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भारत सरकार – रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ – 226011
Government of India - Ministry of Railways
Research, Designs & Standards Organization
LUCKNOW - 226011

No. EL/3.1.35/17 Dated: As signed

**Principal Chief Electrical Engineer,**

- Central Railway, HQs Office, 2nd floor, Parcel Office Bldg., Mumbai – 400 001.
- East Central Railway, Hajipur (Bihar) – 844 101.
- East Coast Railway, Railway Complex, Bhubaneswar – 751 023.
- Eastern Railway, Fairlie Place, Kolkata – 700 001.
- North Central Railway, Prayagraj – 211 001.
- North Eastern Railway, Gorakhpur –273 001.
- North Western Railway, near Jawahar Circle, Jaipur–302 017.
- Northeast Frontier Railways, Maligaon, Guwahati – 781 011
- Northern Railway, Baroda House, New Delhi – 110 001.
- Southern Railway, Park Town, Chennai – 600 003.
- South Central Railway, HQs Office, Rail Nilayam, Secunderabad – 500 071.
- South Eastern Railway, Garden Reach, Kolkata – 700 043.
- South East Central Railway, Bilaspur – 495 004.
- South Western Railway, Hubli – 580020.
- West Central Railway, HQs Office, Opp. Indira Market, Jabalpur – 482 001.
- Western Railway, Church gate, Mumbai – 400 020.
- Banaras Locomotive Works, Varanasi – 221 004.
- Chittaranjan Locomotive Works, Chittaranjan – 713 331 (WB).
- Patiala Locomotive Works, Patiala – 147 003.

**SPECIAL MAINTENANCE INSTRUCTION NO. RDSO/2024/EL/SMI/0332 (Rev. '0')**

## 1.0 Title:

Check Sheet for various activities, parts replacement and parameters to be tested during post inspection testing for IGBT based propulsion equipments in various schedules of 3-phase electric locomotives.

## 2.0 Brief History:

2.1 Indian Railways (IR) is presently manufacturing electric locomotives employing 3-phase propulsion system equipments comprising of IGBT based traction converter, auxiliary converter and vehicle control unit. These propulsion equipments are fitted in WAP5, WAP7,

WAG9 & WAG9H class of locomotives by production units such as BLW, CLW & PLW and further these locos are maintained by Zonal Railways at various loco sheds.

2.2 Railway Board vide letter No. 2006/Elect(TRS)/441/8 pt dtd. 05.12.2023 advised that the overhauling/maintenance activities as well as the material required to be changed periodically for various makes of propulsion equipment must be aligned with the inspection schedules of the locomotives. Checks sheets for various activities/spare replacement as well as parameters to be tested during post inspection testing are required to be framed and issued to all Zonal Railways.

## 3.0 Objective:

To establish uniformity in the check sheets governing activities, part replacement, and post-inspection tests for various makes of IGBT based propulsion equipment within both minor maintenance schedules and major overhauling schedules.

## 4.0 Minor Maintenance Schedule:

A comprehensive but not exhaustive checklist for IGBT-based Traction Converter, Auxiliary Converter and TCN-based VCU in the Minor Maintenance Schedule is outlined below. Electric Loco Sheds are required to inspect the specified points in accordance with the procedures outlined in the Repair and Maintenance Manual provided by the respective supplier of these equipments.

| SN | Equipment | IT | IA/IB | IC |
|---|---|---|---|---|
| **A.** | **IGBT BASED TRACTION CONVERTER** | | | |
| 1. | Check the coolant level indicator situated on the conservator (Expansion Tank). If the coolant is below the minimum mark, top-up with the specified coolant. Check for any signs of leakage. | √ | √ | √ |
| 2. | Visually examine coolant pipe joints for leaks, loose or missing screws and correct as necessary. | √ | √ | √ |
| 3. | Examine the two flange joints for leaks, loose or missing screws. Check gaskets/coolant seals, if dismantling is required. | √ | √ | √ |
| 4. | Visually examine Traction converter coolant pipe drain cock. | √ | √ | √ |
| 5. | Visually examine Traction converter flexible Hoses. | √ | √ | √ |
| 6. | Checking of Stucchi coupling for leakage or rusting. | X | √ | √ |
| 7. | Examine wiring and proper working of coolant pump. | √ | √ | √ |
| 8. | Examine all electrical equipment of traction converter for signs of dirt, corrosion, damage etc. Remove all dust/dirt deposits from the connection insulators. | X | √ | √ |
| 9. | Traction converter proper earthing to be ensured. | √ | √ | √ |
| 10. | Clean the isolating blade and spring contact of earthing switch. | X | X | √ |
| 11. | Check that there is no sign of abnormality from the capacitors. | X | X | √ |
| 12. | Cleaning by Vacuum cleaner. Cleaning/Wiping off the dust on all modules. | X | √ | √ |
| 13. | Check sealing of Door Cover. | X | X | √ |
| 14. | Ensure sealing of incoming cable gland of control card rack to avoid dust entry. | X | X | √ |

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| 15. | Check the ventilation/churning fans of traction converters. Check the ventilation fans of traction converter electronics for its satisfactory working. The fans shall be replaced if found defective. | √ | √ | √ |
| 16. | Download fault log data through laptop/Pen drive and check for any abnormal messages. Necessary corrective/preventive action to be taken for abnormal messages. Record of loco wise fault data should be kept. | √ | √ | √ |
| 17. | Inspect the cubicle with respect to mechanical and electrical integrity. Check all fixings for security and tightness and all wiring are secured and insulations are not damaged, burnt or eroded. Visually inspect all components for physical damage. | X | √ | √ |
| 18. | Examine doors and its lock and integration of locks with key multiplier system. | X | X | √ |
| 19. | As visually as possible, inspect the soft crow bar resistor for evidence of overheating, bending of resistor tapes, discoloration of the resistors or its case or burn marks. Replace any resistor that is damaged or defective. | √ | √ | √ |
| 20. | Inspect pre-charge and 100 Hz resistors for defects, change if needed. | X | √ | √ |
| 21. | Check functioning of high voltage indicator. Replace, if required. | X | √ | √ |
| 22. | Check the FOCs of Traction Converter, if available. | X | √ | √ |
| 23. | Check all earth cables of Traction Converter. | X | √ | √ |
| 24. | Visual checking of all power modules for any abnormalities. | √ | √ | √ |
| 25. | Ensure tightness of all Sub-D connectors mounted on traction converters. | √ | √ | √ |
| 26. | Visual inspection of functionality of Main Contactor and Pre-charging Contactors. | √ | √ | √ |
| 27. | Maintenance of all steel braided hoses, rubber hoses and isolating cocks to be done. | X | √ | √ |
| 28. | Visually inspect cooling modules/heat sink mounted in traction converter, change if any defect. | √ | √ | √ |
| 29. | Visually inspect control cards and power supply cards in electronic cubicle and ensure the tightness. | √ | √ | √ |
| 30. | Ensure the cable intactness in wagos. | √ | √ | √ |
| 31. | Inspect and ensure tightness of DC link voltage sensors. | √ | √ | √ |
| 32. | Checking of pressure sensor and temperature sensor of Air and Coolant. | X | X | √ |
| 33. | Check Working of Radial fans in Traction converters attend/change if defects noticed. | X | √ | √ |
| 34. | Working of 3-ph blower, if available. | √ | √ | √ |
| | | | | |
| **B.** | **IGBT BASED AUXILIARY CONVERTER CUBICLES** | **IT** | **IA/IB** | **IC** |
| 1. | Clean the dust and dirt thoroughly by vacuum cleaner. | X | X | √ |
| 2. | Check the working of ventilation fans of auxiliary converters. | X | √ | √ |
| 3. | Check the tightness of connections of control cards. | X | √ | √ |
| 4. | Download fault log data through laptop/Pen drive and check for any abnormal messages. Necessary corrective/preventive action to be taken for abnormal messages. Record of loco wise fault data should be kept. | √ | √ | √ |

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| 5. | Record the software versions (upload latest version). | X | √ | √ |
| 6. | Inspect the cubicle with respect to mechanical and electrical integrity. Check all fixings for security & tightness, all wirings are secured and insulations are not damaged, burnt or eroded. Visually inspect all components for physical damage. | X | √ | √ |
| 7. | Ensure that all door sealing gaskets are free from cut marks and physical damages. | X | √ | √ |
| 8. | Open the doors and do visual Inspection of all the mounting hardware for the mechanical and electrical components for any slackness by seeing changes in torque markings. | X | √ | √ |
| 9. | Cleaning of dust without opening the modules. | X | X | √ |
| 10. | Check the tightness of all Control & Power cables and all couplers. | √ | √ | √ |
| 11. | Check out the input and output cable connections. If any unacceptable tear outs are found, replace them. | X | √ | √ |
| 12. | Check and remove the dust deposit on terminal area & other parts. | X | X | √ |
| 13. | Cleaning of Dust from all electronics, Electrical equipment, Sensor and capacitors by using vacuum cleaner. | X | √ | √ |
| 14. | Check the VLU & discharge resistor for evidence of overheating. | X | X | √ |
| 15. | After removing the front service door, visual inspection of all Electronics, Electrical Section for excessive dust ingress, presence of foreign object, over heating mark or any other abnormality. | √ | √ | √ |
| 16. | Check the value of DC link capacitance, sine-filter capacitance, battery charger capacitance and snubber capacitance when related abnormal message logged in DDS. Ensure the parameters are within permissible range. Remove dust deposits on the terminal insulators of the capacitors by blowing. Clean properly by brushing with a metallic brush or by rubbing with a cloth. | X | X | √ |
| 17. | Check the working of all churning fans and change if found not working. | X | √ | √ |
| 18. | Check the FOC's of auxiliary converter, if available. | X | √ | √ |
| 19. | All electronics cards for corresponding Aux. Converter, be checked for physical integrity & working. Replace if found faulty. | X | √ | √ |
| 20. | Check and ensure high voltage indicator's functionality. | √ | √ | √ |
| 21. | Check and ensure all temperature sensor's functionality. | X | X | √ |
| 22. | Check all doors and locks of Auxiliary Converter & change if required. | X | X | √ |
| 23. | All EM contactors and its snubber circuit, re-grouping contactors, fuses and MOV to be checked. Replace, if found defective. | X | X | √ |
| 24. | Visually inspect the insulators in the auxiliary converters (BUR) 1, 2 & 3 for damage. | √ | √ | √ |
| 25. | Clean inside the auxiliary converter cabinets using a vacuum cleaner. Remove all traces of dust, dirt and debris from the components, cubicle walls and floor. | X | √ | √ |
| 26. | Tightness of cards. | √ | √ | √ |
| 27. | Check the tightness of all mounting fixation bolts on base and roof. | √ | √ | √ |
| 28. | Checking the earthing connections. | √ | √ | √ |
| 29. | Check all earth cables of Auxiliary Converter, all modules and electronic cubicles. | √ | √ | √ |

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| 30. | Checking the mounting and connection tightness of input cable and input fuse. | √ | √ | √ |
| 31. | Checking of tightness, dust accumulation & overall status of cables, Busbar, CTs, PTs, MOV Sensor and connector of different PCBs. | √ | √ | √ |
| 32. | All MVB connection and cables to be checked. | √ | √ | √ |
| 33. | Checking of fasteners and closing mechanism. Lock fasteners. Replace damaged parts. | √ | √ | √ |
| 34. | Check the security of bolted terminals and mechanical mounting of large components of Controlled Rectifier module, Aux. Inverter module and Battery Charger module. | X | √ | √ |
| 35. | Checking of Aux-Converter during control supply ON, all Electronics Card's LED Status & load sharing Contactor Sequence in 504 Node. | √ | √ | √ |
| 36. | Checking of Contactor sequence in Aux-Converter & HB panel and Redundancy. Check all Feedback and Redundancy of all BUR's. | √ | √ | √ |
| 37. | Visually inspect the insulators in the auxiliary converters (BUR) 1, 2 & 3 for damage. Replace any damaged insulator. | √ | √ | √ |
| 38. | Check the exit air velocity at 4 places in exit duct and average velocity should be more than as specified in SMI-255, Rev.1 or latest. | X | √ | √ |
| 39. | If observed air velocity is less than specified, then machine room air suction filter should be cleaned as per standard practice. | X | √ | √ |
| 40. | Checking of 3-Phase Line Choke of Batt. Charger (if provided) for tightness. | X | X | √ |
| 41. | Measurement of resistance of DC link discharge resistor using DMM if any abnormal DDS is logged. | X | X | √ |
| 42. | Check Input Voltage, Input Current, DC-Link Voltage, DC-link Current, Output Voltage, Output Current, Load current, Output Frequency. | √ | √ | √ |
| 43. | Checking of Battery Charger performance, measure battery Charger Output Voltage & Current. | √ | √ | √ |
| 44. | Checking of total load current. Also check load current of individual motor. | √ | √ | √ |
| 45. | Checking of DC Link discharging time after switching of VCB and confirming the functionality of DC link voltage indicator on service door. | √ | √ | √ |
| 46. | Check the tightness of components in modules, Inverter module, Rectifier module, PCB Cards, AC filter assembly, EFD assembly, Output voltage sensing assembly, Output current sensing assembly, DC link voltage sensing assembly. | X | √ | √ |
| 47. | Inspect Battery Charger MCB-100 and operation & necessary attention if required. | X | √ | √ |
| | | | | |
| **C.** | **TCN BASED VEHICLE CONTROL UNIT** | **IT** | **IA/IB** | **IC** |
| 1. | MVB Administrator card -Check the fault history data – upload. | X | √ | √ |
| 2. | Visually inspect the entire box, enclosure walls, covers & welds for any damage or cracks. | √ | √ | √ |
| 3. | Visually inspect all internal and external cable connections for damage. | √ | √ | √ |
| 4. | Ensure that all glands and connectors are in good condition. | X | √ | √ |
| 5. | Visually inspect the screws securing the VCU to the supporting. | √ | √ | √ |

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| 6. | Check the condition of hinges/brackets for the hinged assembly. | X | √ | √ |
| 7. | Check healthiness of churning fans fitted inside VCU. | X | √ | √ |
| 8. | Ensure the Power supply LED status of all modules which are there on front fascia of the module. | X | √ | √ |
| 9. | Sealing of Door Cover checking. | X | √ | √ |
| 10. | Checking of tightness & overall status of cables and connector of Cards. | X | √ | √ |
| 11. | Cleaning of Dust from all electronics, Electrical equipment, Sensor by using vacuum cleaner. | X | √ | √ |
| 12. | Visual inspection along with checking of tightness of all Sub-D, connectors and proper working of Driver Display Unit. | √ | √ | √ |
| 13. | All MVB connection and cables to be checked. | X | √ | √ |
| 14. | Communication Check: Check the health status of all sub-assemblies on display. | √ | √ | √ |
| 15. | Door lock- Inspection and replaced if defective. | X | √ | √ |
| 16. | Door gasket- Inspection and if damaged then replaced with new one. | X | √ | √ |
| 17. | Application Processor card – Check the software version. | X | X | √ |
| 18. | Earthing shunt tightness check. | X | √ | √ |
| 19. | Check and note down the inlet air velocity. | X | √ | √ |

## 5.0 Major Overhauling Schedule

A comprehensive but not exhaustive checklist for IGBT-based Traction Converter, Auxiliary Converter, and TCN-based VCU in the Major Overhauling Schedule is outlined below. Electric Loco Sheds are required to inspect the specified points in accordance with the procedures outlined in the Repair and Maintenance Manual provided by the respective supplier of these equipments.

| SN | Equipment | TOH | IOH | POH |
|---|---|---|---|---|
| **A.** | **IGBT BASED TRACTION CONVERTER** | | | |
| 1. | Remove the converter cubicles. Clean the dust and dirt thoroughly with vacuum cleaner. | X | √ | √ |
| 2. | Clean the heat sink/cold plate by vacuum cleaner. | X | √ | √ |
| 3. | Cleaning/wiping off the dust shall be carried out on all modules of Traction converter. | √ | √ | √ |
| 4. | Download fault log data through laptop/Pen drive and check for any abnormal messages. (Necessary corrective/preventive action to be taken for abnormal messages. Record of loco wise fault data shall be kept.) | √ | √ | √ |
| 5. | Conduct a voltage test and measure the insulation resistance. Isolate fault if not within specification. The circuit and applied voltage for IR test are given below:<br>(i) Power Circuit w.r.t. body @ 1000VDC : > 100 M Ohm<br>(ii) Control Circuit w.r.t. body @ 500VDC : > 100 M Ohm | X | √ | √ |
| 6. | Visual checking of all power modules for any abnormalities. | √ | √ | √ |

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| 7. | Visually inspect the MUB/Crow bar resistor for evidence of overheating, bending of resistor tapes, discoloration of the resistors or its case, or burn marks. Measure the impedance of the fault detection and MUB/Crow bar resistors. Replace the MUB/Crow bar resistor assembly if damaged or defective or not within specification. | √ | √ | √ |
| 8. | Inspect 100 Hz resistor and precharge resistors for defects, change if needed. | √ | √ | √ |
| 9. | Inspect the cubicle with respect to mechanical and electrical integrity. Check all fixings for security and tightness and all wiring are secured and insulations are not damaged, burnt or eroded. Visually inspect all components for physical damage. | √ | √ | √ |
| 10. | Ensure power module fixing bolts tightness with dc link bus-bar plate. | √ | √ | √ |
| 11. | Visually inspect the traction converter earthing resistors for signs of overheating. | √ | √ | √ |
| 12. | Check all earth cables of Traction Converter. | √ | √ | √ |
| 13. | Replace any resistor of the converter including earthing resistor that is damaged or defective. | √ | √ | √ |
| 14. | Clean the series resonant and DC link capacitors & Inspect for any signs of oil leakage, bulging etc. Measure the values. Replace if not within permissible range. | X | √ | √ |
| 15. | Check the secure electrical connections of the DC link and series resonant circuit capacitor bank. Tighten the fasteners if necessary. | X | √ | √ |
| 16. | Ensure tightness of all Sub-D connectors mounted on traction converters. | √ | √ | √ |
| 17. | Check the working of voltage indicator and current transducer. Replace, if required. | X | √ | √ |
| 18. | Visually inspect the pre-charging and main contactors. Replace the rubber parts. | √ | √ | √ |
| 19. | Visual inspection of functionality of Traction Converter Main Contactor and Pre-charging Contactors. | √ | √ | √ |
| 20. | Check and clean the isolation slack/blade and spring contacts of earthing switch and lubricate. Check its connections for tightness and intactness. | X | √ | √ |
| 21. | Clean and inspect coolant pump according to manufacturer information and check for any coolant leakage. | √ | √ | √ |
| 22. | Overhauling of the coolant pump including replacement of Bearings and gaskets; Run Test of Pump after assembly for leakage and Unusual Sounds. | X | √ | √ |
| 23. | Check the FOCs for Traction Converter with DB loss meter, if available. | √ | √ | √ |
| 24. | Gate drive unit fiber optics – visually inspect. | √ | √ | √ |
| 25. | Ensure sealing of incoming cable gland of control card rack to avoid dust entry. | √ | √ | √ |
| 26. | Ensure the cable intactness in wagos. Visually inspect cables of the converter. | √ | √ | √ |
| 27. | Visually inspect control cards and power supply cards in electronic cubicle and ensure the tightness | √ | √ | √ |

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| 28. | Check the coolant level indicator situated on the conservator (Expansion Tank). If the coolant is below the minimum mark-top up with the specified coolant. Check for any signs of leakage. | √ | √ | X |
| 29. | Replace the coolant (100% quantity including the quantity of coolant available in Radiator) in complete coolant circuit. | X | X | √ |
| 30. | Traction converter-Coolant testing of IGBT based traction converter as per RDSO SMI-325. | √ | √ | √ |
| 31. | Inspect traction converter water cooling pipe drain cock for any abnormality. | √ | √ | √ |
| 32. | Examine all pipe/flange joints for any leaks, looseness or missing screws. Correct if necessary. Check gaskets/coolant seals, if dismantling is required. | √ | √ | √ |
| 33. | Inspect cooling circuit of the traction converter. | √ | √ | √ |
| 34. | Checking of Stucchi coupling for leakage or rusting. | √ | √ | √ |
| 35. | Examine all electrical equipment of traction converter for signs of dirt, corrosion, damage etc. Remove all dust/dirt deposits from the connection insulators. Tightness of all connections to be checked. | √ | √ | √ |
| 36. | Replace the air-cooling hoses, seals on the traction converter doors (WAG9/WAG9H). | 2nd TOH | √ | √ |
| 37. | Replace the air cooling hoses, seals on the traction converter doors (WAP5/WAP7), if available. | X | √ | √ |
| 38. | Maintenance of all steel braided hoses, rubber hoses and isolating cocks to be done. | √ | √ | √ |
| 39. | Replace the air-cooling hoses, seals on the traction converter doors. | X | √ | √ |
| 40. | Clean the area by lightly blowing any dirt deposit. | X | X | √ |
| 41. | Check the capacitors for any abnormality and measure its capacitance. | √ | √ | √ |
| 42. | Visually inspect the traction converter earthing and discharge resistors for signs of overheating. | √ | √ | √ |
| 43. | Inspect and ensure tightness of DC link voltage sensors. | √ | √ | √ |
| 44. | Measurement of Insulation Resistance; L and R Value of coolant Pump. | √ | √ | √ |
| 45. | Replacement/overhauling of the internal churning fans. | X | √ | √ |
| 46. | Checking of pressure sensor and temperature sensor of Air and Coolant. | √ | √ | √ |
| 47. | Replacement of gasket/O-rings in coolant circuit. | X | √ | √ |
| 48. | Examine doors and its lock and integration of locks with key multiplier system. | √ | √ | √ |
| 49. | Check fasteners of converter and its cooling circuit. | √ | √ | √ |
| 50. | Inspection & tightness of foundation & supporting bolts | √ | √ | √ |
| 51. | Checking of Power cable for any damaged/ rubbing/ heating | √ | √ | √ |
| 52. | All MVB connection and cables to be checked. | √ | √ | √ |
| 53. | Check the ventilation fans of traction converter and its electronics for satisfactory working. The fans shall be replaced/overhauled if found defective. | √ | √ | √ |
| 54. | Visual inspection of bushing of transformer for any abnormality. | √ | √ | √ |
| 55. | Reload Traction converter application software on condition basis. | √ | √ | √ |

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| 56. | Visually inspect the OVR resistor for evidence of overheating; bending of resistor tapes, discoloration of the resistors or its case, or burn marks. Replace the OVR resistor assembly if damaged or defective or not within specified limit. | √ | √ | √ |
| | | | | |
| **B.** | **IGBT BASED AUXILIARY CONVERTER** | **TOH** | **IOH** | **POH** |
| 1. | Inspection of churning fan and change if found not working. | √ | √ | √ |
| 2. | Check the working of blower fans of auxiliary converters, if provided and attend/replace the same as per need. | √ | √ | √ |
| 3. | Download fault log data through laptop/Pen drive and check for any abnormal messages. (Necessary corrective/preventive action to be taken for abnormal messages. Record of loco wise fault data should be kept.). | √ | √ | √ |
| 4. | Inspect the cubicle with respect to mechanical and electrical integrity. Check all fixings for security and tightness and all wiring are secured and insulations are not damaged, burnt or eroded. Visually inspect all components for physical damage. | √ | √ | √ |
| 5. | All electronics cards for corresponding Aux. Converter, be checked for physical integrity & working. Replace if found faulty. | √ | √ | √ |
| 6. | Checking of tightness, dust accumulation & overall status of cables, Busbar, CTs, PTs, MOV, Sensor and connector of different PCBs. | √ | √ | √ |
| 7. | Check the security of bolted terminals and mechanical mounting of large modules/components of Aux. rectifier (Rectifier module) and Aux. inverter module. | √ | √ | √ |
| 8. | Check the auxiliary converter base mounting tightness. | √ | √ | √ |
| 9. | Check the condition of gasket of DC link capacitor bank, if used. Replace if damaged. | X | √ | √ |
| 10. | Replace contact tips of EMC, if required. | X | X | √ |
| 11. | Check the condition of gaskets of Rectifier, Inverter and battery charger module. Replace if damaged. | X | √ | √ |
| 12. | Check the value of DC link capacitance bank, sine-filter capacitance values, battery charger capacitance and snubber capacitance & record it and ensure within permissible range. Remove dust deposits on the terminal insulators of the capacitors by blowing brushing with a metallic brush or by rubbing with a cloth. | √ | √ | √ |
| 13. | Check the tightness & proper fitment of 3 phase couplers of Aux. Converter. | √ | √ | √ |
| 14. | Clean inside the auxiliary converter cabinets using a vacuum cleaner. Remove all traces of dust, dirt and debris from the components, cubicle walls and floor. | √ | √ | √ |
| 15. | Replace the gasket on door and cable entry point/hole, if required. | √ | √ | √ |
| 16. | Overhaul the contactors in the auxiliary converters 1, 2 & 3 and replace the contact tips. | X | √ | √ |
| 17. | Clean the reactors and transformers in the auxiliary converter cabinets using compressed air. Remove all traces of dirt, dust and debris. | X | √ | √ |
| 18. | Clean all dirt and dust deposit from the terminal side of the phase reference transformer and Auxiliary surge arrester insulator. Cleaning is by means of blowing out bushing off with a cloth. | √ | √ | √ |

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| 19. | Cleaning of heat sink, duct and overall Aux converter by Blower/Vacuum cleaner. | √ | √ | √ |
| 20. | Visually inspect the insulators in the auxiliary converters (BUR) 1, 2 & 3 for damage. Replace any damaged insulator. | √ | √ | √ |
| 21. | Replace the seals on the auxiliary converter cabinets and equipment modules. | √ | √ | √ |
| 22. | All EP contactors, re-grouping contactors, fuses and MOV to be checked and replace, if found defective. | √ | √ | √ |
| 23. | Check the VLU & discharge resistor for evidence of overheating. | √ | √ | √ |
| 24. | Check the FOCs of Auxiliary Converter with DB loss meter, if available. | √ | √ | √ |
| 25. | Check and ensure voltage indicator's functionality. | √ | √ | √ |
| 26. | Check and ensure all temp. sensor's functionality. | √ | √ | √ |
| 27. | Check the auxiliary converter doors/covers are proper & door lock operation. | √ | √ | √ |
| 28. | Visually inspect the insulators in the auxiliary converters (BUR) 1, 2 & 3 for damage. | √ | √ | √ |
| 29. | Vacuum cleaning of BUR from inside & back side. | √ | √ | √ |
| 30. | Tightness of cards. | √ | √ | √ |
| 31. | Check the tightness of components in modules i.e. Inverter module, Rectifier module, PCB bus station, AC filter assembly, EFD assembly, Output voltage sensing assembly, Output current sensing assembly, DC link voltage sensing assembly. | √ | √ | √ |
| 32. | Visual inspection of Chokes and Capacitors after removing backside cover of Converter. | X | √ | √ |
| 33. | Checking the mounting and connection tightness of chokes & capacitors. | X | √ | √ |
| 34. | Clean the sine filter chokes and battery charger transformers in the auxiliary converter cabinets by blowing with dry air. Remove all traces of dirt, dust and debris. Visually check for any abnormalities and Ensure tightness of same. | X | √ | √ |
| 35. | Checking the earthing connections. | √ | √ | √ |
| 36. | Check all earth cables of Auxiliary Converter, all Modules and electronic cubicles. | √ | √ | √ |
| 37. | Check the tightness of all Control & Power cable connections and all couplers. | √ | √ | √ |
| 38. | All MVB connection and cables to be checked. | √ | √ | √ |
| 39. | Checking of fasteners and closing mechanism. Lock fasteners. Replace damaged parts. | √ | √ | √ |
| 40. | Checking of 3-Phase Line Choke of Batt. Charger for tightness and IR test by 500V Megger. | X | √ | √ |
| 41. | Measurement of resistance of DC link discharge resistor using DMM. | √ | √ | √ |
| 42. | Checking of Aux-Converter during control supply ON, all Electronics Card's LED Status & load sharing Contactor Sequence in 504 Node. | √ | √ | √ |
| 43. | Checking of Contactor sequence in Aux-Converter & HB panel and Redundancy. Check all Feedback and Redundancy of all BUR's. | √ | √ | √ |
| 44. | Checked Input Voltage, Input Current, DC-Link Voltage, DC-link Current, Output Voltage, Output Current, Load current, Output Frequency. | √ | √ | √ |

| | | | | |
|---|---|---|---|---|
| 45. | Checking of Battery Charger performance, measure battery Charger Output Voltage & Current. | √ | √ | √ |
| 46. | Checking of load current of individual motor. Also check the total current of aux. converter. | √ | √ | √ |
| 47. | Checking of DC Link discharging time after switching of VCB and confirming the functionality of DC link voltage indicator. | √ | √ | √ |
| 48. | Visually inspect the sine wave filter for any physical damage and measure the capacitance. Replace any damaged /faulty capacitor. | √ | √ | √ |
| 49. | Visually check the power connections of Input Cables input fuse and chokes. | √ | √ | √ |
| 50. | Record the software versions (upload latest version). | √ | √ | √ |
| 51. | Inspect Battery Charger MCB-100 and operation & Necessary attention if required. | √ | √ | √ |
| 52. | Checking of snubber ckt. of EM contactors & replace it if found faulty. | √ | √ | √ |
| 53. | Visually check each electronic cards for any defects such as loose components, IC tightness on IC socket, leakage/deform of capacitors, dust accumulation.<br>*Note: Handling of electronic card should be done with ESD protection.* | √ | √ | √ |
| 54. | Ensure that all door sealing gaskets are free from cut marks and physical damages. | √ | √ | √ |
| 55. | Open the doors and do visual Inspection of all the mounting hardware for the mechanical and electrical components for any slackness by seeing changes in torque markings. | √ | √ | √ |
| 56. | Ensure all cable ties are tight and intact of OFC cables are in good condition. | √ | √ | √ |
| 57. | While doing maintenance if any abnormality/damage of components and cable are found it should be addressed. | √ | √ | √ |
| 58. | Check out the input and output cable connections. If any unacceptable tear outs are found, replace them. | √ | √ | √ |
| 59. | Check the exit air velocity at four places in exit duct and average velocity should be more than as specified in SMI-255, Rev.1 or latest. | √ | √ | √ |
| 60. | If observed air velocity is less than specified, need to clean the machine room air suction filter by shed. | √ | √ | √ |
| 61. | Remove dust and dirt from insulating and heat convection surface. | √ | √ | √ |
| | | | | |
| **C.** | **TCN BASED VEHICLE CONTROL UNIT**<br>*Note: Handling of electronic card should be done with ESD protection.* | **TOH** | **IOH** | **POH** |
| 1. | Visually check physical damage and insulation defects | √ | √ | √ |
| 2. | Check for loose fixing of any connection | √ | √ | √ |
| 3. | Check the tightness of all PCB cards and couplers/connections. | √ | √ | √ |
| 4. | Replace the back-up batteries in the vehicle control unit bus station diagnostic and communication computers. | X | √ | √ |
| 5. | Replace the seals in the UIC socket. | X | X | √ |
| 6. | Reload the software to the vehicle control unit bus station computer. | X | X | √ |

| | | | | |
|---|---|---|---|---|
| 7. | Examine the UIC Socket at both ends of the locomotive to make sure the covers operate freely. Inspect electrical contacts and if necessary, blow clean with an airline. | √ | √ | √ |
| 8. | Replacement of the instrument cooling fan. | X | √ | √ |
| 9. | Ensure working of instrument cooling fan. | √ | √ | √ |
| 10. | Check setting of temperature sensor in VCU. | X | √ | √ |
| 11. | Visually check all the cards for any capacitor leakage. Blow the cards and remove any dirt. | √ | √ | √ |
| 12. | Measure dB loss of fibre-optic cable of SR. Clean, if required. | X | √ | √ |
| 13. | Clean Heat Exchangers at the back of the electronic rack. | X | X | √ |
| 14. | Handling and cleaning of PCB as per RDSO guideline (ELRS/TC/0091 dated 13.02.06). | √ | √ | √ |
| 15. | MVB Administrator card -Check the fault history data – upload. | √ | √ | √ |
| 16. | Door locks – Inspection and replaced if defective. | √ | √ | √ |
| 17. | Inspection of door and cable entry point/hole and if damaged then replaced with new one. | √ | √ | √ |
| 18. | Application Processor card – Check the software version from VCU tool. | √ | √ | √ |
| 19. | Sub-D coupler tightness check of each card. | √ | √ | √ |
| 20. | Earthing shunt tightness check. | √ | √ | √ |
| 21. | Visually inspect the entire box, enclosure walls, covers & welds for any damage or cracks. | √ | √ | √ |
| 22. | Visually inspect all internal and external cable connections of the SD for damage. | √ | √ | √ |
| 23. | Ensure that all glands and connectors are in good condition. | √ | √ | √ |
| 24. | Visually inspect the screws securing the VCU to the supporting. | √ | √ | √ |
| 25. | Check the condition of hinges/brackets for the hinged assembly. | √ | √ | √ |
| 26. | Functional Checking of VCU during control supply ON, all Electronics Card's LED Status. | √ | √ | √ |
| 27. | Checking the earthings connections of VCU & DDU. | √ | √ | √ |
| 28. | Cleaning of dust from all electronics, Electrical equipment, Sensor by using vacuum cleaner. | √ | √ | √ |
| 29. | Visual inspection along with checking of tightness of all sub-D, connectors and proper working of Driver Display Unit. | √ | √ | √ |
| 30. | Cleaning of heat sink, duct and overall VCU by Blower/Vacuum cleaner. | √ | √ | √ |
| 31. | Replacement of Gasket: The replacement of gasket on door and cable entry point/hole is being checked in every schedule and replacement on conditional basis. | √ | √ | √ |
| 32. | All MVB connection and cables to be checked. | √ | √ | √ |
| 33. | Check the tightness of Fiber Optic cables. | √ | √ | √ |
| 34. | Ensure the Power supply LED status of all modules which are there on front fascia of the module. | √ | √ | √ |
| 35. | Communication Check: Check the health status of all sub-assemblies. | √ | √ | √ |
| 36. | Check and note down the inlet air velocity. | √ | √ | √ |

## 6.0 Must Change Items

Details of Must Change Items are detailed as below:

| SN | Equipment | TOH | IOH | POH |
|---|---|---|---|---|
| **A.** | **TRACTION CONVERTER** | | | |
| 1. | The air cooling hoses, seals on the traction converter doors (WAP5/WAP7/WAG9/9H). | X | √ | √ |
| 2. | Silica gel in breather assembly. | √ | √ | √ |
| 3. | Converter coolant (WAP5/WAP7) | X | X | √ |
| 4. | Converter coolant (WAG9/9H) | X | IOH2/ IOH4 | √ |
| 5. | Contact tips of Electro-magnetic contactors (WAP5/WAP7) | X | X | √ |
| 6. | Contact tips of Electro-magnetic contactors (WAG9/9H) | X | IOH2/ IOH4 | √ |
| 7. | Traction converter coolant flexible pipe line (WAP5/WAP7) | X | X | √ |
| 8. | Traction converter coolant flexible pipe line (WAG9/9H) | X | IOH2/ IOH4 | √ |
| 9. | Stucchi Coupling rubber parts (WAP5/WAP7) | X | X | √ |
| 10. | Stucchi Coupling rubber parts (WAG9/9H) | X | IOH2/ IOH4 | √ |
| 11. | DC link capacitor & resonance circuit capacitor (WAP5/WAP7)<br>**Remarks:**<br>Dry type to be replaced in POH on condition basis as per maintenance manual. | X | X | √ |
| 12. | DC link capacitor & resonance circuit capacitor (WAG9/9H)<br>**Remarks:**<br>Dry type to be replaced in IOH2/IOH4 on condition basis as per maintenance manual. | X | X | √ |
| 13. | Traction converter gauge glass rubber parts(WAP5/WAP7) | X | X | √ |
| 14. | Traction converter gauge glass rubber parts(WAG9/9H) | X | IOH | X |
| 15. | Internal Cooling fan complete (WAP5/WAP7) | X | X | √ |
| 16. | Internal Cooling fan complete (WAG9/9H) | X | IOH2/ IOH4 | X |
| 17. | SR Pressure Sensor & Temperature Sensor (WAP5/WAP7) | X | X | √ |
| 18. | SR Pressure Sensor & Temperature Sensor (WAG9/9H) | X | IOH2/ IOH4 | X |
| **B.** | **AUXILIARY CONVERTER** | | | |
| 1. | Gasket of DC link capacitor bank. | X | √ | √ |
| 2. | Gasket of rectifier, inverter and battery charger modules, if provided. | X | X | √ |
| 3. | Internal cooling fan. | X | √ | √ |
| 4. | Seals on the Aux. Converter cabinets & equipment modules. | X | √ | √ |
| 5. | Contact tips of Electro-Magnetic Contactor. | X | X | √ |
| 6. | Contact tips of contactors in the BUR 1, 2 & 3. | X | √ | √ |
| 7. | Set of rotary switch, if provided. | X | X | √ |

| | | | | |
|---|---|---|---|---|
| 8. | All DC link bank capacitors<br>**Remarks:**<br>To be replaced in POH on condition basis as per Maintenance manual. | X | X | √ |
| **C.** | **VCU bus station** | | | |
| 1. | Internal cooling fan. | X | √ | √ |
| 2. | Back up batteries in VCU bus station diagnostic & communication computers. | X | √ | √ |
| 3. | The seals in the UIC socket. | X | X | √ |
| 4. | All Fibre-optic cable of Power Converter, including spares. | X | X | √ |

## 7.0 Post-inspection Parameters Check:

After completing the aforementioned maintenance activities as per schedule, the following minimum parameters may be verified using monitoring software on a laptop. Recorded parameters must adhere to the specified acceptance criteria limits with the specific manufacturer for whom these parameters are intended to be recorded. In cases where acceptance criteria are not defined, such parameters should be noted solely for record-keeping purposes. It is imperative to ensure that doors of propulsion equipment are securely closed during the parameter check, and the prescribed safety procedures must be strictly followed.

| SN | Parameters to be tested | Acceptance Criteria* | Remarks |
|---|---|---|---|
| **IGBT based traction converter** | | | |
| 1. | Input Voltage | 890V – 1500V | Corresponding to OHE between 17-30KV |
| 2. | Input Current | < 25 Amp | No load current |
| 3. | Input Frequency | 50 Hz ± 8% | --- |
| 4. | DC-Link Voltage | 2800V | Nominal DC link voltage |
| 5. | DC-link Current | --- | --- |
| 6. | Output Voltage | --- | Output in VVVF |
| 7. | Output Current | --- | |
| 8. | DC Link discharging Time | <600 seconds | DC link discharge initiates when there is no input available. |
| **IGBT based auxiliary converter** | | | |
| 1. | Input Voltage | 700V – 1200V | Corresponding to OHE between 17-30KV |
| 2. | Input Current | < 85 Amp (BUR-1)<br>< 105 Amp (BUR-2)<br>< 66 Amp (BUR-3) | Input current at 19KV OHE as per load distribution on Aux. Con. |
| 3. | Input Frequency | 50 Hz ± 8% | --- |
| 4. | DC-Link Voltage | --- | Different in various makes |
| 5. | DC-link Current | --- | --- |
| 6. | Output Voltage | 415V ± 5% | --- |

| | | | |
|---|---|---|---|
| 7. | Output Current | < 105 Amp (BUR-1)<br>< 131 Amp (BUR-2)<br>< 84 Amp (BUR-3) | Output current as per normal load distribution considering o/p pf = 0.8. |
| 8. | Output Frequency | 50 ± 3% | --- |
| 9. | Battery Charger Output Voltage | 110V ± 5% | --- |
| 10. | Battery Charger Output Current | ---- | Depend upon load. |
| 11. | DC Link discharging Time | <300 seconds | DC link discharge initiates when there is no input available. |

***** *The acceptance criteria given in above table are solely for reference, and it is recommended to verify them with the specific manufacturer for whom these parameters are intended to be recorded.*

**8.0 Application to the Class of Locomotives:**

Propulsion Equipments comprising of IGBT based Traction Converter, Auxiliary Converter and TCN based VCU fitted in WAP5, WAP7, WAG9 & WAG9H class of locomotives.

**9.0 Agency of Implementation:**

All Electric Loco Sheds/Workshops Holding 3-Phase Electric Locomotives.

**10.0 Periodicity of Implementation:**

Minor Schedule Inspections (IA/IB/IC), TOH, IOH, POH Overhauling Schedules and any other unscheduled maintenance.

-sd-
for Director General (Elect.)

Encl: Nil

**Copy to:**

Secretary (Electrical),
Railway Board, Rail Bhawan,
New Delhi – 110 001

Digitally Signed by Amit Kumar Saraf
Date: 08-04-2024 12:21:24
Reason: Approved
for Director General (Elect.)

Encl: Nil