ambient, and vibration levels shall remain within permissible limits. After satisfactory completion of all tests, the traction motor shall be certified fit for service.
12. After the incoming test and record data, the PSU shall carry out complete dismantling of the

Traction Motor (TM), including removal of the pinion, labyrinth, speed sensor and other subassemblies. Initial dry cleaning and solvent cleaning of the stator, rotor and end frames shall be carried out to remove oil, grease, dust and contaminants.

13. All actions under the Reliability Action Plan shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
14. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
15. **SMI/MS/TC/STR FOR TM are as follows:**

SN	Description	SMI
1	Fitting of Nuts, bolts, screws	1
2	Condition monitoring of bearings by SPM Meter	58
3	General guidelines to follow for balancing of rotor and blower impellers	152
4	General guidelines to follow for balancing of rotors and cooling blowers in position	199
5	Provision of rubber compound RTV 738 in the terminal box of three phase asynchronous traction motor type 6 FRA 6068.	209
6	Modified Method of VPI for three phase asynchronous traction motor type 6FRA6068	210
7	Improved Method of brazing of terminal bus rods on respective phase rings of the stator windings of three phase traction motor type 6FRA6068.	211
8	Pre-testing of speed sensor	252
9	Pre-testing of temperature sensors	260
10	Detection of rotor bar crack & stator defect for traction motor type 6FRA6068 used on WAG9 / WAP7 locomotives by measurement of inductance.	262
11	Use of extreme pressure lubricant paste for shafting of rotors of traction motors type 6FRA6068 and 6FXA7059 to prevent damage to stampings and scoring of shafts at the time of removal of shaft	272
12	Implementation for detection of rotation of outer racers of bearing and assembly components by checking metal content in grease sample 3 Phase traction motors type 6FRA6068 and 6FXA7059.	273
13	Ensuring proper fitment of traction motor bearings in 6FRA6068 TM	278
14	Use of Induction Heater for heating of End Shields/End frames of traction motors for bearing fitment	301
15	Implementation for periodicity & quantity of re-greasing in minor schedule in every alternate schedule (i.e. 1st IB, 2nd IA, 2nd IC) for Traction Motor (TM) type 6FRA6068.	307
16	SMI for Magnetic Particle Testing (MPT) of Traction Motor (TM) nose stay in conventional locomotives/EMUs/MEMUs/Metro Railways, TM suspension holder support and motor support in WAG9/WAP7 locomotives and Traction Motor support arm in WAP5 locomotives.	311
17	Use of Dial Snap Gauges for measurement of shaft diameter of traction motor for Electric Locomotives.	314
18	Use of Bore Gauge for measurement of internal diameters of End Shield/Racer during bearing fitment.	318
19	Improving reliability of armature shaft by not rebuilding armature shaft by welding for conventional and three phase locomotives.	321

20	Use of grease gun equipped with digital grease meter for greasing of roller bearings of traction motors and MSU bearings of electric locomotives.	322
21	Procedure of measurement of axial clearance and limit of axial clearance for Traction motor type 6FRA6068.	323
22	Procedure of measurement of Radial Clearance of Bearings	336
	MS	MS NO.
23	Modification of Drive End - Outer Labyrinth of WAG9/ WAP7 Traction Motor type 6FRA 6068	314
24	Modification of fixing arrangement temperature sensor fitted on traction motor type 6FRA 6068 of WAG9/WAP7.	350
25	Modification to support the DE and NDE side overhangs and augmentation of insulation scheme of stators of Three phase traction motor type 6FRA 6068 during	355
26	Modification to support the DE and NDE side overhangs and augmentation of insulation scheme of stators of Three phase traction motor type 6FRA 6068 during	356
27	Provision of change over switch in Traction Converter for speed sensor of Traction Motor	371
28	Modification of Bellows and its Mounting arrangement of existing Traction Motors type 6FRA 6068 used in WAG9/WAP7 class of locomotives (retrofitment).	373
29	Modification of Bellows and its Mounting arrangement on New Traction Motors type 6FRA6068 used in the WAG9/WAP7 class of locomotives(new manufacturing).	374
30	Ensuring availability of Grease outlet channel at NDE side of TM type 6FRA 6068 used in WAG-9 and WAP-7 locomotives	387
31	Measurement of dimensions of various assembly components and ensuring adequate interferences during replacement of TM bearings.	415
32	Use of 5 mm solid end plates in place of existing 5 x 1 mm thick spot.welded laminated end plates assemblies for stators & rotors of TM type 6FRA 6068.	423
33	Modification to avoid failure of temperature sensors due to increase in resistance value of temperature sensor cable shielding.	437
34	Modification in resistance ring to increase the radial gap between resistance ring and end ring in Scheme-II design of rotors for traction motor type 6FRA6068	438
35	Modification in drawing of outer bearing cap (DE) to drain out ingressed gear case oil from TM type 6FRA6068.	439
36	Implementation of bearing cap NDE to achieve adequate lateral thrust in Traction motor (TM) assembly of 6FRA6068 TM in WAG9/ WAP7 class of locomotives.	460
37	Modification for providing dummy plate in cab roof in place of Air Conditioning unit.;	461
38	Implementation for modification in drawing of Outer bearing cap DE to achieve adequate lateral thrust in Traction motor (TM) assembly of 6FRA6068 TM in WAG9/WAP7 class of locomotives.	466
39	Modification in Hex. Socket CSK Head Screws for fixing of Traction motor Bellow plate to achieve adequate mechanical strength in Traction motor (TM) type 6FRA6068 for WAG9/WAP7 class of locomotives.	472
40	Modification in Mounting arrangement of Leather Bellows of Traction Motors type 6FRA6068.	476

41	Adoption of Traction motor labyrinths of TM type 6FRA6068 as per original dimensions given by ABB to eliminate problem of gear case oil ingress in TM.	478
42	Modification Sheet for increasing grease outlet hole on End Frame DE side from 9 mm to 12 mm in Traction motor type 6FRA6068.	485
43	Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC	496
	TC	TC
44	Indigenization of lubricants for WAP5/WAP7/WAG9 rev 4	34
45	Implementation for storage & handling of lubricant/greases used in Electric locomotives.	104
46	Technical Circular on Year of manufacturing codification on TM & MSU	117
47	General Guidelines for uses of Videos Bore scope for checking the inaccessible location of electric locomotives to avoid failures.	144
48	Technical Circular for Interchangeability and Maintainability of Hall Effect Speed Sensors provided in IGBT based 3-phase electric locomotives.	145
	STR(Schedule of Technical Requirements)	STR
49	Repair, rehabilitation of motorised bogie frames	81
50	Gears and Pinions of Electric Locomotives	22

12. Traction Motor - Must change items as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest

SN	Description
1	Set of cylindrical roller Bearing along with Outer/inner labyrinth pins and accessories for three phase traction motor type 6FRA 6068
2	TM Pinion of WAG9 / WAP7
3	TM Terminal Board Assembly (WAG9) (IOH2 and IOH4)
4	Speed sensor probe housing (WAG9) (IOH2 and IOH4)
5	Bellows of TM
6	Temperature strip
7	Servoplex SHC-120 (IOCL) grease for traction motor bearing of WAG-9/WAP-7
8	All Rubber/Plastic item (eg O ring, Hose, Gasket, Seal, etc)
9	All Hardware (eg. Nut, Bolt, Washer, Fasteners, Screw, Pin, O ring etc.)
10	End plate "O" Rings & the gaskets on the terminal box of TM
11	Gasket of temperature sensor cover

D. Scope of work for IOH of 3 Phase Traction Motor 6FRA 6068

The PSU shall be responsible for complete inspection, overhauling, testing, rectification, replacement and certification of Traction Motor and associated equipment during IOH, in accordance with OEM manuals and applicable RDSO SMIs/MS/TCs.

1. The PSU shall carry out incoming inspection and electrical tests on the traction motor including Insulation Resistance (IR) test of stator windings. Inductance measurement between phases shall be conducted at the TM terminal box using an LCR meter as per SMI-262 or latest, ensuring the phase difference is within prescribed limits. Incoming radial and axial play shall also be measured using dial gauges and recorded.
2. The PSU shall undertake complete dismantling of the traction motor including removal of speed sensor, probe housing, pulse generator ring (PGR), clamp plate, angle ring, NDE bearing cap and other associated components using approved tools. The pinion shall be extracted using a hydraulic extraction system, and inner races and rotor labyrinths shall be removed using induction heating while maintaining prescribed temperature limits. Drive End (DE) and Non-Drive End (NDE) end shields and bearings shall be removed.
3. Detailed visual, dimensional and mechanical inspection of the stator, rotor, end frames and other components shall be carried out. Specialized tests such as Inductance Test, Growler Test, Dye Penetrant Test (RDPT), Ultrasonic Testing (UST) and Magnetic Particle Testing (MPT) shall be performed wherever applicable. Necessary repairs or replacement of defective components shall be carried out in accordance with applicable SMIs, Technical Circulars (TCs) and Modification Sheets (MS).
4. The stator, rotor and end frames shall be thoroughly cleaned using dry compressed air, vacuum cleaners, and approved halogen-free solvent cleaning agents like White Spirit or Xylol-CHR (chemically pure) to remove oil, grease, and contaminants from the stator and rotor. The stator and rotor shall be baked in a temperature-controlled oven to remove moisture. The stator shall then be varnished with approved anti-tracking varnish and allowed to dry to restore insulation strength.
5. All bearings, pinion, O-ring, Gasket and other associated accessories shall be replaced as per IOH schedule. The bearing inner race shall be fitted on the rotor in accordance with RDSO Modification Sheet MS-415 or latest applicable standard.
6. The rotor shall be thoroughly cleaned and dynamically balanced. A surge comparison test (approximately 5 kV) shall be conducted on the stator winding to detect inter-turn faults, and a Growler Test (SMI-163 or latest) shall be carried out on rotor bars and end rings. UST and RDPT shall be performed on the rotor shaft, particularly at pinion and bearing seating areas, to detect internal or surface defects. Magnetic Particle Testing (MPT) as per SMI-311 or latest shall also be carried out at critical stress locations where required.
7. A new pinion shall be fitted in accordance with the procedure specified in RDSO SMI-278 or latest instructions. Prior to fitment, the taperness of the shaft and pinion shall be verified using approved gauges (RDSO Drawing No. SKEL-5032 and SKEL-5043 or latest). Dye transfer (colour matching) test shall be conducted to ensure proper contact between the pinion and shaft taper with minimum 90% contact area. The pinion shall be mounted using a hydraulic press arrangement with controlled pressure (approximately 1700–1900 bar and not exceeding 2000 bar) ensuring the specified travel of the pinion within the shaft.
8. Bearings and labyrinth rings shall be fitted on the rotor and end frames after verification of all critical dimensions in accordance with MS-415 or latest. Precision measuring instruments

such as Dial Snap Gauges (SMI-314 or latest) and Bore Gauges (SMI-318 or latest) shall be used for measurement. Heating for shrink fitment shall be carried out using induction heating equipment as per SMI-301 or latest, ensuring temperature does not exceed 120°C. Proper lubrication using approved grease shall be carried out during assembly.

9. The PSU shall inspect, modify and standardize the traction motor speed and temperature sensor systems including associated cabling and connectors. Temperature sensor mounting shall comply with MS-350 or latest, with proper earthing of shielding as per MS-437 or latest. The gap between the speed sensing probe and the Pulse Generator Ring (PGR) shall be maintained between 0.5 mm and 1.0 mm as per TC-145 or latest. Adoption of IGBT type speed sensors shall be carried out where applicable in accordance with MS-458 or latest.
10. After completion of overhaul activities, the traction motor shall be assembled as per applicable SMIs, MS and TCs. Greasing shall be carried out as per SMI-307 or latest, and modified bellows arrangements shall be provided where applicable as per MS-476 / MS-472 or latest. Radial play shall be verified as per SMI-278 / SMI-336 or latest, and axial play shall also be measured to ensure compliance with prescribed limits before testing.
11. After assembly, the traction motor shall undergo a mandatory no-load run test on a VVVF test plant. The motor shall be run up to rated voltage and frequency (approximately 400 V, 50 Hz) and operated for about one hour in each direction. Bearing temperature rise, vibration and noise levels shall be monitored. The bearing temperature rise shall not exceed 40°C above ambient, and vibration levels shall remain within permissible limits. After satisfactory completion of all tests, the traction motor shall be certified fit for service.
12. After the incoming test and record data, the PSU shall carry out complete dismantling of the Traction Motor (TM), including removal of the pinion, labyrinth, speed sensor and other subassemblies. Initial dry cleaning and solvent cleaning of the stator, rotor and end frames shall be carried out to remove oil, grease, dust and contaminants.
13. All actions under the Reliability Action Plan shall be implemented strictly in accordance with TC-142 or the latest applicable instructions issued by the competent authority.
14. All the must changed items shall be replaced in accordance with the Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest
15. **SMI/MS/TC/STR FOR TM are as follows:**

SN	Description	SMI
1	Fitting of Nuts, bolts, screws	1
2	Condition monitoring of bearings by SPM Meter	58
3	General guidelines to follow for balancing of rotor and blower impellers	152
4	General guidelines to follow for balancing of rotors and cooling blowers in position	199
5	Provision of rubber compound RTV 738 in the terminal box of three phase asynchronous traction motor type 6 FRA 6068.	209
6	Modified Method of VPI for three phase asynchronous traction motor type 6FRA6068	210
7	Improved Method of brazing of terminal bus rods on respective phase rings of the stator windings of three phase traction motor type 6FRA6068.	211
8	Pre-testing of speed sensor	252
9	Pre-testing of temperature sensors	260
10	Detection of rotor bar crack & stator defect for traction motor type 6FRA6068 used on WAG9 / WAP7 locomotives by measurement of inductance.	262
11	Use of extreme pressure lubricant paste for shafting of rotors of traction motors	272

	type 6FRA6068 and 6FXA7059 to prevent damage to stampings and scoring of shafts at the time of removal of shaft	
12	Implementation for detection of rotation of outer racers of bearing and assembly components by checking metal content in grease sample 3 Phase traction motors type 6FRA6068 and 6FXA7059.	273
13	Ensuring proper fitment of traction motor bearings in 6FRA6068 TM	278
14	Use of Induction Heater for heating of End Shields/End frames of traction motors for bearing fitment	301
15	Implementation for periodicity & quantity of re-greasing in minor schedule in every alternate schedule (i.e. 1st IB, 2nd IA, 2nd IC) for Traction Motor (TM) type 6FRA6068.	307
16	SMI for Magnetic Particle Testing (MPT) of Traction Motor (TM) nose stay in conventional locomotives/EMUs/MEMUs/Metro Railways, TM suspension holder support and motor support in WAG9/WAP7 locomotives and Traction Motor support arm in WAP5 locomotives.	311
17	Use of Dial Snap Gauges for measurement of shaft diameter of traction motor for Electric Locomotives.	314
18	Use of Bore Gauge for measurement of internal diameters of End Shield/Racer during bearing fitment.	318
19	Improving reliability of armature shaft by not rebuilding armature shaft by welding for conventional and three phase locomotives.	321
20	Use of grease gun equipped with digital grease meter for greasing of roller bearings of traction motors and MSU bearings of electric locomotives.	322
21	Procedure of measurement of axial clearance and limit of axial clearance for Traction motor type 6FRA6068.	323
22	Procedure of measurement of Radial Clearance of Bearings	336
	MS	MS NO.
23	Modification of Drive End - Outer Labyrinth of WAG9/ WAP7 Traction Motor type 6FRA 6068	314
24	Modification of fixing arrangement temperature sensor fitted on traction motor type 6FRA 6068 of WAG9/WAP7.	350
25	Modification to support the DE and NDE side overhangs and augmentation of insulation scheme of stators of Three phase traction motor type 6FRA 6068 during	355
26	Modification to support the DE and NDE side overhangs and augmentation of insulation scheme of stators of Three phase traction motor type 6FRA 6068 during	356
27	Provision of change over switch in Traction Converter for speed sensor of Traction Motor	371
28	Modification of Bellows and its Mounting arrangement of existing Traction Motors type 6FRA 6068 used in WAG9/WAP7 class of locomotives (retrofitment).	373
29	Modification of Bellows and its Mounting arrangement on New Traction Motors type 6FRA6068 used in the WAG9/WAP7 class of locomotives(new manufacturing).	374

30	Ensuring availability of Grease outlet channel at NDE side of TM type 6FRA 6068 used in WAG-9 and WAP-7 locomotives	387
31	Measurement of dimensions of various assembly components and ensuring adequate interferences during replacement of TM bearings.	415
32	Use of 5 mm solid end plates in place of existing 5 x 1 mm thick spot.welded laminated end plates assemblies for stators & rotors of TM type 6FRA 6068.	423
33	Modification to avoid failure of temperature sensors due to increase in resistance value of temperature sensor cable shielding.	437
34	Modification in resistance ring to increase the radial gap between resistance ring and end ring in Scheme-II design of rotors for traction motor type 6FRA6068	438
35	Modification in drawing of outer bearing cap (DE) to drain out ingressed gear case oil from TM type 6FRA6068.	439
36	Implementation of bearing cap NDE to achieve adequate lateral thrust in Traction motor (TM) assembly of 6FRA6068 TM in WAG9/ WAP7 class of locomotives.	460
37	Modification for providing dummy plate in cab roof in place of Air Conditioning unit.;	461
38	Implementation for modification in drawing of Outer bearing cap DE to achieve adequate lateral thrust in Traction motor (TM) assembly of 6FRA6068 TM in WAG9/WAP7 class of locomotives.	466
39	Modification in Hex. Socket CSK Head Screws for fixing of Traction motor Bellow plate to achieve adequate mechanical strength in Traction motor (TM) type 6FRA6068 for WAG9/WAP7 class of locomotives.	472
40	Modification in Mounting arrangement of Leather Bellows of Traction Motors type 6FRA6068.	476
41	Adoption of Traction motor labyrinths of TM type 6FRA6068 as per original dimensions given by ABB to eliminate problem of gear case oil ingress in TM.	478
42	Modification Sheet for increasing grease outlet hole on End Frame DE side from 9 mm to 12 mm in Traction motor type 6FRA6068.	485
43	Traction Motor Dropping Detection System (TMDDS) in WAP-7/WAG-9/9H/9HC	496
	TC	TC
44	Indigenization of lubricants for WAP5/WAP7/WAG9 rev 4	34
45	Implementation for storage & handling of lubricant/greases used in Electric locomotives.	104
46	Technical Circular on Year of manufacturing codification on TM & MSU	117
47	General Guidelines for uses of Videos Bore scope for checking the inaccessible location of electric locomotives to avoid failures.	144
48	Technical Circular for Interchangeability and Maintainability of Hall Effect Speed Sensors provided in IGBT based 3-phase electric locomotives.	145
	STR (Schedule of Technical Requirements)	ST R
49	Repair, rehabilitation of motorised bogie frames	81
50	Gears and Pinions of Electric Locomotives	22

16.Traction Motor - Must change items as per Railway Board's L. No. 20216/Elect

(TRS)/138/2 Pt., dated 18.01.2023 or latest

SN	Description
1	Set of cylindrical roller Bearing along with Outer/inner labyrinth pins and accessories for three phase traction motor type 6FRA 6068
2	TM Pinion of WAG9 /WAP7
3	TM Terminal Board Assembly (WAG9) (IOH2 and IOH4)
4	Speed sensor probe housing (WAG9) (IOH2 and IOH4)
5	Bellows of TM
6	Temperature strip
7	Servoplex SHC-120 (IOCL) grease for traction motor bearing of WAG-9/WAP-7
8	All Rubber/Plastic item (eg O ring, Hose, Gasket, Seal, etc)
9	All Hardware (eg. Nut, Bolt, Washer, Fasteners, Screw, Pin, O ring etc.)
10	End plate "O" Rings & the gaskets on the terminal box of TM
11	Gasket of temperature sensor cover

17. List of Major Conditional Items in Traction Motor:

1. Rewinding of stator :

- Stripping and removing the existing winding from the stator. Thorough cleaning of the stator core. Inspection of the core for any damage. Performing a core loop loss test. Implementing any necessary stator modifications.
- Manufacturing new stator coils. Placing the fabricated coils into the stator core slots. Placement of slot wedges.
- Brazing all joint connections. Bracing and final finishing of the coil overhangs.
- Vacuum Pressure Impregnation (VPI) of the complete stator. Testing and measure electrical property like Meggar , Insulation Resistance, inductance of coil etc

2. Replacement/ ReBaring of rotor bar :

- Removal of damaged rotor bars and resistance ring from the rotor core, ensuring no damage to the core laminations.
- Thorough cleaning of the rotor core, including removal of any foreign particles, dust, and residue.
- Performance of a core loss test (sometimes referred to as a ring flux test) on the rotor core to assess the condition of the core laminations and identify any inter-laminar short circuits or excessive core losses.
- Precise measurement and checking of the shaft dimensions against specifications, including diameter at bearings, seal areas, and couplings, to identify any wear or deformation.
- Modification of rotor core as per modified design, if unmodified, e.g. Replacement of any mechanical component like end ring, stamping type resistance ring, etc., as per design to be adopted.
- Mechanized brazing of rotor bars and resistance ring. Swaging of rotor bars. Balancing of rotors

3. Replacement of DE/NDE End Shield :

Thoroughly cleaning the end shields and their holes, followed by visual inspection and dimensional measurement against specifications. Threaded holes on the DE/NDE end shield must be checked and repaired using Helicoil if necessary, and out-of-tolerance

shields withdrawn from service and replaced with new ones.

4. Re-shafting / Re-Axling of Rotor :

- a. Inspection after cleaning and measuring critical dimensions to confirm the need for re-shafting.
- b. Repairing or re-building the shaft by welding is strictly prohibited due to its detrimental effect on metallurgical properties, which can lead to micro-cracks and premature fatigue failure.
- c. Rotors identified for re-shafting must receive a newly machined shaft conforming to CLW Drawing No. 1.TWD.096.009o or latest, with the shaft diameter at the bearing seats strictly maintained between 180.053 mm and 180.068 mm.

2. Special terms and condition of the contract

1. "Railway PSUs only to participate" in the tender. The offer received other than railway owned PSUs shall not be considered and summarily rejected.
2. Schedule maintenance (POH) of the locomotives shall be as per the maintenance schedule issued by Railway Board vide letter no. 2022/M(L)/165/5 dated 07.12.2022 or latest. Regarding maintenance of locomotives, PSU shall examine all the guidelines issued from time to time by the Railway Board/RDSO and the same shall be implemented during the maintenance as per clause 17.6 of agreement.
3. During maintenance, all Must Change Items (MCIs) shall be replaced in accordance with Railway Board's Letter No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest and scope of work or the latest instructions issued thereafter (as per the clause 17.6 of tender document/ Agreement).
4. The work instructions and check sheets shall be prepared by the PSU. While preparing the work instructions and check sheets, the PSU must ensure the incorporation of all relevant Special Maintenance Instructions (SMIs), Maintenance Schedules (MS), Technical Circulars (TCs), STRs and Operation & Maintenance (O&M) Manuals already issued by railway or OEM's Manual /Guide line/Maintenance Practice of equipment. Each work instruction and check sheet must include the necessary safety guidelines as per the clause 17.3 of tender document/agreement.
5. These documents / drawings / specifications may be revised from time to time (as per latest SMIs / MS / TC issued by RB / RDSO / CLW), as and when required. However, final approval shall be obtained from the authorized representatives of CWM/ELW/DB before implementation. Implementation of these instructions can be verified by IR personnel to ensure proper quality and correct procedure of maintenance is ensured by PSU as per the clause 17.3.2 of tender document/agreement.
6. All material required for overhauling should be procured as per approved specification/approved source of IR. Inspection of material procured will be done by RDSO/RITES/Any third party approved by Railways as stipulated in specification/instructions. In case of any doubt/deviation CWM/ELW/DB or his authorized representative must be consulted.
7. Vendors for various materials are available on an approved panel by various vendors controlling agencies i.e (IE /RDSO/CLW/BLW etc.). So, material should be procured from approved vendors wherever applicable. Approved vendors list is available at vendor directory on UVAM portal. In case of any doubt CWM/ELW/DB or his authorized representative must be consulted.
8. For maintenance activities, the PSU shall examine and implement all guidelines and instructions issued from time to time by the Railway Board and RDSO.
9. The scope of work is based on the relevant SMIs, TCs, MSs, STRs currently available, but it is not exhaustive. The PSU shall conduct due diligence, continuously check for, and incorporate any newly issued SMIs, TCs,MSs & STRs. Furthermore, the PSU shall examine the guidelines and instructions issued from time to time by the Railway Board and RDSO. In case any clarification is required, the same shall be obtained from the authorized representatives of CWM/ELW/DB.
10. The PSU shall maintain adequate unit-exchange spares to meet the prescribed cycle time for both POH and IOH schedules as per the tender document/Agreement clause 29.4.

11. The IGBT based propulsion / Hotel Load Converter system is already covered under the CAMC by the Railway sheds. Therefore, the PSU may liaise with the Railway sheds whenever a locomotive arrives at the Dabhoi Workshop for POH. The PSU may coordinate with the Railway sheds to call the OEMs representative for overhauling to the system under the existing CAMC so that the cycle time of POH meets.
12. The complete list of facilities available including civil infrastructure, Mechanical, Electrical & S&T equipment available in the workshop and M&Ps and T&Ps will be provided to the PSU during the handing over time with joint survey/verification.
13. For the maintenance of Machinery & Plants (M&Ps) Annual Maintenance Contract(AMC) shall be given by PSU to OEMs as far as possible. Where AMC is not possible, the PSU shall maintain the infrastructure and facilities through a judicious mix of in-house and outsourced model. Railways shall handover a complete list of M&Ps with the details of their AMC and / or Warranty details to the PSU, in a manner understandable to both the parties so that the AMC can be operated / action under warranty can be claimed by the PSU whenever required.
14. The PSU (firm) may, if required, take the equipment to the OEM's/Firm premises for overhauling in order to meet the stipulated turnaround time, after obtaining approval from the CWM/ELW/DB or his authorized representative, in accordance with Railway procedures. The transportation charges for taking the equipment to the OEM's/Firm premises shall be borne by the PSU.
15. The PSU shall provide all personal Safety equipment like industrial helmet, safety shoes, gloves etc. to all the employees and shall ensure the use of the same by staff while on duty.
16. The PSU must ensure strict adherence to all relevant statutory provisions throughout the execution of the work. This includes, but is not limited to, compliance with regulations pertaining to Primary Occupational Health & Safety, Primary Occupational Health, Electrical & Technical Standards, Environmental & Waste Management, and Specialized Equipment Regulations. Specifically, compliance with the Factories Act, 1948, along with all associated rules, regulations, and amendments, is mandatory, as are all other applicable labour, safety, environmental, and welfare legislations.
17. PSU shall be responsible for compliance of all relevant Acts / Laws, including Factory Act, Labour laws, Minimum wages Act, Environment & Pollution laws etc. The PSU shall discharge its obligations in accordance with good industry practice. If any Government agency imposes a penalty for not following any of the statutory law/regulations, the penalties/fine will be paid by the PSU.
18. Designated officials of PSU shall act as the Occupier and Factory Manager (Principal Employer) as per Factories Act. In case, a dispute is raised by the Labour department/concerned authority for approval of Occupier and Factory Manager as per Factories Act, then WR may assist/act upon to resolve the issue as advised by concerned labour department/authority of State Govt.
19. The PSU shall constitute an Internal Complaints Committee (ICC) in compliance with the Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 for all personnel engaged directly or indirectly, including through sub-contractors.
20. The PSU shall not employ any person below 18 years of age for execution of work under the contract. Every worker employed must possess a valid Medical Certificate of Fitness, issued by a Certifying Surgeon, certifying that the worker is fit to work as an adult. The certificate shall be kept in the custody of the PSU, and the worker shall carry

a token/reference to the certificate while on duty. The Medical Fitness Certificate shall be valid for one (1) year at a time and shall be renewed annually.

21. The PSU shall submit Police Verification Certificates for all contractual staff and labour deployed for Workshop and kept in the custody of PSU itself.
22. The PSU shall ensure round-the-clock availability of an ambulance at the workshop premises and shall also ensure that all Contractor and contract employees are covered under valid medical insurance.
23. All stationery items, IT equipment, office equipment, infrastructure, furniture, other consumables like printer cartridges, registers etc. required for operation, maintenance, inspection, documentation, record keeping and administrative purposes shall be arranged and provided by the PSU at its own cost.
24. Inspection of works (i.e POH/IOH/upgradation) shall be carried out by the Railway (i.e. CWM/ELW/DB or his nominated representative) at any stage of the work as per the tender document/agreement clause 19.3 and clause 18.3.4.
25. The PSU shall replace equipment or items, whose useful life completed (other than must change items) as per Railway Board letter No. 2022/AC II/2/1 dt 06.06.2022 or latest. The list of items to be replaced will be jointly decided by CWM/ELW/DB or their authorized representative and the authorized representative(s) of PSU during the time of POH/IOH. The above equipment / items shall be dealt in accordance with the tender document/agreement clause 17.6.
26. The PSU shall modify the supporting minor accessories like cables, joint welding, electrical spares, etc. wherever necessary.
27. The PSU shall, at its own cost, engage an independent Quality Assurance (QA) team. To ensure zero conflict of interest, this team shall operate with absolute functional independence from the PSU's execution and project management divisions. The QA team shall report directly and exclusively to the Railway Administration (CWM/ELW/DB or their authorized representative).

The QA team shall carry out periodic and time-to-time quality checks of all critical and non-critical activities. Accountability and Fixed Responsibility the QA team shall be held professionally responsible for the following, but is not limited to:

- Verification of Compliance: Certifying that all works—including overhauling, material procurement, and infrastructure upgrades—strictly adhere to the Railway's approved Quality Assurance Plan (QAP) and technical specifications.
- Liability for Oversight: The QA team shall be held accountable for any quality lapses, deviations, or non-conformities in the work they have cleared. Failure to identify systemic defects or substandard materials during inspections shall be deemed a contractual failure on the part of the QA team.
- Stop-Work Authority: The QA team is empowered to suggest an immediate "Stop-Work" order to the PSU if critical safety or quality protocols are being bypassed and the same shall be immediately informed to the CWM/ELW/DB or their authorized representative for further process.
- Process Audits: Periodic and surprise checks of maintenance and overhauling workflows.
- Material Validation: Physical inspection and verification of Test Certificates (TCs) for all materials/components before use.
- Infrastructure Oversight: Monitoring the technical integrity of all upgradation and development works.

Every inspection shall culminate in a Joint Quality Assurance Note. This document must

be signed by both the PSU's execution authority and the QA team authorized person. By signing, the QA team provides a formal warranty that the inspected activity meets the required standards. These records shall be submitted directly to the Railway Administration.

The PSU shall ensure that the independent QA team is deployed within three (3) months from the date of issuance of the Letter of Acceptance (LOA) or prior to commencement of work by the PSU, whichever is earlier. No work shall be cleared for payment or progress credit until the QA team is active on-site.

28. The Quality Assurance (QA) team engaged by the PSU shall report daily to the Railway Administration, i.e. CWM/ELW/DB or his authorized representative, and shall submit a daily written inspection report detailing Inspections carried out, Observations made, deficiencies, deviations or non-conformities noticed, Defect notices, if any, issued during the quality checks.

The PSU shall be fully responsible and liable to promptly attend to, rectify and close all deficiencies, deviations or defect notices identified during the quality checks, within the time frame specified by the Railway Administration. Rectification actions taken by the PSU shall be documented and closure of deficiencies shall be recorded through a joint compliance / closure note.

29. A computerized contract labour management system shall be implemented to ensure efficient workforce management, transparency and worker welfare. The system shall be deployed by the PSU. The system shall maintain a centralized database of all contract workers, including certified identification, Biometric-based attendance, demographic details, police verification, medical fitness, insurance, PF and statutory compliance records as per applicable labour laws.
30. Utility vehicles and also drivers (as per requirement) will be provided by the PSU for the transport of railway officials to the workshop.
31. In case where approved drawings or specifications of any equipment, items, or kits are not available, the PSU shall procure the same from the Original Equipment Manufacturer (OEM) or its authorized dealer. In such instances, prior approval of CWM/ELW/DB or its authorized representative shall be obtained by the PSU.

32. Public Sector Undertaking (PSU) is responsible for obtaining all necessary workshop certifications, although the list provided is indicative and not exhaustive. The required certifications include:

1. Integrated Management System (IMS): ISO 45001:2018, ISO 14001:2015, and ISO 9001:2015.
2. Operational Excellence: 5S, Industry 4.0, and 6 Sigma.
3. Environmental & Energy: Green Co Rating, ISO 50001, and compliance with The Water/Air (Prevention & Control of Pollution) Acts.
4. Specialized: Welder classification, and Petroleum and Explosives Safety Organization (PESO) approval.

The entire expenditure associated with securing these certifications will be borne by the PSU.

33. MANPOWER ELIGIBILITY:

The manpower deployed by the PSU and/or its sub-contractor shall be strictly in accordance with the provisions of the Tender Document / Agreement, particularly Clause 5.5.1 and Clause 17.15.1, with respect to numbers, categories, deployment pattern and

responsibilities. However, in addition to the above, the qualification, competency and skill level of the deployed manpower shall mandatorily comply with the requirements specified below :

SN	Designation	Minimum Educational qualifications and/or Experience
1	SR. SUPERVISOR	Graduate Degree in Mechanical/Electrical/electronic/IC or equivalent Engineering with minimum experience of 3 years or Diploma in Mechanical/Electrical/electronic or equivalent with minimum experience 5 years.
2	JR. SUPERVISOR	Graduate Degree in Mechanical/Electrical/electronic/IC or equivalent Engineering with minimum experience of 1 years or Diploma in Mechanical/Electrical/electronic or equivalent Engineering with minimum experience 3 years.
3	SKILLED	ITI in electrical/fitter/welder/machinist or equivalent with minimum experience 1 years.
4	SEMI-SKILLED	ITI in electrical/fitter/welder/machinist or equivalent.
5	UNSKILLED	10th pass or its equivalent
6	CRANE OPERATOR	10th pass or its equivalent with minimum experience of 3 years in Industrial crane operating.

In addition to the aforementioned qualifications, specific supplementary qualifications are essential. Please note that the list of required competence certificates provided is indicative, not exhaustive. The actual certifications and qualifications for each role may differ, and extra certifications might be necessary based on the specific scope of work, project demands, and all relevant national, state, and local laws, rules, and regulations. Mandatory compliance with all statutory and regulatory requirements is required. The necessary certificates include :

Profession	Required Competence Certificate	Remarks / Statutory Basis
Crane Operator (EOT/Gantry)	Form 11 (Competency Certificate)	Issued by a "Competent Person" under the Factories Act after a practical load test.
NDT Technician	ASNT/ISNT Level II or III	Mandatory for testing axles, wheels, and bogie frames for cracks using Ultrasonic (UT) or Magnetic Particle (MT).
High Pressure Welder	IBR / AWS / ISO 9606-1 Certification	Required for structural welding on locomotive chassis and pressure vessels. (Ref: Rly Board letter No.2025/M(W)1/814/6, dated 24/03/2025 or latest)
HT/LT Electrician	Electrical Supervisor License (A-Grade)	Issued by State/Central Electricity Authority; mandatory for working on 25kV traction systems.
C&M Staff (Chemist)	ISO/IEC 17025 Lead	Required for staff managing

	Auditor/Lab Cert.	chemical labs, fuel analysis, and metallurgical testing.
Metrology Staff	NABL Calibration Competency	Ensures all workshop gauges and torque wrenches are calibrated to national standards.
Fire & Safety Officer	NEBOSH / ADIS (Fire & Safety)	Specialized in industrial fire management (especially transformer oil fires).
Heavy Vehicles	Heavy Goods Vehicle (HGV) License	Motor Vehicles Act

34. The PSU shall ensure that the entire work site is kept clean, tidy and free from all scrap, debris, waste material and litter at all times during the execution of the work.

35. Payment terms/Condition:

- I. Payment of the maintenance fee to the PSU shall be governed by the provisions of the Tender Document / Agreement Article 26. For any accounting year, the locomotive price applicable for payment purposes shall be determined by adjusting the base amount specified under Clause 26.1.3 of the Tender Document / Agreement, to account for variation in costs as per the Maintenance Index. The annual adjustment of the locomotive price shall be carried out strictly in accordance with the Maintenance Index formula specified in Article 48 of the Tender Document / Agreement.
The amount arrived at after applying the Maintenance Index adjustment to the locomotive price shall be treated as the applicable locomotive price for that accounting year, and payments to the PSU shall be made accordingly.
- II. The bill shall be paid to the PSU as per the article 28 of tender document/agreement.
- III. Schedule of rate of Payable spare under clause 29 of tender document/agreement, will be finalized by a committee of at least 3 JAG members nominated by the zonal railway vide RB letter no.2024/Elect(TRS)/720/1 dated 14.05.2025.
- IV. For IOH of Motorised Bogie (Co-Co) / Traction Motor (6FRA 6068) If any defects/damages are noticed at the Workshop, PSU shall inform to the Government in reasonable detail the particulars of defects, deficiencies or damages of items which are replaced as additional items other than the schedule items and the cost of thereof. Then a Joint assessment shall be done by PSU and Owning Railway Shed to work out additional cost, other than IOH. Cost shall be based on Scheduled Rates of Payable Spares (as per clause 17.6 of tender document/agreement) along with 10% (ten percent) of the spares cost toward manpower. During IOH of Motorised Bogie (Co-Co) / Traction Motor (6FRA 6068), all its Must Change Items should be replaced as per Railway Board's L. No. 20216/Elect (TRS)/138/2 Pt., dated 18.01.2023 or latest.
- V. The Government may at any time inspect the Locomotive / Bogie / TM to verify the defect, deficiency or damages reported in accordance with the above Clause IV.
- VI. GST will be paid as per GST Law, GST/SGST/UTGST/IGST as amended by Central/State Governments from time to time. GST will be paid as per actual and input credit for GST to be passed on to Indian Railways.
- VII. Bill passing officer would be Sr.DEE/Dabhoi or Dy.CWM/ELWDB or the officer nominated by CWM/DB.
- VIII. Bill paying Officer would be AFA (W&S) PRTN/WR.

36. Failure

- I. **POH of Locomotive:** In the event of any failure on account of POH which is attributed to POH of the locomotive within 100 days of POH by PSU then such failure shall be attended by the PSU strictly in accordance with the provisions of Clause 21.3 (In case of Workshop) of the Tender Document/Agreement.
 - II. **IOH motorized bogie and traction motor:** Any failure of motorized bogie and traction motor on account of IOH which is attributed to IOH of motorised bogie or traction motor within 100 days of IOH by PSU shall be on the account of PSU. Such failure shall be attended by Railway loco shed or PSU. The actual material cost for such attention shall be borne by PSU. If motorized bogie and traction motor is attended by the loco shed then PSU may request the loco shed for joint assessment of actual material cost of such attention. The PSU shall be liable to pay additional 20% of this cost as Damages. If there is any failure purely on account of poor workmanship, the PSU shall pay to Railway an amount equal to 0.5 % of Maintenance Fee of IOH for the motorized bogie/Traction motor as Damages for each such failure up to the ceiling limit of 10% of Maintenance Fee of IOH for the motorized bogie/Traction motor.
37. The up-gradation of existing infrastructure/facilities and the development of additional infrastructure/facilities and equipment provided by the PSU shall be covered under warranty in accordance with the provisions of Clause 20.3.2 of the Tender Document/Agreement.
38. All spares supplied by the PSU under Article 29 shall carry warranty in accordance with the provisions of Clause 29.1.3 of the Tender Document/Agreement.
- 39. Completion period of IOH of Motorized Bogie and Traction Motor**
- I. The Railway shall intimate the PSU for lifting of Motorized Bogie and/or Traction Motor for Intermediate Overhaul (IOH) through official communication such as official e-mail / WhatsApp message supported with reference letter, or any other mode of communication mutually agreed between the Railways and the PSU.
 - II. Upon receipt of such intimation from the Railway, the PSU shall arrange lifting of the Motorized Bogie / Traction Motor from the respective shed within 03 (three) days from the date of intimation.
 - III. The PSU shall complete the IOH of the Motorized Bogie and deliver the overhauled Motorized Bogie back to the concerned shed within 11 (eleven) days, inclusive of calling, transportation, overhaul, testing and delivery, calculated from the date of intimation.
 - IV. The PSU shall complete the IOH of the Traction Motor and deliver the overhauled Traction Motor back to the concerned shed within 08 (eight) days, inclusive of calling, transportation, overhaul, testing and delivery, calculated from the date of intimation.
 - V. Traction Motors shall normally be offered to the PSU for IOH in a lot size of 03 (three) to 06 (six) numbers. The lot size may be increased or decreased depending upon availability of Traction Motors in the railway shed. Traction Motors may also be offered as per arising for overhaul. No additional completion time shall be admissible for lot sizes exceeding 06 (six) numbers. However, additional Traction Motors may be offered for IOH before completion of the ongoing lot, and the PSU shall undertake the same without any additional time extension, unless specifically agreed otherwise.
 - VI. Motorized Bogies shall normally be offered to the PSU for IOH in a lot size of 02 (two) to 04 (four) numbers. The lot size may be increased or decreased depending upon availability of Motorized Bogies in the railway shed. Motorized Bogies may also be offered as per arising for overhaul. No additional completion time shall be admissible

for lot sizes exceeding 04 (four) numbers. However, additional Motorized Bogies may be offered for IOH before completion of the ongoing lot, and the PSU shall undertake the same without any additional time extension, unless specifically agreed otherwise.

40. Damages Condition:

- I. **POH of Locomotive:** The duration of POH activities shall be as per the RDSO letter no EL/3.1.28 (DML) dated 13.01.2023 or latest, if the delay in the duration of POH then the PSU shall pay the damage as per the tender document/agreement clause 21.2(In case of Workshop) .
- II. **IOH motorized bogie and Traction motor:**
The stipulated duration for completion of Intermediate Overhaul (IOH) shall be in accordance with the above clause 39 of special condition of contract.
In the event the PSU fails to complete/deliver the IOH activity within the time period specified above clause 39, the PSU hereby agrees that it shall be liable to pay damages to the Government. The damages shall be calculated at the rate of 0.5% (zero point five percent) of the Maintenance Fee applicable for IOH of the Motorized Bogie and/or Traction Motor, for every delay of one week or part thereof, beyond the stipulated completion period.
- III. If the PSU fails to deploy manpower in accordance with Clause 17.15.1 of the Tender Document/Agreement, the PSU shall be liable to pay a damage at the rate of 300% of the applicable minimum wages per person per day, calculated on a quarterly basis.
For the avoidance of doubt, "staff deployed by the PSU" shall mean personnel directly engaged in core activities, namely Locomotive POH, IOH of motorized bogies, and traction motors.
- IV. During the Maintenance Period, if any deficiency or discrepancy is observed by the Chief Workshop Manager (CWM) or his authorized representative in the operation and maintenance of the Workshop—including, but not limited to, cleanliness of the workshop premises, security arrangements, upkeep of gardening areas, fire-fighting systems, DG sets, CCTV systems, solar systems, lighting, and other general utilities—the same shall be intimated to the PSU. The PSU shall be responsible for rectifying such deficiency/discrepancy within three (03) days from the date of such intimation.
In the event of failure to rectify the deficiency/discrepancy within the stipulated period, the PSU shall be liable to pay a damage of ₹5,000/- (Rupees Five Thousand only) per day for each day of delay beyond the prescribed period, until such deficiency/discrepancy is duly rectified.

41. Mobilization Advance

Railway shall make payment of Interest bearing advance (Mobilization Advance), on the request of the contractor. The payment and recovery of such Advances shall be made as under:

This shall be limited to Rs. 25.00 Cr. (Twenty five Crores) and shall be paid in 2 stages:

Stage-1: 50% (fifty percent) of Total Mobilization Advance mentioned above on signing of the Contract agreement.

Stage-2: 50% (fifty percent) of Total Mobilization Advance mentioned above on

mobilisation of Site-establishment, setting up offices, bringing in equipment and actual commencement of work.

The stage-1 of advance shall be payable immediately after signing of contract agreement. The stage 2 of advance shall be payable at the time of mobilisation, only after submission of an utilization certificate by the contractor that the Stage 1 advance has been properly utilized in the contract. These Advances shall be payable against irrevocable guarantee (Bank Guarantee, FDRs) from a scheduled commercial bank of India of at least 110% of the value of the sanctioned advance amount (covering principal plus interest). The interest shall be paid in accordance with the provisions of Railway Board's letter No. 2018/CE-I/CT/1 dated 10.03.2022, as amended from time to time.

The recovery and all other conditions shall be in accordance with Para 46.(4) & 46.(5) of the IR Standard GCC, April 2022, including all correction slips.

42. INSPECTION OF MOTORISED BOGIE / TRACTION MOTOR:

A. Preliminary Joint Inspection:-

A preliminary joint inspection shall be carried out at the Owing Railway Shed prior to handing over the Traction Motor / Motorised Bogie to the PSU. The inspection shall be conducted jointly by the Shed representative of Railways and the authorized representative(s) of PSU.

During the inspection, the physical condition of the Traction Motor / Motorised Bogie shall be examined and recorded to certify that the unit is fit to be taken up for overhaul as per the approved RDSO specification. The inspection observations shall be jointly documented and signed by both the parties.

B. Stage Inspection:-

One or more stage inspection(s) may be conducted during the course of overhaul at the PSU premises by the authorized representative of CWM/ELW/DB or the concerned Owing Railway Shed.

Such inspection(s) may be carried out either with prior intimation or as a surprise inspection at any time during the overhaul process. The Railway representatives shall be permitted free access to inspect the progress and quality of work at PSU premises, with or without prior notice.

After dismantling of the Traction Motor / Motorised Bogie at PSU premises, a joint stage inspection shall be conducted before commencement of overhaul activities. This inspection shall be coordinated with the Railways for identification and replacement of condition-based items as per the approved Scope of Work.

During stage inspection, the Traction Motor / Motorised Bogie shall be checked for smooth running and for compliance of relevant electrical and mechanical parameters as per the Scope of Work.

C. Final Inspection:-

After completion of overhaul and on intimation by PSU, the overhauled Traction Motor / Motorised Bogie shall be offered for final inspection to the authorized representative of Owing Railway Shed. During the final inspection, all necessary tests and checks as per the Scope of Work shall be conducted. The PSU shall ensure that the Traction Motor / Motorised Bogie is kept fully ready in all respects for inspection.

The PSU shall give prior written intimation at least two (02) days in advance of the

date of inspection (i.e. 02 days prior to completion of IOH) through the official Railway e-mail or WhatsApp to the concerned Owning Railway Shed. If the Concerned owning Railway shed representative does not arrive within 02 days(Two days) for the final Inspection then the CWM/DB representative will do the Inspection and dispatch the overhauled Traction Motor / Motorised Bogie to the Concerned Railway shed by PSU.

43. TRANSPORTATION of Motorized bogie/Traction Motor:

- A.** The transportation of men and materials will be arranged by the PSU on his account. All incidental arrangements for safe transport of material/insurance/taxes/permits up to the 400 kms will be the responsibility of the PSU.
- B.** The PSU has to collect traction motor/motorized bogie from Electric Loco Sheds of railway and transport the same to PSU premises by Road Transport or by Rail at its own risk & cost. After Overhauling of traction motor/ motorized bogie, return the same to Electric Loco Sheds by Road transport or by Rail at PSU's risk & cost.
- C.** All the associated papers and formalities will have to be completed by the PSU and transport papers for transit and crossing state-border entry points etc. (if any) will have to be arranged by the PSU themselves for transport in either direction. For that purpose, the Railways shall provide the ownership certificate of the equipment.
- D.** However, only loading and unloading of traction motor/motorized bogie and its associate / released (if any) material at Railway's premises will be done by Railway and delivery to be done by the PSU on "Door Delivery" basis.
- E.** Freight, Transportation, transit Insurance, Octroi, packing and handling charges will be borne entirely by the PSU.