INDEX FOR SPECIAL MAINTENANCE INSTRUCTIONS

Sl. No.	SMI No.	Date issued	Subject
1	TI/MI/0001	23.10.1982	Failure of 25 kV pedestal insulator and to use only solid core support insulator.
2	TI/MI/0007	04.06.1984	Use of disk insulator in place of 9-T solid core insulators of 25 kV ac OHE.
3	TI/MI/0008/Rev 0	14.09.1984	Failure of 9-t insulator due to non provision of double eye distance rod at BWA location.
4	TI/MI/0011/Rev 1	25.05.2001	SMI for 25kV solid core insulators before installation
5	TI/MI/0018/Rev 3	01.04.2006	Winch type regulating equipment.
6	TI/MI/0026/Rev 2	10.07.2003	Periodical maintenance instruction & trouble shooting guidelines for capacitor bank.
7	TI/MI/0027/Rev0	03.03.1998	Development of 107 mm2 silver bearing copper contact wire (silver contents 0.1%)
8	TI/MI/0028/Rev2	28.09.2001	Overhead equipments (OHE) on turn out/cross over to avoid panto entanglements.
9	TI/MI/0029/Rev3	01.04.2006	3:1 Ratio, 3 Pulley type regulating equipment.
10	TI MI 0032 Rev 2	19.02.2020	SMI for provision of buried rail at SWS with conventional earthing
11	TI/MI/0034/Rev 0	01.06.1999	Contact wire in out of run OHE.
12	TI/MI/0035/Rev1	28.09.2001	Provision of pipe on HEX Tie Rod of auto Tensioning Device (ATD).
13	TI/MI/0036	08.09.1999	Provision of insulated cadmium Copper catenary wire under over line structure on 25kV ac traction system.
14	TI/MI/0037/Rev 1	01.08.2000	Maintenance instruction for OHE contact wire and associated fittings.
	TI/MI/0037/Rev 2	21.10.2022	Maintenance instruction for OHE contact wire and associated fittings.
	TI/MI/0037/Rev 3	30.05.2025	Maintenance instruction for OHE contact wire and associated fittings.
15	TI/MI/0038/Rev 1	01.08.2004	Inspection test schedule for traction power transformer.
	TI/MI/0038/Rev 2	05.05.2006	Transformer - inspection and test schedule
16	TI/MI/0039/Rev 1	01.10.2003	Schedule of periodic overhauling of traction transformer.
	TI/MI/0039/Rev 2	22.09.2017	MI for Overhauling of traction transformer
17	TI/MI/0040/Rev 0	05.04.2005	measuring the severity of pollution by brush wash method.
18	TI/MI/0041/Rev 1	08.04.2010	Maintenance instructions for lightning arresters.
19	TI/MI/0042	12.12.2008	Testing of 25 KV porcelain & composite insulators before installation.
20	TI/MI/0043/Rev 2	01.08.2008	Instruction for 8-wheeler tower wagons covering instructions for DETC & DHTC.
21	TI/MI/0044 (Rev 0)	28.01.2009	Application of technology in the field of loading/unloading mechanism in electrified siding
	TI/MI/0044 Rev 1	18.09.2017	Guidelines for overhead hopper/chute/crane loading/unloading of rakes in electrified sidings.
22	TI/MI/0045	01.11.2009	Maintenance instructions for Gas Auto tensioning device.
23	TI/MI/0047	26.09.2012	Special maintenance instructions for precautions while splicing insulated Cadmium-Cupper catenary wire.
24	TI/MI/0048	13.08.2012	Special maintenance instructions for provision of dis connector assembly to the lightning arresters provided over 25 KV side traction system on Indian Railways.
	TI MI 0048 Rev 2	22.03.2023	LA disconnector jumper connection
25	TI/MI/0049	17.05.2017	Tolerances and Limits in 25KV AC OHE installation with 65/107 sqmm Catenary and Contact with tension
26	TI/MI/0050	06.09.2017	Prevention from Bird Menance on Traction Installation (OHE and PSI)
27	TI/MI/0051	11.12.2017	Installation of Ending clamps
28	TI/MI/0052	27.06.2017	Special Maintenance Instructions for 4 Wheeler Tower Wagon
29	TI/MI/0053	05.10.2017	Pre and Post Monsoon precautions for Traction Installations
30	TI/MI/0054	13.09.2017	Maintenance Instructions for 25KV Vacuum Circuit Breaker and Interrupter
	TI/MI/0054 Rev-1	23.07.2025	Maintenance Instructions for 25KV Vacuum Circuit Breaker and Interrupter
31	TI/MI/0055	26.10.2017	Mintenance Instructions for Identification of defects on Traction Installation Equipments using Thermo Vision
32	TI MI 0056	13.03.2018	Prevention of Monkey Menace
	TI/MI/0056 Rev 2	18.11.2020	Prevention of Monkey Menace
33	TI/MI/0057	2021	SMI for finding joint location & flaw in the joint of jointed grooved Copper Contact wire
34	TI/MI/0058	25.02.2019	To Prevent Contact wire parting at RRA
	TI MI 0058 Rev.1	10.08.2021	To prevent Contact wire parting at RRA clamp
35	TI/MI/0059	20.01.2020	Prevention of bird faults & melting of catenary wire under suspension clamp
	TI/MI/0059 Rev 1	04.01.2024	Provision of Anti-bird disc & packing saddle with catenary suspension clamp
	TI/MI/0059 Rev 2	05.11.2024	Material of Anti Bird disc has been revised from Acrylic to Polycorbonate
	TI/MI/0059 Rev 3	05.11.2024	Anti bird disc & packing saddle with catenary suspension clamp - 21.03.25
36	TI/MI/0060	01.12.2022	Maintenance manual for TRD equip for - 160 kmph train operation
37	TI/MI/0061	17.04.2025	Insulating Paint sapcifications
38	TI/MI/0062	24.04.2025	Standard arrangement of false catenary under Overhead strictures

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Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No. TI/MI/0001 Rev.0

No. TI/OHE/SE/M/8 **Dt. 23/10/1982**

The Chief Electrical Engineer
South Eastern Railway,
Garden Reach,
Calcutta- 700 043.

Sub: Failure of 25 kV pedestal insulator at Loc. 314/31 on 24/07/1982.
Ref: Your letter No. CEE/D/101/ ADA, dated 18/09/1982.

****

From the details of failures of the insulators sent vide your letter mentioned above, it would appear that no investigations have been carried out by South Eastern Railway themselves. You are requested to investigate the failures in detail and advise results to RDSO.

From the photographs and the sketch sent with your letter it appears that this insulator had developed a crack in the first or second shed due to torsion which may have been applied on the insulator by misalignment of the isolator. The crack in the porcelain shed would have reduced the distance of puncture path between the two metallic ends. The insulator may have punctured during the stormy weather on 24/07/1982 possibly due to a lightening surge.

It may be recalled that 4 failures of these type of insulators had been reported to RDSO vide letter No. CKP. T.D.107, dated 26/12/79. Were these failures also of same type or of different type?

The tension strength of these insulators is only 100 kgm and there is a possibility of development of crack if the contacts of the isolators are not aligned. South Eastern Railway may please conduct a cyclic check of all the isolators provided with this type of insulator to examine if there are any cracks. Besides, these insulators should be kept clean to preclude any possibility of flash over/puncture.

It is also advised that in future only solid core support insulators should be used with 25 kV, 66 kV and 132 kV isolators and bus bars.

Sd. (K.K Agarwal)
for Director General /TI.

Da: Nil

Copy to the Chief Electrical Engineer:

1. Central Railway, Bombay V.T.-400 001.
2. Eastern Railway, faillie Place, Calcutta- 700 001.
3. Northern Railway, Baroda House, New Delhi- 110 001.
4. Southern Railway, Park Town, Madras – 600 003.
5. South Central Railway, Secunderabad-500 371.
6. South Eastern Railway, garden Reach, Calcutta – 700 043.
7. Western Railway, Churchgate, Bombay –400 020.

Sd. (K.K Agarwal)
for Director General /TI.

DA: Nil

Copy to the Secretary (Electrical), railway Board, Rail Bhavan , New Delhi. In the initial stages of electrification, cap and pin type pedestal insulators to RI No. 6050 (BICC Drawing No. K 70755-99) were used. The torsion strength of theses insulators is less and these insulators may develop cracks if isolator contacts are not aligned which in turn may cause flashover/puncture of the insulator. Railways having these insulators may please conduct an immediate cyclic check to examine if there are any cracks.

Sd. (K.K Agarwal)
for Director General /TI.

DA: Nil

Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No. TI/MI/0007 Rev.0

No. TI/OHE/GA Dt. 04/06/1984

The Asstt General Manager,
Central Organisation for
Railway Electrification,
Jaika Bhavan, 3rd Floor,
Commercial Road, Civil Lines,
Nagpur – 440 001.

Sub: Use of disc insulator in place of 9- tonne solid core insulators of 25 kV ac OHE.

Ref: RDSO's letter of even No. dated 04/09/78.

****

Vide RDSO' s letter of even no. dated 04/09/78, RE Projects were authorised to use disc insulators to the extent they were short of supply of 9-tonne insulators at the following locations:-

i) 25 kV feeder anchor locations.
ii) Anti-creep anchor locations.
iii) 25 kV feeder suspension locations.
iv) Return conductor anchor locations.
v) Auxiliary transformer jumper suspension locations.
vi) 25 kV cross-feeders at substations and switching stations.

In view of the better availability of 9- tonne insulators and the fact that the quality control on the manufacture of disc insulators is not adequate and that the disc insulators do puncture occasionally as reported by Eastern Railway, it is considered that only solid core 9-tonne insulators should be used in 25 kV ac OHE for above applications. This supersedes RDSO's letter of even No. dated 04/09/78.

Please acknowledge receipt.

Sd. (K.K Agarwal)
for Director General /TI.

DA: Nil

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Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No. TI/MI/0008 Rev.0

No. ETI/OHE/SE/M/8 Dt. 14/09/1984

General Manger (Electrical),
Central Railway
Bombay V.T. 400 001.

Sub: Failure of 9 tonne insulators.
****

The Chief Inspector (OHE) was deputed to BSL form 17/07/84 to 18/07/84 to investigate into the cause of failures of 9-tonne insulators in BSL Division. He has reported that the balance weight anchor locations have not been provided with the double eye distance rod (RT-5183) in BSL Division. It is a serious matter. At higher temperatures, without the double eye distance rods 9- tonne insulators will foul with the tie rods of anti falling devices provided with the auto tension devices. This would be detrimental to the performance of the insulators . This was also brought to the personal notice of Sr. DEE(TRD)BSL, by DD(OHE) Shri Aroroa during the 7th MSG (TRD) meeting held recently at Bombay.

It is requested that urgent action may please be taken to provide the double eye distance rods at the balance weight anchor locations.

Kindly acknowledge receipt.

(K.K. Agarwal)
for Director General/TI

Encl: Nil

1. Copy to the Chief Electrical Engineer:

(1) Central Railway, Bombay V.T.-400 001.
(2) Eastern Railway, faillie Place, Calcutta- 700 001.
(3) Northern Railway, Baroda House, New Delhi- 110 001.
(4) Southern Railway, Park Town, Madras – 600 003.
(5) South Central Railway, Rail Nilayam, Secunderabad-1.
(6) South Eastern Railway, garden Reach, Calcutta – 700 043.
(7) Western Railway, Churchgate, Bombay –400 020.

2. Chief Project Managers, Railway Electrification.

1 Western Railway, Kota – 324 002.
2 Central Railway, Mathura- 281 002.
3 Post Box No. 77, DRM's office building (C. Rly.),
2nd Floor, Kings Way Road, Nagpur – 440 001.
4 South Eastern Railway, Ranchi, (BIHAR)- 834 001.
5 Western Railway, Pratap Nagar, Vadodara – 390 004.
6 South Central Railway, Vijayawada (AP)- 520 001.

3 **The Chief Electrical Engineer**, Railway Electrification,
Southern Railway, Poonamalle High Road, Egnore,
Madras – 600 008.

4 **The Chief Electrical Engineer**, Railways Electrification,
South Central Railway, Vijayawada (AP)- 520 001.

5 **Secretary** (Electrical), Railway Board, Rail Bhawan, New Delhi.

C/- ETI/OHE/INS/1 FILE.

(K.K. Agarwal)
for Director General/TI

Encl: Nil

SPECIAL MAINTENANCE INSTRUCTIONS (SMI) FOR 25 kV SOLID CORE INSULATORS BEFORE INSTALLATION

1. OBJECTIVE : To specify testing procedure of 25kV solid core porcelain insulators at site / depot before installation and furnish the test values for different types of insulators supplied against different specifications.

2. BACKGROUND : To weed out the insulators which develop defect during transit/handling, it was advised vide SMI No.TI/MI/0011 'Rev 0' to test each insulator for routine tensile load test at site/depot before installation. The routine load to be applied was also advised. Vide SMI No.TI/MI/0024 Rev.`0', a gadget for routine test was circulated.

2.1 Addendum & Corrigendum Slip No. 1 to RDSO's Specification No.ETI/OHE/15(9/91) was issued in May 1999 and Slip Nos 2 & 3 were issued in Feb/March 2000. In A & C Slip No. 1, the minimum specified failing load in tension as well as minimum specified failing bending moment have been increased for stay arm and bracket insulators. In A & C Slip No.2 additional routine tests and in A & C Slip No.3, regular inspection by RDSO were specified. Supply of the insulators as per A & C Slip No. 1 to 3 has started and so the revision of SMI is imperative.

3.0 **TEST JIG AND DEAD LOADS TO BE APPLIED :**

3.1 For conducting the routine tensile load test either Universal Testing Machine of adequate capacity may be used or the simple arrangement shown in the enclosed sketch No.ETI/OHE/SK/611 (in 2 sheets) may be used.

3.2 Considering weight of double rail as 120 kg/m the dead load `Y' kg to be provided for conducting routine tensile load test for one minute according to the type of insulator and specification to which the insulator is supplied, shall be as follows :

SPECIFICATION No. ETI/OHE/15(9/91)

Type of Insulator	Routine load @ 60% of specified value	Dead Load `Y' to be provided.
Stay arm and Bracket insulators	3240 Kgf	108 kg.
9-tonne insulator	5940 Kgf	523 Kg.

SPECIFICATION No. ETI/OHE/15(9/91) with A & C Slip No. 1,2, 3

Type of Insulator	Routine load @ 70% of specified value	Dead Load `Y' to be provided.
Stay arm and Bracket insulators	4900 Kgf	363 kg.
9-tonne insulator	6930 Kgf	675 Kg.

3.3 The dead load `Y' to be provided has been calculated taking into account the dead weight of the double rail only as 120 kg/m and it is for guidance only. While fabricating the jig, additional fixtures, holding clamps / brackets, rails other than 60kg rail etc. may be used by the Railways / Projects for better fabrication/operation of the jig. These additional fixtures and rails other than 60kg rail shall change the dead weight of the jig and vary the values of dead weight `Y' to be provided. It is, therefore, imperative that the jig should be calibrated suitably using a good dynamometer to determine the exact dead weight `Y' to be provided so as to apply the specified routine load on the insulators according to the type and specification to which they are supplied.

4.0 **PROCEDURE**

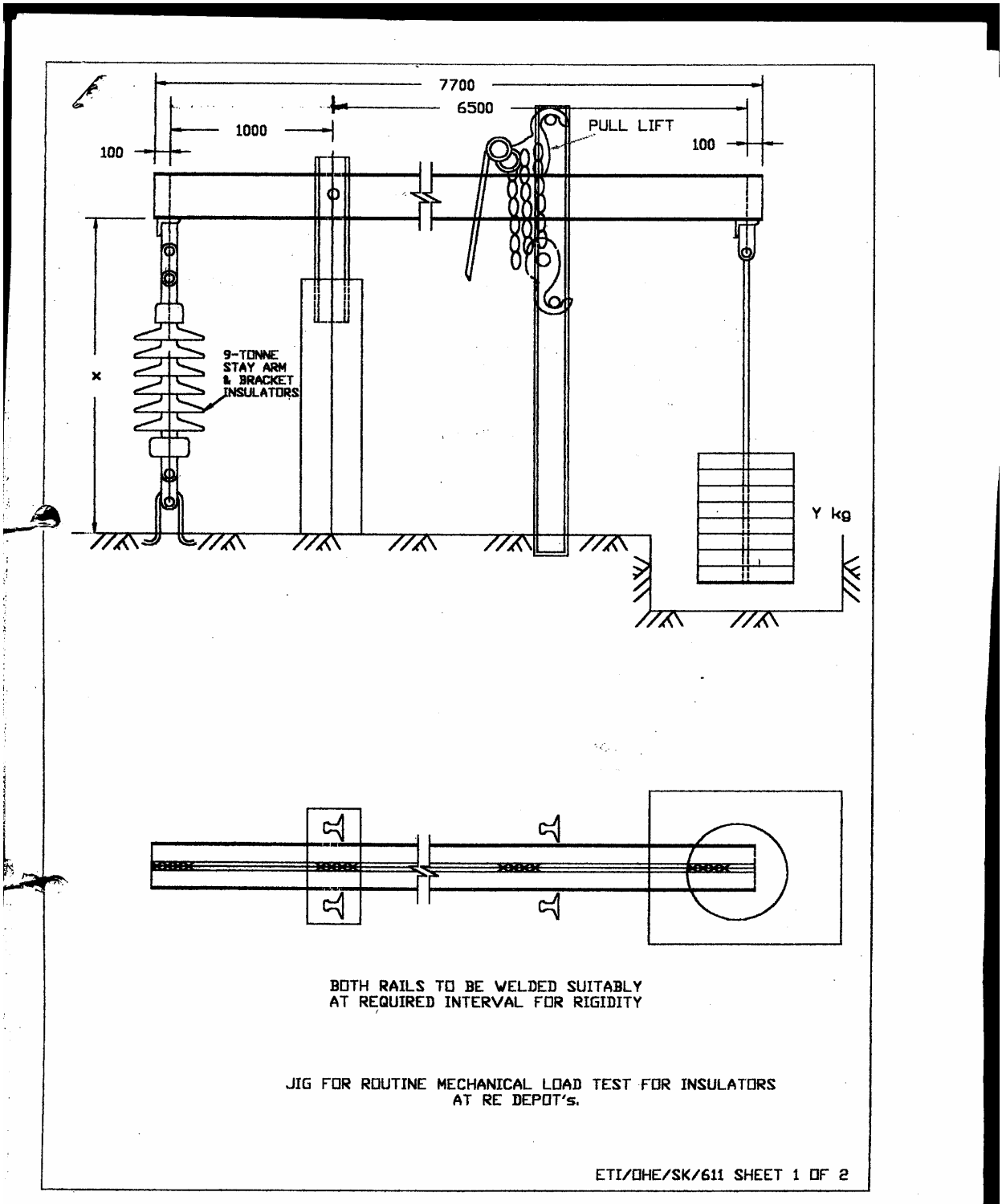
i) Calibrate the testing jig using a good dynamometer to determine the dead load to be applied so that the specified routine tensile load is applied on the type of insulator tested as per the specification to which it is supplied.

ii) Maintain the routine tensile load for one minute and then release.

iii) Check the insulators which pass the above test for any defect developed during the routine test such as cement crack, core pull out, deformation in the metal fitting, hook etc.

iv) Use the insulator which withstands the above routine tensile load without developing any defect indicated above.

ENCLOSURE: ETI/OHE/SK/611 (Sheet 1 of 2 and 2 of 2)


7700
6500
1000
100
100
PULL LIFT
9-TONNE
STAY ARM
& BRACKET
INSULATORS
X
Y kg
BOTH RAILS TO BE WELDED SUITABLY
AT REQUIRED INTERVAL FOR RIGIDITY
JIG FOR ROUTINE MECHANICAL LOAD TEST FOR INSULATORS
AT RE DEPOT's.
ETI/OHE/SK/611 SHEET 1 OF 2

NOTES:-

1. THE DIMENSIONS ARE IN MILLIMETERS.
2. THE DISTANCE ‘X’ SHOULD BE PREDETERMINED FOR CONDUCTING ROUTINE TENSILE LOAD TEST SO THAT STAY ARM , BRACKET AND 9-TONNE INSULATORS CAN BE TESTED IN THE SAME TESTING JIG.
3. BEFORE CONDUCTING ROUTINE TENSILE LOAD TEST , THE TESTING JIG SHOULD BE CALIBRATED WITH A GOOD DYNAMOMETER FOR VERIFICATION OF LOAD APPLIED ON THE INSULATOR. IF REQUIRED THE DEAD LOAD SHALL BE INCREASED/DECREASED.
4. SUITABLE FIXTURES ARE TO BE DEVELOPED AND USED FOR TESTING DIFFERENT TYPES OF INSULATORS.
5. 60 Kg RAILS ARE TO BE USED IN FABRICATION OF JIG.

Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No.TI/MI/00018 Rev-3

1. TITLE : Auto Tensioning Device (ATD) /Regulating Equipment.

2. APPLICATION : Winch Type ATD.

3.0 OBJECTIVE:

3.1 ATDs are meant for regulation of tension in OHE conductors & one of the important equipment, which need special attention in respect of installation as well as maintenance, as improper installation & maintenance may lead to disturbed OHE profile, resulting in poor dynamic behavior of OHE, which may, on occasion, cause panto entanglements at turnouts/cross-overs, neutral sections etc.

3.2 The failure pattern of last 7 years has been thoroughly studied by RDSO & it is observed that winch type ATD has contributed to 96% failures, though its population is about 45 % on IR.

3.3 Special attention needs to be given during POH as per laid down instructions, because if POH is carried out properly, certain specified checks may not be required to be carried out during other schedules and performance of ATD can be improved to a large extent.

3.4 Railways having large number of failures, may like to complete the cycles of visual checks, if possible, utilizing magnifying glass without taking power block. It will help to identify the ropes with broken strands, as in certain cases, Railways have been reporting strands cutting on counter weight side.

4.0 DETAILS OF SPECIAL MAINTENANCE INSTRUCTIONS:

4.1 MONTHLY CHECKS

4.1.1 Check for **missing Balance Weights** and if found missing, panto lower/raise caution or speed restriction for passing trains (in tension lengths involving turn outs, crossovers and overlaps) should be imposed by the concerned staff.

4.1.2 Check for **free movement of ATD** by slightly pushing up or pulling down the counter weights. If obstruction in movement of counterweights is observed and the counterweight do not come back to the position from where pushed / pulled, measure the force required to move the counterweights with the help of spring balance. If the force is more than 10 kg, then take the following action:

a) Check the parallelism of hex tie rod of antifalling device and if required, set it right.

b) Check for bent/deformed/ missing, guide tube and deformation of eye of base counterweight and counterweight eye rod. If it is not found in order, take corrective action to remove the defects. If the equipment is completely jammed, the equipment should be dismantled and bearings should be replaced with only SKF 6305 – 2RS1 or NBC 6305-LLU.

4.2 Annual Checks:

4.2.1 Auto Tensioning Device:

(i) Check visually whether drum of the regulating equipment is in **alignment** with the OHE. If not, then check center-to-center distance of hole of the bent arm right and bent arm left for matching each other. If the holes do not match each other, replace the defective bent arm.

(ii) Ensure that **Clevis vertical bolt** is not over tight so as to ensure free swiveling action of drum at different temperatures.

(iii) Check that **eye & clevis** is free to swivel. If not, file the back of clevis to obtain sufficient clearance between it and the edge of the anchor fitting without seriously affecting the strength of the fitting.

(iv) Check the **angle spacers** over hex tie rod for free movement.

(v) Check that the **hex pipe** of suitable length have been provided over hex tie rods as per the table given in ANNEXURE-A.

4.2.2 STAINLESS STEEL WIRE ROPES:

(i) Check thoroughly the **condition of stainless steel wire rope** through magnifying glass, for loose wires/strands, broken wires/strands, rusting, pitting/corrosion and bird caging. If any of these defects is observed, the wire rope should be replaced immediately with new **lubricated wire rope**.

(ii) Lubricate the wire ropes at least once in a year with "BALMEROL ROPELUBE 1000".

4.2.3 ATD & WIRE ROPE COMBINED

(i) Check that the **stainless steel wire rope** does not over ride each other on the helical grooves of the drum. If any overriding is observed, it should be corrected manually after releasing the tension on the regulating equipment.

(ii) Check that the **stainless steel wire rope** is centrally placed over the groove of the pulleys, if not then release the tension on ATD and manually set the wire ropes centrally on the grooves.

(iii) Check for **rusting / corrosion /deformation /b**reakage of **all the components**. If these are observed, then the defective components should be replaced.

(iv) Check for looseness of fasteners and if required, tighten them

(v) Check for appreciable **grazing of side walls of drum**/wheel disc by the wire rope carrying counter weight. If appreciable grazing of side walls of pulleys is observed, then take the following action:

(a) Straighten the sidewalls of drum /wheel disc by a few mild blows with wooden mallet, If found bent. If these cannot be straightened, replace the wheel disc or drum as the case may be.

(b) Loosen or tighten the bolt connecting the bent arms to the clevis and eye and ensure that there is no grazing.

(c) Check if the drum is tilted in vertical plane towards the bent arm right/left. If it is, then insert a beveled washer in between the clevis of eye & clevis and mast anchor fitting from bent arm right/left side, so that drum becomes vertical.

(d) Ensure that the insertion of washer between clevis & eye and arm anchor fitting for verticality of drum does not obstruct the swiveling action.

(e) Check for deformity of the drum/ wheel disc/pulley. If these are deformed then replace them.

(f) Check that the **mast anchor fitting** is correctly fitted, so that its eye is in horizontal plane. If not, fit it correctly, by loosening the bolts, connecting it to mast, set the anchor fitting right and tighten the bolts. If the deformation/ manufacturing defects on the mast anchor fitting are observed, it should be replaced.

(v) Check Z-Y dimensions and if required, adjust them according to adjustment charts as given in ANNEXURE-B.

4.3 CHECKS DURING POH

(i) ATD should be taken out of service & dismantled carefully.

(ii) Check the pulley, drum, bent arms & bearing housing, for any change in dimensions and if found deformed, repair/ replace, the defective part. The **bearing** should be replaced during each POH with a new bearing of NBC 6305 LLU or SKF 6305 2RS1.

(iii) **Ovality** of SS wire rope should be checked at three places (near pulleys) 300 mm apart by measuring rope diameter at right angles. If ovality is found more than 0.51 mm, wire rope should be replaced with a new lubricated wire rope.

(iv) Grooves of the drum should be checked with the help of **GO-NOGO gauge**. If the grooves and ridges separating the grooves have been found damaged due to overriding of the rope, the drum should be replaced.

(v) The gap between the drum and disc should be uniform and adequate for free movement of the wire rope.

(vi) Special care should be taken while inserting the wire rope in SS wire rope end fitting, the strands of wire rope should not be open out while reeving over the wedge piece.

(vii) Check thoroughly the condition of stainless steel wire rope through magnifying glass for loose wires/strands, broken wires/strands, rusting, pitting/corrosion and bird caging. If any of these defects is observed, the wire rope should be replaced immediately with new lubricated wire rope.

(viii) End reversal of wire rope should be done during each POH.

5. MAINTENANCE OF ATD RECORDS

The regulating equipment (ATD) should be checked and maintained as per the maintenance instruction. OHE depot should keep up to date, records of all ATD's in their sections, as per the format given at ANNEXURE –C.

6. AGENCY FOR IMPLEMENTATION

Railways and RE project units.

7. REFERNCE DRAWINGS AND SPECIFICATIONS :

7.0 REFERNCE DRAWINGS AND SPECIFICATIONS :

(i)	Drg. No.ETI/OHE/P/5300 Rev H & related part drgs.	- Regulating equipment (winch type) 5:1 ratio.
(ii)	Drg. No.RE/33/G/00193	- Adjustment chart of regulating equipment (winch type and pulley block type)

☺☺☺☺☺☺☺

ANNEXURE-A

LENGTH OF PIPE ON HEX TIE ROD OF 2300 MM

Tension lengths (m)	Length of pipe which can be provided (mm)			
	0° C	5° C	10° C	15° C
750	Nil	75	140	205
700	40	100	160	220
650	70	125	180	240
600	100	150	205	255
550	130	180	225	270
500	160	205	245	290
450	190	230	265	305
400	220	255	290	320
350	250	280	310	340
300	280	305	330	355
250	310	330	350	375
200	340	355	375	390

LENGTH OF PIPE ON HEX TIE ROD OF 2200 MM

Tension lengths (m)	Length of pipe which can be provided (mm) on hex tie rod of 2200mm length			
	0° C	5° C	10° C	15° C
750	NIL	NIL	40	105
700	NIL	NIL	60	120
650	NIL	25	80	140
600	NIL	50	105	155
550	30	80	125	170
500	60	105	145	190
450	90	130	165	205
400	120	155	190	220
350	150	180	210	240
300	180	205	230	255
250	210	230	250	275
200	240	255	275	290

ANNEXURE-B

Z = Distance between axis of movable pulley and drum
Y = Distance between bottom of counter weight and top of muff

ADJUSTMENT CHART FOR WINCH TYPE ATD																	
VALUES OF 'Z' IN mm FOR VALUE OF L IN METERS																	
T/L	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850
0	1280	1310	1339	1369	1399	1429	1458	1488	1518	1548	1577	1607	1637	1667	1696	1726	1756
5	1276	1301	1327	1352	1378	1403	1429	1454	1480	1505	1531	1556	1582	1607	1633	1658	1684
10	1271	1293	1314	1335	1356	1378	1399	1420	1441	1463	1484	1505	1526	1548	1569	1590	1611
15	1267	1284	1301	1318	1335	1352	1369	1386	1403	1420	1437	1454	1471	1488	1505	1522	1539
20	1263	1276	1288	1301	1314	1327	1339	1352	1365	1378	1390	1403	1416	1429	1441	1454	1467
25	1259	1267	1276	1284	1293	1301	1310	1318	1327	1335	1344	1352	1361	1369	1378	1386	1395
30	1254	1259	1263	1267	1271	1276	1280	1284	1288	1293	1297	1301	1305	1310	1314	1318	1322
35	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250
40	1246	1242	1237	1233	1229	1225	1220	1216	1212	1208	1203	1199	1195	1191	1186	1182	1178
45	1242	1233	1225	1216	1208	1199	1191	1182	1174	1165	1157	1148	1140	1131	1123	1114	1106
50	1237	1225	1212	1199	1186	1174	1161	1148	1135	1123	1110	1097	1084	1072	1059	1046	1033
55	1233	1216	1199	1182	1165	1148	1131	1114	1097	1080	1063	1046	1029	1012	995	978	961
60	1229	1208	1186	1165	1144	1123	1101	1080	1059	1038	1016	995	974	953	931	910	889
65	1225	1199	1174	1148	1123	1097	1072	1046	1021	995	970	944	919	893	868	842	817

CORRESPONDING VALUES OF 'Y' IN MILIMETERS																	
T/L	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850
0	2649	2798	2946	3095	3244	3393	3541	3690	3839	3988	4136	4285	4434	4583	4731	4880	5029
5	2628	2755	2883	3010	3138	3265	3393	3520	3648	3775	3903	4030	4158	4285	4413	4540	4668
10	2606	2713	2819	2925	3031	3138	3244	3350	3456	3563	3669	3775	3881	3988	4094	4200	4306
15	2585	2670	2755	2840	2925	3010	3095	3180	3265	3350	3435	3520	3605	3690	3775	3860	3945
20	2564	2628	2691	2755	2819	2883	2946	3010	3074	3138	3201	3265	3329	3393	3456	3520	3584
25	2543	2585	2628	2670	2713	2755	2798	2840	2883	2925	2968	3010	3053	3095	3138	3180	3223
30	2521	2543	2564	2585	2606	2628	2649	2670	2691	2713	2734	2755	2776	2798	2819	2840	2861
35	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
40	2479	2458	2436	2415	2394	2373	2351	2330	2309	2288	2266	2245	2224	2203	2181	2160	2139
45	2458	2415	2373	2330	2288	2245	2203	2160	2118	2075	2033	1990	1948	1905	1863	1820	1778
50	2436	2373	2309	2245	2181	2118	2054	1990	1926	1863	1799	1735	1671	1608	1544	1480	1416
55	2415	2330	2245	2160	2075	1990	1905	1820	1735	1650	1565	1480	1395	1310	1225	1140	1055
60	2394	2288	2181	2075	1969	1863	1756	1650	1544	1438	1331	1225	1119	1013	906	800	694
65	2373	2245	2118	1990	1863	1735	1608	1480	1353	1225	1098	970	843	715	588	460	333

Annexure-C

5:1 RATIO, WINCH TYPE ATD

FORMAT FOR RECORDING THE OBSERVATIONS/MEASUREMENTS

त्म्ब्त्क छत्प

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RAILWAY :----------

DATE OF INSPECTION:---

DIVISION :----------

SECTION :----------

LOCATION:----------

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement, if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
1.	Drum and wheel disc	Manufacturer: Date of installation:	(i) Visual examination of wear of drum with Go, Nogo gauge & Wheel disc (ii) Visual examination of wear of bent arms on both side (iii) Grazing of side walls of drum/wheel disc with wire rope (iv) Alignment of drum with OHE (v) Gap between drum and wheel disc					

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement, if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
2.	Pulley	Manufacturer: Date of installation:	(i) Visual examination of wear of pulley, bent arms (ii) Movement of axle (iii) Grazing of side walls of pulley with wire rope (iv) Alignment of pulley block of ATD with OHE and bent arms					
3.	S. S. Wire rope	Manufacturer: Year of manufacturer: Date of installation: Specification to which procured:	(i) Condition of SS wire rope (ii) Position of SS wire rope over pulley groove (iii)Date of lubrication (iv)Measurement of X, Y dimensions as per adjustment chart of ATD (v) Status of inner and outer strands of wires (vi) Ovality of SSWR over radically moving portion of rope.					

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
4.	Bearing	Bearing No.: Manufacturer: Date of installation:	(i) Condition of felt and grease seal					
5.	Clevis & Eye	Type(Al Bz or forged steel): Manufacturer:	(i) Visual examination (ii) Alignment of clevis with fixed pulley (iii) Movement of clevis & eye					
6.	Hex tie rod	Make: Date of installation:	(i) Visual examination for rusting/corrosion/ deformation/breakage (ii) Parallelism of hex tie rod (iii) Length of hex tie rod (iv) Movement of angle spacer of hex tie rod					
7.	Counter weights	Make: Date of installation:	(i) Check for missing counter weights (ii) Check deformation of eye of the base CW					

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
8.	Mast anchor fitting	Manufacturer Date of installation Type	(i) Check deformation of fitting (ii) Check whether eye of fitting is in horizontal plane.					
9.	Guide Tube		(i) Check for bent/deformed/missing guide tube					
10.	Fastners		(i) Looseness of fasteners					

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RESEARCH DESIGN AND STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW- 11.

1. **Titles**

Periodic maintenance instructions and trouble shooting guidelines for capacitor banks provided on Indian Railways.

2. **Applicable to:**

All class of capacitor banks.

3. **Object of special maintenance instructions:**

To arrest the Maintenance failures of capacitor banks on Indian Railways due to maintenance problems and develop suitable guidelines suiting to all category of capacitor banks provided on Indian Railways.

To develop a suitable Guideline which shall assist the users for proper rectification of the capacitor banks failures by observing the schedule maintenance and taking suitable remedial action.

4. **Instructions:**

4.1 Three monthly schedule:

4.1.1 Clean the dust over the insulators with the help of a damp cloth. In case of oily deposits carbon tetrachloride or any other suitable solvent may be used for cleaning of the insulators.

4.1.2 Observe for any dielectric leakage/seepage, if any leakage/seepage is found, rectify it as given in Para 5.

4.1.3 Observe for any birdcages in and around the traction substations.

4.1.4 Observe physically for any abnormal temperature rise of the capacitor units.

4.2 Six monthly schedule

4.2.1 All the above items as mentioned in Three Monthly Schedule.

4.2.2 Check the excessive tension on any of the connectors. Ease out the tension on the bushings, if required.

4.2.3 Observe for any rust collection/corrosion marks on the metallic parts and clean them.

4.2.4 Observe the current and voltage variations for the capacitor bank for at least 24 hours (Hourly readings of voltage and current for the capacitor bank should be recorded. If continuous recording facility is available, the same may be used). Compare the records of measurements with last recorded readings. Measurements with Digital meters shall be ideal. Examine and execute the changes for the past few years.

4.3 Annual Maintenance Schedule.

4.3.1. All the above items as mentioned in 4.2.

4.3.2 Ensure proper tightening of the fasteners and the connectors.

4.3.3 Check for functioning of protective relays with the help of primary injection test kit & secondary injection test kit.

4.3.4 Measure temperature rise in 24 hours of the capacitor unit, which is innermost, by applying a suitable thermometer on the can of the capacitor bank. The temperature rise in no case should be 15 deg. C above the ambient temperature (Temperature of capacitor container can be measured by fixing a thermo-meter on the wall of the container, its bulb being at one fourth of the height of capacitor down from the top).

4.3.5 Check that the NCT settings are as per RDSO guidelines and note that the NCT relay settings have remained stable for last 5 years. Change in the NCT relay settings are required to be examined.

4.3.6 Measure the capacitance value and tan delta of the capacitor units at nearly the same ambient temperature. Compare with last measured values.

4.4 Trouble shooting Guidelines for Capacitor Bank on I.R.

S.No	TROUBLE	CAUSE	REMEDIAL ACTION
1.	Leakage of dielectric from capacior can	Minor transient damages. Dents etc.	a) Minor seepage may be attended by M-seal (fast drying type compound). b) Extent of leakage may be studied. Depending upon the extent of leakage, the same attended or units rejected. Original manufacturer can also be referred.

2	Seepage of dielectric.	a) Improper handling during transportation. b) Due to tension coming on bushings by terminal connectors. c) Overheating of capacitor bank.	a) Attend by using Araldite or M-seal (fast drying type compound) b) Ease out the tension by using proper size of terminal connectors. Arrest dielectric seepage by M- seal type fast drying compound. c) Eliminate overheating of capacitor banks by instructions at S. No. 3
3.	Overheating of the units (can temperatrature should not be more by15 deg. C above ambient).	a) Poor ventilation. Erection is near a hot body. b) Capacitor units values have changed over the last recorded values. c) Excessive oil seepage/leakage. d) Capacitor drawing high currents.	a) Change location. b) Capacitor unit elements inside the capacitor unit have failed. Replace capacitor unit with a new one if needed (Ref: Item 6 for details). c) The dielectric might have run the safe limit. The unit might fails. Replace unit. Measure capacitor value and decide. d) The dielectric medium aged. Refer to manufacturer and replace units. e) Refer Point No. 4 for details.
4.	Capacitor drawing high current	a) High system voltage. b) Harmonic current.	a) Reduce voltage by changing taps of the transformer. b) Harmonics in the system are on the increase. Conduct harmonic analysis.
5.	Capacitor drawing lower current	a) Less system voltage. b) A capacitor value of individual cell has changed due to blowing of internal fuses.	a) Correct voltage by transformer. b) Measure capacitance value and if changes are there. Replace the units. c) Check Neutral CT and associated protection for proper functioning.
6.	Abnormal bulging/ bursting of capacitor units.	a) Gas formation due to internal arching.	a) Replace unit. b) Check neutral CT and associated protection for proper functioning.

7.	Black marks on bushing of the capacitor banks.	a) External fault between terminal and container. b) High voltage surge due to lightning or restriking of circuit breakers.	a) Clean bushing and check installation for external short circuits ,presence of bird cages etc. b) Check for effectiveness of the lighting arrestor and its proper rating. c) Consult original manufacturer, if situation persists.
8.	Terminals overheated or melted.	a) Loose terminal connectors or corrosion is taking place.	b) Properly tighten connectors. c) Clean for rust/ corrosion. If required, change the connector.
9.	Capacitor bank tripping on unbalanced protection.	a) Capacitor unit rating has changed. b) Neutral C.T. connections not proper or setting wrong.	a) Replace unit, if value has changed (Ref. Item 6 for details)

5. **Arresting leakage**

Take out the defective unit having leakage/seepage and put it in a position so that the leakage/seepage point is topmost. The capacitor unit is filled with dielectric but on the top some nitrogen is present. The can should be placed such that the dielectric does not ooze out from the cracked location. Clean the seepage point by carbon tetrachloride or a similar oil removing solvent, so that it is perfectly dried. Apply fast drying type M-seal compound (or equivalent) for arresting the leakage of the can. For arresting the leakage near the insulator bushings, araldite (or equivalent) may be used. Allow it to dry for 6-8 hrs. or as recommended by the adhesive supplier. Re-erect the unit after making a red cross mark with the paint, which is visible from down below so as to identity the capacitor unit from the ground level. Continue to monitor the capacitor bank for its performance.

This exercise is applicable for attention of minor leakage of the capacitor units only. For major leakage from the bushings or otherwise where the dielectric might have already reduced to a level where the internal elements are getting exposed the capacitor unit may be replaced.

6. **Bird Electrocution Problem:**

To avoid the bird electrocution leading to capacitor failure problem, provide bird caps made of polypropylene on the capacitor's terminal bushings and PVC sleeves on the bus-bars. These caps and sleeves should be procured from RDSO approved H.T. capacitor vendors and should have a minimum 15 kV, AC voltage withstand value continuously.

7. **Measurement of capacitance**:

Use a digital multimeter capable of recording reading in microfarad upto first decimal place. The range of the capacitance meter should be 2 to 100 microfarad minimum. Measure the readings of the capacitance upto the first decimal value. Also note the ambient temperatures. Reading of the capacitor values is likely to change (within 0 to –5%) in the initial 3 to 12 months. These may be recorded for reference only. Any changes in values beyond this period from 0 to 3% per unit suggest starting of the deterioration cycle of the capacitor units. Such capacitor banks should be measured for the values more often. Changes in values beyond –6% indicates that the capacitor bank is likely to fail and should be removed from service.

8. **Measurement of Tan Delta (Dielectric loss angle)**:

The tan delta measurements should be done annually with the help of a standard shearing bridge. Abrupt changes in the dielectric constants shall be the indicators of deterioration of the capacitor. The measured value of the dielectric loss angle shall not exceed 0.0005.

8 **References**:

i) UNISTAR Installation, operation and Maintenance of High voltage Power capacitors.
ii) Rough Metallized PP for AC Applications by Denis Pallemand & Lucien Tamic.
iii) Performance assessment and field Experience by S.A Backer & P.R.B.Nair.
iv) The Effect of water content of the impregnation Liquid on Agening of All Film Capacitor Windings by H. Suonppa, T. Martinmaki & V. Rasanen.

9. Suggestion for improvement upon these instructions are most welcome and may be addressed to Executive Director/TI, R.D.S.O., Manak Nagar,Lucknow-226 011

(N.K.Gupta)
Director/TI-V

Distribution:
Copy to:
1. Secretary (Elec.), Railway Board , New Delhi – 110 001.

2. **Chief Electrical Engineer**:
i.) Central Railway, Mumbai CST- 400 001.
ii.) Eastern Railway, Fairlie Place, Kolkata – 700 001.
iii.) Northern Railway, Baroda House, New Delhi- 110 001.
iv.) Southern Railway, Park Town, Chennai – 600 003.
v.) South Central Railway, Rail Nilayam, Secunderabad – 500 371.
vi.) South Eastern Railway, Garden Reach, Kolkata – 700 043.
vii.) Western Railway, Churchgate, Mumbai – 400 020.

Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No. TI/MI/0027 Rev.0

No. ETI/OHE/COND/CC-1/2 Dt: 03/03/1998

Chief Electrical Engineer,
Eastern Railway,
Fairlie Place,
Calcutta 700 001

Sub: Development of 107 mm^2 silver bearing copper contact wire (Silver content 0.1%).
Ref: This office letter of even number dated 20/03/1995.

****

In terms of Item 2.1 of XVIIth MSG (TRD) meeting held at Eastern Railway on 16th & 17th January 1995 and also item 3.1 of XXth MSG(TRD) meeting held at Northern Railway, Shimla on 25th & 26th September 1997, it is requested that developmental order for silver bearing copper contact wire, 107 mm^2 may be placed at the earliest. While placing the order, type of jointing technique should also be specified. The contact wire would be put on filed trials in limited quantity in suburban sections where rate of wear of contact wire has been observed to be on higher side.

It is darified that the suppliers presently approved for hot rolled contact wire (with joints) may be considered for placement of this developmental order. M/s Veekay Industries, Delhi have already confirmed to this office about the development of silver bearing contact wire. As this type of contact wire is being developed for the first time for Indian Railway, it's prototype testing shall be witnessed by RDSO. Please arrange to place the order expeditiously with the advise of this office.

Sd. (R.K Saxena)
for Director General/TI

Encl: Nil

Copy to Post for Confirmation.

Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION NO.TI/MI/0028 REV - 2

SPECIAL MAINTENANCE INSTRUCTION (SMI) FOR OVERHEAD EQUIPMENT ON TURNOUTS/CROSSOVERS TO AVOID PANTO-ENTANGLEMENTS

1. TITLE Adjustment of Overhead Equipment (OHE) on turnouts/cross-overs to avoid panto entanglements.

2. APPLICATION All cases of turnouts and crossovers.

3. OBJECTIVE Points and crossings are one of the important locations which need special attention in respect of erection as well as maintenance, because wrong erection / maladjustment of the OHEs at the structures, particularly at the obligatory structure may lead to pantograph entanglements causing disruption in traffic.

4. REFERENCE DRAWINGS AND SPECIFICATIONS

(i) Drg.No ETI/OHE/G/02141 Rev. C - General arrangement of regulated OHE at turnouts(Overlap & crossed type)

(ii) Drg.No ETI/OHE/G/02151 -General arrangement of regulated OHE at crossovers (Overlap & crossed type)

(iii) Specification No. ETI/OHE/53(6/88) with A & C slip Nos 1 to 4 – Principles of OHE Layout Plans & Sectioning Diagrams for 25 kV ac traction

(iv) Design Manual , July 1994, Vol.3, Chapter-4 - Wiring of points and crossings.

(v) ACTM Vol-II (Part-I) 1994 Chapter-III -Overhead equipment.

5. INSTRUMENTS AND APPLIANCES REQUIRED

Tower Wagon and other T & P items as usually required for erection/ maintenance of OHE.

6. DETAILS SPECIAL INSTRUCTIONS.

6.1 Before checking turnout, check the pantograph of tower wagon for following:-

(a) Clean and check panto pan for grooves, horizontally (with spirit level when raised) or any other abnormality. The permissible depth of groove is 1 mm. If it exceeds, replace the strips. Check whether the strip fixing screws are projecting beyond the strip surface. If yes , tighten loose screws. Check the strips for sharp edges and projecting particles. Round off the edges of strips with a file.

(b) Check the main springs for cracks/breakage. In case of cracks / breakages, replace the springs.

(c) Check the bow plunger for free sliding while pressing. In case of jamming, loosen the sleeves fixing the spring boxes and turn them around their vertical axis until jamming is removed.

6.2 Check that the overhead equipment (OHE) at points & crossings on main lines is overlap type as shown in drawing nos. ETI/OHE/G/02141 Rev. C and ETI/OHE/G/02151. If not, modify it according to the drawings. If for any reason, crossed type OHE is erected on mainline, convert it to overlap type, if possible, otherwise impose speed restriction of 100 km/h.

6.3 Obligatory Structure

(a) Check the track separation at obligatory structure. For best results, the track separation should be between 500 mm and 700 mm. However, if due to site conditions it is not possible to locate obligatory structure as mentioned above, it should be located at the position where the track separation is 150 to 700 mm.

(b) Ensure that the turnout span is 54 m or less in case of overlap type arrangement. In case of crossed type arrangement the limitation of turnout spans shall be as per Drg, ETI/OHE/G/02141 Rev.C

(c) Ensure that the drop bracket is provided for supporting the steady arm assembly with steady arm hook and the vertical distance between register arm axis and contact plane in this case is 300 mm. In case where steady arm with eye piece and steady arm clamp is provided
the distance between register arm axis and contact plane should be 250 mm.

(d) Measure the implantation of obligatory structure. If it is less than 3 m, take corrective action to increase it to 3 m.

(e) Ensure that the register arm tubes of the bracket assembly are in horizontal position and not displaced.

(f) Ensure that the passing clearance of nearest obstruction i.e. bracket insulator , register arm tube etc. from the dynamic panto swept zone is more than 100 mm but at the same time the electrical clearance between extreme of panto swept zone and any nearest earthed structure should not be less than 320 mm.

6.4 Auto- Tensioning Device (ATD)

6.4.1 For ATD of turnout, crossover and concerned mainline OHE tension lengths the following should be observed :-

(a) Redundant length of hex tie-rod of limiting device should be bridged by inserting pipe of suitable length on OHE side as indicated in SMI No. TI/ MI/0035 Rev.1.

(b) Ensure that SMI No. TI/MI/0029 Rev.1 and SMI No. TI/MI/0018 Rev.1 are followed.

6.5 Turnout/Crossover OHE

6.5.1 The turn out OHE adjustments should be done and values of different parameters should be checked with the movements of tower wagon as under :-

i.) From main line to turnout
ii.) From turnout to main line
iii) On main line

(a) Measure the stagger of contact wires at support at obligatory structure. Compare these values with the values indicated in as erected drawing and adjust if required , taking care that the horizontal separation of two contact wires at support is not less than 50mm. In no circumstances the stagger of contact wire of turnout OHE should exceed 300mm.

(b) Measure sag of contact wires of mainline and turnout OHEs on either side of obligatory structure. If it is not as per standards, redropper the OHE.

(c) Measure the heights of contact wires of the mainline OHE and turnout OHE at support point at obligatory structure without any upward/downward thrust on the contact wires. The contact wire of the mainline OHE should be 50mm below the contact wire of turnout OHE . If not so ,then taking the reference of contact wire of main line OHE, the height of contact wire of turnout OHE should be adjusted so that it is 50 mm above the contact wire of main line OHE.

(d) Measure the difference in heights of contact wire of main line OHE and contact wire of turn out OHE in the entire danger zone which falls within 10 m towards turnout from obligatory structure. In the entire danger zone, ensure that the contact wire of turnout OHE is 50 mm above the contact wire of main line OHE. However , at 10 m from obligatory structure towards turnout the

vertical difference in the height of two contact wires shall not be less than 30 mm**.**

(e) Run the tower wagon on main line and check whether the pantograph touches contact wire of turnout OHE in the over - lapping zone. If yes, adjust OHE of turnout to ensure that pantograph does not touch the contact wire of turn out OHE.

(f) Check with the tower wagon running on turnout track towards main line track, that the pantograph of tower wagon takes up the contact wire of main line OHE smoothly at a point 650mm to 720mm from its centre line. If it does not takeover smoothly, then check the vertical difference between the two contact wires and if required, adjust it.

(g) Check with tower wagon running from main line track to turnout track ,that pantograph glides smoothly from main line contact wire to secondary line contact wire . If not, adjust the OHEs to ensure the same.

(h) In case of unregulated OHE, retensioning of conductors should be adopted prior to change of season. The turnout/crossover OHE should be checked up thoroughly and, if required, adjusted to maintain the above mentioned parameters.

(i) In case of crossed type turnout check the following :-

(i) Check that the contact wire of turnout OHE is above that of main line OHE and centrally passes through the contact wire crossing bar in case the contact wire crossing is used. The contact wire of the turn out OHE should not rest over the contact wire of main line OHE and crossing contact wire is free to move. Check that there is no abrasion between the contact wire of main line OHE and that of turnout OHE at the crossing point. Check that the crossing contact wire does not infringe with the PG clamps of the contact wire crossing bar assembly. If it infringes, shift the location of contact wire crossing bar assembly suitably.

(ii) Check the condition of contact wire crossing assembly for looseness of fasteners of P.G. clamps and alignment of crossing bar. Tighten the P.G. clamps , align the crossing bar or replace deformed crossing bar, if required.

(j) In case of diamond crossings with slips equipped with crossed type OHE, measure the distance between two knuckle tube assemblies. It should be 9m. Check that two knuckle tube assemblies are horizontal and located symmetrically on either side of centre line of diamond crossing. If not, adjust the position and alignment of knuckle tube assemblies. Check the knuckle tube assemblies for looseness. If required, tighten the fasteners.

(k) Check that all other fittings/ components are sound and free from corrosion,. rusting, crack, deformation etc. If any abnormality is noticed the particular component should be replaced.

6.6 'G' Jumper

(a) Check that 'G' jumpers are provided at a distance of 5.6m from obligatory structure. If the distance is less, shift the 'G' jumper to the specified location. The arrangement of 'G' jumper should comply with that indicated in drawing No.ETI/OHE/G/05102 Rev. C

(b) Ensure that the nuts & bolts at PG clamps are neither too tight nor too loose.

(c) Ensure that the length of 'G' jumper is as specified in Drg. No. ETI/OHE/G/05102 Rev.C. If less, replace the 'G' jumper with jumper of specified length.

6.7 Section Insulator (SI)

(a) Ensure that the location of section insulator is as per the principles of OHE layout plan & sectioning diagrams.

(b) Check with spirit level that the runners of section insulator are in the same horizontal plane. If not, the level should be adjusted by section insulator adjustable droppers.

(c) Check that the panto passage under section insulator is smooth and runners are not hit by panto pan.

(d) Measure the track separation at the location of section insulator. It should be equal to or more than 1.65 m if the section insulator is erected with the free ends of the runners towards the centre of the turnout and equal to or more than 1.45 m if the section insulator is erected with free ends of the runners away from the centre of turnout. If these distances are below the values indicated above, location of section insulator should be shifted away from the centre of the turnout. The track separation is measured at the extreme end of the part of section insulator assembly towards the centre of the turnout.

(e) Measure the stagger at section insulator. It should be within +/-100 mm.

(f) Measure the sag of section insulator. It should be zero. If not , adjust it to zero by adjustable droppers of section insulator and/or by re-droppering the OHE of the span.

(g) Check contact wire ending clamp of section insulator and ensure that any slipping of contact wire has not taken place. Take corrective action in case of contact wire slipping.

(g) Check for all the components/ parts of section insulators and replace the defective parts.

7. PERIODICITY OF IMPLEMENTATION OF SMI

The arrangement of OHE at turnouts and crossovers for regulated OHE should be checked annually and adjustments carried out, if necessary , so that the equipment is maintained as per the standards. In case of unregulated OHE, re-tensioning of the OHE should be done prior to change of season and the turnout /crossover OHE should be checked up thoroughly and, if required, adjusted.

Proper records of turnout/crossover, ATD and section insulator assembly should be maintained as per details given in Annexure 'A' . If any change in profile due to track shifting etc is noticed, Engg. Branch should be informed and efforts should be made to restore original standards parameters. If it is not possible to achieve the original standard parameters the new values to be set but strict vigil should be kept on such turnouts/crossovers.

8. AGENCY FOR IMPLEMENTATION

Railways and RE project units.

ANNEXURE – A

FORMAT FOR RECORDING THE OBSERVATIONS/MEASUREMENTS

---------- RAILWAY

---------- DIVISION

TRACTION DISTRIBUTION BRANCH

TURNOUT/CROSSOVER NO.

S.N	Description		Std. value	Measured value			
1	Particulars of Turnout/crossover(Give the number i.e.1:8½ , 1:12 etc.)		-	-	-	-	-
2	Section		-	-	-	-	-
3	Location No.		-	-	-	-	-
4	Date Checked		-	-	-	-	-
5	Type of Arrangement - Crossed type/Overlap type		-	-	-	-	-
6	Height of Contact Wire above rail level at support at Obligatory Structure	Main Line Contact Wire (mm), (H)					
		Turnout Contact Wire (mm)	H+50 *				
7	Turnout span (m)	54 (Max)					
8	Height of Contact Wire in Overlapping Zone	Mainline Contact Wire (mm) (H1)					
		Turnout Contact Wire (mm)	H 1+50 *				
9	Stagger of Contact Wire at Obligatory Structure	Mainline Contact wire (mm) Turnout Contact wire(mm)	200 max. 300 max.				
10	Sag of section insulator of Turnout/Crossover		Zero				
11	Movement of tower wagon from mainline to turnout a) Take off b) Point of take off (in m from O/S)		650 mm to 720 mm from centre line of pantograph ---				
12	Movement of tower wagon from turnout to mainline a)Take on b) Point of take on (in m from O/S)		650 mm to 720mm from centre line of pantograph ---				
13	Stagger of section insulator at turnout/crossover		+/- 100 mm				

14	Track separation at the location of section insulator (m) (a) Runners towards the centre of turnout (b) Runners away from the centre of turnout		1.65 Min 1.45 Min				
15	Condition of ATD of turnout/mainline OHE		Free to move				
16	Length of pipe provided in hex tie rod of limiting device to bridge redundant length of hex tie rod.		As per SMI No. TI/MI/0035 Rev.1				
17	Setting distance (implantation) of obligatory structure (m)		3.0 Min				
18	Track separation at obligatory structure (mm)		150 to 700				
19	Distance of 'G' jumper from obligatory structure (m)		5.6				
20	Length of 'G' jumper. (m)		4.0				
21	Deviations from SEDs						
22	Adjustments done ,if any						
23	Remarks						
24	Name of supervisor and designation						
25	Signature of Supervisor						

* **In case of overlap type arrangement.**

Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No.TI/MI/00029 Rev-3

1. TITLE : Auto Tensioning Device (ATD) /Regulating Equipment.

2. APPLICATION : 3:1 Ratio three pulley type ATD.

3.0 OBJECTIVE:

3.1 ATDs are meant for regulation of tension in OHE conductors & one of the important equipment, which need special attention in respect of installation **as well as maintenance,** as improper installation & maintenance may lead to disturbed OHE profile, resulting in poor dynamic behavior of OHE, which may on occasion cause panto entanglements at turnouts/cross-overs, neutral section etc.

3.2 The failure pattern of last 7 years has been thoroughly studied by RDSO & it is observed that most of the failures of SS wire rope are with winch type ATD. Failures of 3 pulley ATDs have also been reported 2003-04 onwards, even though it has contributed only 4% to failures, with population of 45 % on IR. RDSO has reframed the maintenance instruction for 3-pulley type ATDs, clearly indicating action to be taken during monthly & annual checks and POH of ATDs, so as to arrest failures of stainless steel wire ropes and ATD.

3.3 Special attention needs to be given during POH as per laid down instructions, because if POH is carried out properly, certain specified checks may not be required to be carried out during other schedules and performance of ATD can be improved to a large extent.

3.4 Railways having large number of failures, may like to complete the cycles of visual checks, if possible, utilizing magnifying glass without taking power block. It will help to identify the ropes with broken strands, as in certain cases, Railways have been reporting strands cutting on counter weight side.

4. DETAILS OF SPECIAL MAINTENANCE INSTRUCTIONS:

4.1 MONTHLY CHECKS

4.1.1 Check for missing **Balance Weights** and if found missing, panto lower/raise caution or speed restriction for passing trains (in tension lengths involving turn outs, crossovers and overlaps) should be imposed by the concerned staff.

4.1.2 Check for **free movement of ATD** by slightly pushing up or pulling down the counter weights. If obstruction in movement of counterweights is observed and the counterweight do not come back to the position from where pushed / pulled measure the force required to move the counterweights with the help of spring balance. If the force is more than 10 kg, then take the following action:

a) Check the parallelism of hex tie rod of antifalling device and if required, set it right.

b) Check for bent/deformed/ missing guide tube and deformation of eye of base counterweight and deformation of counterweight eye rod, take corrective action to remove the defects. If the equipment is completely jammed, the equipment should be dismantled and bearings should be replaced with only SKF 6305 – 2RS1 or NBC 6305-LLU.

4.2 Annual Checks:

4.2.1 Auto Tensioning Device:

(i) Check visually whether all the **pulleys** are in same vertical plane, pulley block of the ATD is in alignment with the OHE and the bent arms of the pulley block are parallel to the pulley. If not, then check, center to center distance of holes of the bent arms of pulley/pulley block. If the holes do not match with each other, replace bent arms.

(ii) Check that **eye & clevis** is free to swivel, if not, file the back of clevis to obtain sufficient clearance between it and the edge of the anchor fitting, without seriously affecting the strength of the fitting.

(iii) Check the **angle spacers** over hex tie rod are free to move.

(iv)Check that the **hex pipe** of suitable length have been provided over hex tie rods as per the table given in ANNEXURE-A.

4.2.2 STAINLESS STEEL WIRE ROPES:

(i) Check thoroughly the condition of **stainless steel wire rope** through magnifying glass for loose wires/strands, broken wires/strands, rusting, pitting/corrosion and bird caging. If any of these defects is observed, the wire rope should be replaced immediately with new **lubricated wire rope**.

(ii) Lubricate the wire ropes at least once in a year with "BALMEROL ROPELUBE 1000".

4.2.3 ATD & WIRE ROPE COMBINED

(i) Check that the **stainless steel wire rope** is centrally placed over the groove of the pulleys, if not, then release the tension on ATD and manually set the wire ropes centrally on the grooves.

(iii)Check for rusting / corrosion /deformation /breakage of **all the components**. If these are observed, then the defective components should be replaced.

(iii) Check for appreciable grazing of side walls of pulleys, by the wire rope . If appreciable grazing of side walls of pulleys is observed, then take the following action:

(a) Straighten the side walls of pulley by a few mild blows with wooden mallet. If these can not be straightened, replace the pulley/pulleys.

(b) Loosen or tighten the bolt connecting the bent arms to the clevis & eye to ensure that there is no grazing between & the section of wire rope carrying counterweight.

(c) Check that the mast anchor fitting is correctly fitted so that its eye is in horizontal plane. If not, fit it correctly, by loosening the bolts connecting it to mast, set the anchor fitting right and tighten the bolts. If the deformation/ manufacturing defects on the mast anchor fitting are observed, it should be replaced.

(d) Check if the pulley is tilted in vertical plane towards the bent arm right/left. If it is, then insert a beveled washer in between the clevis of

eye & clevis and mast anchor fitting from bent arm right/left side, so that pulley becomes vertical.

(iv)Check **X-Y dimensions** and if required, adjust them according to adjustment charts as given in ANNEXURE-B.

4.3 CHECKS DURING POH

(i) ATD should be taken out of service & dismantled carefully.

(ii) Check the pulley, bent arms & bearing housing for any change in dimension and if found deformed, it should be repaired/ replaced. The **bearing** should be replaced during each POH with a new bearing of NBC 6305 LLU or SKF 6305 2RS1.

(iii) Ovality of SS wire rope should be checked at three places(near pulleys) 300 mm apart by measuring rope diameter at right angles. If ovality is found more than 0.51 mm, wire rope should be replaced with a new lubricated wire rope.

(iv) Special care should be taken while inserting the wire rope in SS wire rope end fitting, the strands of wire rope should not be open out, while reeving over the wedge piece.

(v) Check thoroughly the condition of **stainless steel wire rope** through magnifying glass for loose wires/strands, broken wires/strands, rusting, pitting/corrosion and bird caging. If any of these defects is observed, the wire rope should be replaced immediately with new **lubricated wire rope.**

(vi) End reversal of wire rope should be done during alternate POH.

5. MAINTENANCE OF ATD RECORDS

The regulating equipment (ATD) should be checked and maintained as per the maintenance instruction. OHE depot should keep up to date, records of all ATD's in their sections, as per the format given at annexure –C.

6. AGENCY FOR IMPLEMENTATION

Railways and RE project units.

7. REFERNCE DRAWINGS AND SPECIFICATIONS :

(i) Drg. No.ETI/OHE/P/5500-1 Rev K Sheet-1of 2 - Regulating equipment (3-pulley type) 3:1 ratio.

(ii) Drg. No.ETI/OHE/P/5500-1 Rev.C Sheet-2 of 2 - Part details of regulating equipment (3 : 1 ratio)

(iii) Drg. No. ETI/OHE/G/00195 - Adjustment chart of regulating equipment three pulley type

(vi) Drg. No.TI/DRG/OHE/ATD/RDSO/ 00001/99/1 - Regulating equipment (three pulley type) 3:1 ratio (modified).

(v) Drg. No. TI/DRG/OHE/ATD/RDSO/ 00002/99/**1** - Part details of regulating equipment 3 : 1 ratio (Modified)

(vi) Drg No. TI/DRG/OHE/ATD/RDSO/ 00003/99/0 - Adjustment chart of regulating equip. three pulley type (3:1 ratio) Modified.

(viii) Drg No. TI/DRG/OHE/ATD/RDSO/ 00008/05/0 - Drawing of M-18 X 75/32 bolt with castle nut.

☺☺☺☺☺☺☺

ANNEXURE-A

THREE PULLEY TYPE ATD (3:1 RATIO)-OLD

Tension lengths(m)	Length of pipe which can be provided (mm)			
	0° C	5° C	10° C	15° C
750	85	150	215	280
700	115	175	235	295
650	145	200	255	310
600	175	225	275	330
550	205	250	300	345
500	235	280	320	360
450	265	305	340	380
400	295	330	360	395
350	325	355	385	420
300	355	380	405	430
250	385	405	425	450
200	415	430	450	465

THREE PULLEY TYPE ATD (3:1 RATIO)-MODIFIED

Tension lengths(m)	Length of pipe which can be provided (mm)			
	0° C	5° C	10° C	15° C
750	95	155	220	285
700	125	185	240	300
650	155	210	265	320
600	185	235	285	335
550	215	260	305	355
500	240	285	330	370
450	270	310	350	385
400	300	335	370	405
350	330	360	390	420
300	360	385	410	440
250	390	410	435	455
200	420	440	455	470

X = Distance between axis of movable pulley and fixed pulley

Y = Distance between bottom of counter weight and top of muff

ADJUSTMENT CHART FOR 3 PULLEY ATD(OLD)

VALUES OF 'X' IN mm FOR VALUE OF L IN METERS

T/L	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
0	1080	1110	1139	1169	1199	1229	1258	1288	1318	1348	1377	1407	1437	1467	1496	1526
5	1076	1101	1127	1152	1178	1203	1229	1254	1280	1305	1331	1356	1382	1407	1433	1458
10	1071	1093	1114	1135	1156	1178	1199	1220	1241	1263	1284	1305	1326	1348	1369	1390
15	1067	1084	1101	1118	1135	1152	1169	1186	1203	1220	1237	1254	1271	1288	1305	1322
20	1063	1076	1088	1101	1114	1127	1139	1152	1165	1178	1190	1203	1216	1229	1241	1254
25	1059	1067	1076	1084	1093	1101	1110	1118	1127	1135	1144	1152	1161	1169	1178	1186
30	1054	1059	1063	1067	1071	1076	1080	1084	1088	1093	1097	1101	1105	1110	1114	1118
35	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050
40	1046	1042	1037	1033	1029	1025	1020	1016	1012	1008	1003	999	995	991	986	982
45	1042	1033	1025	1016	1008	999	991	982	974	965	957	948	940	931	923	914
50	1037	1025	1012	999	986	974	961	948	935	923	910	897	884	872	859	846
55	1033	1016	999	982	965	948	931	914	897	880	863	846	829	812	795	778
60	1029	1008	986	965	944	923	901	880	859	838	816	795	774	753	731	710
65	1025	999	974	948	923	897	872	846	821	795	770	744	719	693	668	642

CORRESPONDING VALUES OF 'Y' IN MILIMETERS

T/L	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
0	2389	2479	2568	2657	2746	2836	2925	3014	3103	3193	3282	3371	3460	3550	3639	3728
5	2377	2453	2530	2606	2683	2759	2836	2912	2989	3065	3142	3218	3295	3371	3448	3524
10	2364	2428	2491	2555	2619	2683	2746	2810	2874	2938	3001	3065	3129	3193	3256	3320
15	2351	2402	2453	2504	2555	2606	2657	2708	2759	2810	2861	2912	2963	3014	3065	3116
20	2338	2377	2415	2453	2491	2530	2568	2606	2644	2683	2721	2759	2797	2836	2874	2912
25	2326	2351	2377	2402	2428	2453	2479	2504	2530	2555	2581	2606	2632	2657	2683	2708
30	2313	2326	2338	2351	2364	2377	2389	2402	2415	2428	2440	2453	2466	2479	2491	2504
35	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300
40	2287	2275	2262	2249	2236	2224	2211	2198	2185	2173	2160	2147	2134	2122	2109	2096
45	2275	2249	2224	2198	2173	2147	2122	2096	2071	2045	2020	1994	1969	1943	1918	1892
50	2262	2224	2185	2147	2109	2071	2032	1994	1956	1918	1879	1841	1803	1765	1726	1688
55	2249	2198	2147	2096	2045	1994	1943	1892	1841	1790	1739	1688	1637	1586	1535	1484
60	2236	2173	2109	2045	1981	1918	1854	1790	1726	1663	1599	1535	1471	1408	1344	1280
65	2224	2147	2071	1994	1918	1841	1765	1688	1612	1535	1459	1382	1306	1229	1153	1076

ADJUSTMENT CHART FOR 3 PULLEY ATD(modified)

VALUES OF 'X' IN mm FOR VALUE OF L IN METERS

T/L	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
0	1330	1360	1389	1419	1449	1479	1508	1538	1568	1598	1627	1657	1687	1717	1746	1776
5	1326	1351	1377	1402	1428	1453	1479	1504	1530	1555	1581	1606	1632	1657	1683	1708
10	1321	1343	1364	1385	1406	1428	1449	1470	1491	1513	1534	1555	1576	1598	1619	1640
15	1317	1334	1351	1368	1385	1402	1419	1436	1453	1470	1487	1504	1521	1538	1555	1572
20	1313	1326	1338	1351	1364	1377	1389	1402	1415	1428	1440	1453	1466	1479	1491	1504
25	1309	1317	1326	1334	1343	1351	1360	1368	1377	1385	1394	1402	1411	1419	1428	1436
30	1304	1309	1313	1317	1321	1326	1330	1334	1338	1343	1347	1351	1355	1360	1364	1368
35	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300
40	1296	1292	1287	1283	1279	1275	1270	1266	1262	1258	1253	1249	1245	1241	1236	1232
45	1292	1283	1275	1266	1258	1249	1241	1232	1224	1215	1207	1198	1190	1181	1173	1164
50	1287	1275	1262	1249	1236	1224	1211	1198	1185	1173	1160	1147	1134	1122	1109	1096
55	1283	1266	1249	1232	1215	1198	1181	1164	1147	1130	1113	1096	1079	1062	1045	1028
60	1279	1258	1236	1215	1194	1173	1151	1130	1109	1088	1066	1045	1024	1003	981	960
65	1275	1249	1224	1198	1173	1147	1122	1096	1071	1045	1020	994	969	943	918	892

CORRESPONDING VALUES OF 'Y' IN MILIMETERS

T/L	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
0	2389	2479	2568	2657	2746	2836	2925	3014	3103	3193	3282	3371	3460	3550	3639	3728
5	2377	2453	2530	2606	2683	2759	2836	2912	2989	3065	3142	3218	3295	3371	3448	3524
10	2364	2428	2491	2555	2619	2683	2746	2810	2874	2938	3001	3065	3129	3193	3256	3320
15	2351	2402	2453	2504	2555	2606	2657	2708	2759	2810	2861	2912	2963	3014	3065	3116
20	2338	2377	2415	2453	2491	2530	2568	2606	2644	2683	2721	2759	2797	2836	2874	2912
25	2326	2351	2377	2402	2428	2453	2479	2504	2530	2555	2581	2606	2632	2657	2683	2708
30	2313	2326	2338	2351	2364	2377	2389	2402	2415	2428	2440	2453	2466	2479	2491	2504
35	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300	2300
40	2287	2275	2262	2249	2236	2224	2211	2198	2185	2173	2160	2147	2134	2122	2109	2096
45	2275	2249	2224	2198	2173	2147	2122	2096	2071	2045	2020	1994	1969	1943	1918	1892
50	2262	2224	2185	2147	2109	2071	2032	1994	1956	1918	1879	1841	1803	1765	1726	1688
55	2249	2198	2147	2096	2045	1994	1943	1892	1841	1790	1739	1688	1637	1586	1535	1484
60	2236	2173	2109	2045	1981	1918	1854	1790	1726	1663	1599	1535	1471	1408	1344	1280
65	2224	2147	2071	1994	1918	1841	1765	1688	1612	1535	1459	1382	1306	1229	1153	1076

Annexure-C

3:1 RATIO, THREE PULLEY TYPE ATD

FORMAT FOR RECORDING THE OBSERVATIONS/MEASUREMENTS

त्म्ब्त्क छत्त रू ..

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RAILWAY :---------- **DATE OF INSPECTION:----------**

DIVISION :----------

SECTION :----------

LOCATION:----------

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
1.	Pulley	Manufacturer: Date of installation:	(i) Visual examination of wear of pulley, bent arms (ii) Movement of axle (iii) Grazing of side walls of pulley with wire rope (iv) Alignment of pulley block of ATD with OHE and bent arms					
2.	S. S. Wire rope	Manufacturer: Year of manufacturer: Date of installation: Specification to which procured:	(i) Condition of SS wire rope (ii) Position of SS wire rope over pulley groove (iii)Date of lubrication (iv)Measurement of X, Y dimensions as per adjustment chart of ATD (v)Status of inner and outer strands of wires (vi)Ovality of SSWR over radically moving portion of the rope.					

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
3.	Bearing	Bearing No.: Manufacturer: Date of installation:	(i) Condition of felt and grease seal					
4.	Clevis & Eye	Type(Al Bz or forged steel): Manufacturer: Date of Installation:	(i) Visual examination (ii) Alignment of clevis with fixed pulley (iii) Movement of clevis & eye					
5.	Hex tie rod	Make: Date of installation:	(i) Visual examination for rusting/corrosion/ deformation/breakage (ii) Parallelism of hex tie rod (iii) Length of hex tie rod (iv) Movement of angle spacer of hex tie rod					
6.	Counter weights	Make: Date of installation:	(i) Check for missing counter weights (ii) Check deformation of eye of the base CW					

SN	Item	Details of item	Checks	Observation	Remedial action taken	Details of replacement if any	Previous inspection (Routine/AOH/IOH/POH) dates with record no.	Remark
7.	Mast anchor fitting	Manufacturer Date of installation Type	(i) Check deformation of fitting (ii) Check whether eye of fitting is in horizontal plane.					
8.	Guide Tube		(i) Check for bent/deformed/missing guide tube					
9.	Fastners		(i) Looseness of fasteners					

(141)
CEDE
DY.CEE/TRD
TRD/TECH
88
5/3.

(11)

Government of India,
Ministry of Railways
Research Designs & Standards Organisation,
Manak Nagar, Lucknow– 226 011

Telephone: 2465763 (O).
42805(Off.)
Fax : 91-0522-2465763
E-mail:dti.rdso@gmail.com

पत्रांक: टीआई/पीएसआई/अर्थिङ्ग/पॉलिसी/14

दिनांक: 26.02.2020

To,
The Principal Chief Electrical Engineer,

(i) Central Railway, Station Building, Mumbai CST – 400 001.
(ii) Eastern Railway, Fairlie Place, Kolkata-700 001.
(iii) East Central Railway, Hajipur-844 101.
(iv) East Coast Railway, Bhubaneshwar-751 023.
(v) Northern Railway, Baroda House, New Delhi - 110 001.
(vi) North Central Railway, Allahabad-211 015.
(vii) North Eastern Railway, Gorakhpur-273 012.
(viii) North Frontier Railway, Mailgaon - 781 011.
(ix) North Western Railway, Jaipur – 302 017.
(x) Southern Railway, Park Town, Chennai- 600 003.
(xi) South Central Railway, Railnilayam, Secunderabad-500 371.
(xii) South Eastern Railway, Garden Reach, Kolkata-700 043.
(xiii) South East Central, Railway, Bilaspur-495 004.
(xiv) South West Railway, DRM's Office, Hubli-580 028.
(xv) Western Railway, Churchgate, Mumbai-400 020.
(xvi) West Central Railway, Jabalpur- 482 001.
(xvii) Konkan Railway, Belapur Bhavan, Sector-11, CBD Belapur, Navi Mumbai 400614.
(xviii) CAO, CORE Allahanbad-211001.

विषय: विशेष रखरखाव निर्देश (SMI) सं. TI / SMI / 0032 Rev.02.
(Special Maintenance Instruction (SMI) no. TI/SMI/0032 Rev.02)

संदर्भ: (i) This office letter no. TI/PSI/EARTHING/POLICY/14 dated 26.11.2019.
(ii) Railway Board letter no. 2013/RE/161/122 dated 30.09.2019.

The draft the SMI No. TI/SMI/0032 Rev.02 was circulated to Zonal Railways vide this office letter referred (i) above. Based on the comments received, Special Maintenance Instruction (SMI) no. TI/SMI/0032 Rev.02 (Provision of Buried Rail at Switching Posts with Conventional Earthing System) has been finalised by this office and same is enclosed herewith for necessary action please.

This is issued with approval of the competent authority.

आशीष 26.02.2020
(डा. आशीष अग्रवाल)
निदेशक टी आई -3
कृते महानिदेशक (टी आई)

संलग्नक: SMI No. TI/SMI/0032 Rev.02

प्रतिलिपि: ED/RE, Railway Board, Rail Bhavan, New Delhi – 110 001

(140)

Government of India

Ministry of Railways

SPECIAL MAINTENANCE INSTRUCTION No.

TI/SMI/0032 Rev- 02

For

SETTING UP EARTHING STATION AT SWITCHING POSTS (SSP & SP)

WITH CONVENTIONAL EARTHING SYSTEM

Issued By

Traction Installation Directorate

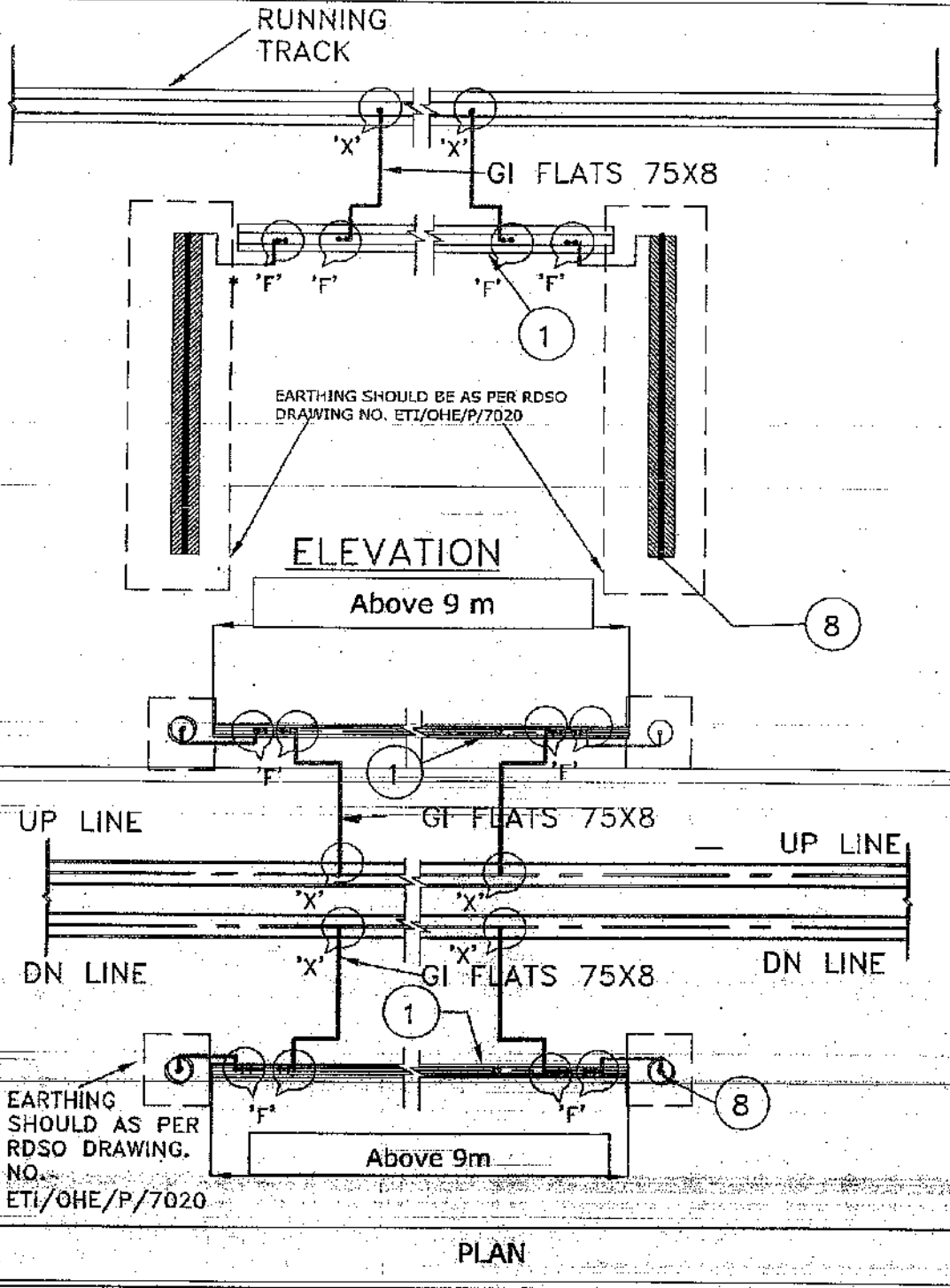
Research Designs & Standards Organisation

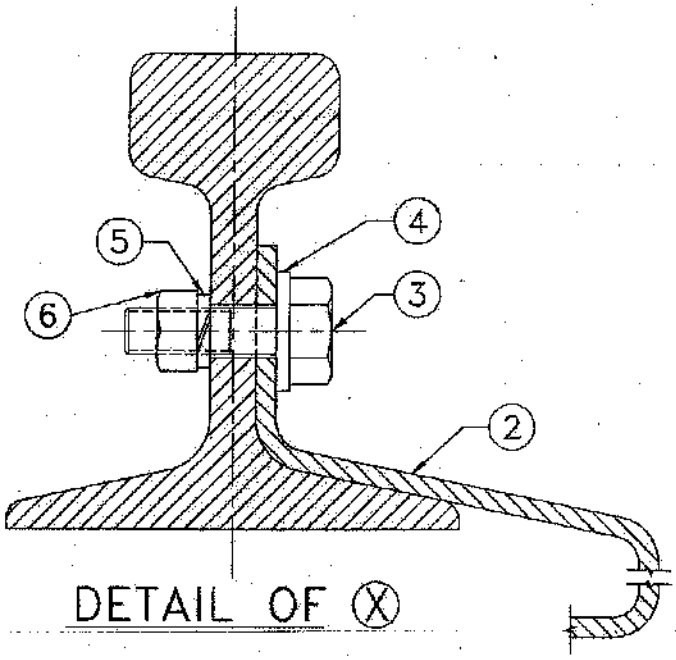
Lucknow – 226011.

February, 2020

6.0 Connection arrangement of the Running Rail – Buried Rail – Earth Electrodes

* For detail of 'X' refer page no. 05 of this SMI.
* For detail of 'F' refer RDSO Drawing no. ETI/PSI/0212-1





7.0 The Earth electrode shall be made as per Drawing No. ETI/OHE/P/7020.

8.0 For Buried Rail Drawing No. ETI/PSI/0212-1 to be referred.

9.0 Schedule of materials:

Ref:	Description	Quantity
1.	Above 9 m long rails or TRD masts.	02 Nos.
2.	Galvanised Iron Flats of 75mm X8 mm	as required
3.	M-12 Bolts (Stainless steel)	04 Nos
4.	Plain washer	04 Nos
5.	Lock washer (Spring steel)	04 Nos
6.	Nuts	04 Nos
7.	M-20 Bolts (Stainless steel) (for connection of GI flat to buried rail)	16 Nos
8.	Earth electrode as per RDSO Drawing no. ETI/OHE/P/7020	04 Nos

****

1.0 INTRODUCTION

1.1 This SMI supersedes the SMI No. TI/SMI/0032 Rev.01 issued by RDSO vide letter no. TI/PSI/Earthing/Policy/14 dated 01.04.2014.

1.2 With advances in track technology the Rail is no longer at ground potential which has been the assumption of existing Earthing Code ETI/PSI/120 & ETI/OHE/71. The structures have been conventionally bonded to the Rail with belief that the structure would be grounded through the Rail. Whereas, now Rail sees earth through the structures many-a-times with increasing rail-formation insulation.

1.3 The immediate concerns which arise are the rising of Rail potentials, affect on the efficacy of existing protection scheme and safety of Rail vehicles. Thus, it is decided to create Earthing stations at a place near the Switching Posts (SP/SSP). Idea is to create a positive, strong and deliberate earth connection to improve system resilience.

1.4 The SMI No. TI/SMI/0031 Rev.01 was discussed in the 30th MSG (TRD) held at Mount Abu on 13th & 14th April 2018 and 31st MSG (TRD) held at Somnath on 08th & 09th November 2019. The group deliberated for the revision of SMI.

2.0 REFERRED DOCUMENTS

SN	Document	Description	Number
1.	Specification	Code for Bonding and Earthing for 25 kV, a.c., 50 Hz Single Phase Traction System.	ETI/OHE/71
2.	Specification	Code of Practice for Earthing of Power Supply Installations for 25 kv, ac, 50Hz, Single Phase traction System.	ETI/PSI/120
3.	Specification	Specification for Exothermic Welding (Connection for Bonding, Earthing /Grounding)	TI/SPC/OHE/EXOTHRMBOND/0100 (04/10)
4.	Specification	Specification for Stainless Steel fasteners for 25kV AC Traction Overhead equipment	TI/SPC/OHE/FASTNERS/0120 rev.01
5.	Drawing	Earthing Station	ETI/OHE/P/7020
6.	Drawing	Typical Earthing Layout at Feeding Station	ETI/PSI/203
7.	Drawing	Typical return Current connection to Buried Rail at 132/25 kV Traction Sub Station	ETI/PSI/0212-1
8.	Drawing	Return Current Connection to the Sub Sectioning and Paralleling Post.	ETI/PSI/0201-1
9.	Drawing	Return Current Connection to the Sectioning and Paralleling Post.	ETI/PSI/0202-1

3.0 It may be noted that in conventional electrification which uses a running Rail for return circuit, one end of Transformer's secondary is connected to this Earthing system, thereby making full traction current flow through this system. It may be further noted that full load current would not necessarily take: Running Rail>Buried Rail>Transformer. Some current can as well get to the transformer from Earth Electrode>Earth Grid>Transformer.

4.0 Existing Arrangement for Earthing the Tracks

There are no direct earth connections except at the Feeding posts. The design philosophy assumes that the Rails are naturally at ground potential and the structures get earthed by connection to the Rails.

Present connection at Feeding Post has been described in RDSO Drawing No. ETI/PSI/203. The following are main components of the present Feeding Post Earthing Station:-

4.1 BURIED RAIL: Acts as maintenance free Earth Bus.

4.2 EARTHGRID: Connects various ground Electrodes and reduces the possibility of higher Step Potential.

4.3 EARTH ELECTRODES: Couples the Buried Rail to parent earth and hence bringing down the Earth potential.

5.0 DESIGN OF THE EARTHING STATION

Two Earthing Stations near the Switching Station, one on either side of the UP and DN track, shall be provided. For multi track system [i.e. Block Sections having more than two tracks (UP & DN track)], separate Earthing Station for each track shall be provided.

5.1 GENERAL ARRANGEMENT

Preferably Rail or TRD mast (all type) of length more than 9 m shall be used to create an Earth station. The released Rails/TRD Masts should always be preferred. Two Earth Electrodes shall be provided at each end of the Buried Rail as per RDSO Drawing No. ETI/OHE/P/7020. Thus the Buried Rail would be configured as Earth Bus.

5.2 DESIGN

A trench, of size about 0.6 m x 'X' m, with a depth of about 1 m from the ground level shall be dug on the track side. ('X' should be more than 2 m of the length of the Rail/TRD mast used)

5.2.1 At a distance of about 1.5m ± 0.5 m, from either ends of the Buried Rail, two 19 mm Φ holes are drilled for connection to earth pits. 02 more holes at 1.5m ± 0.5 m from the above holes to be drilled for connection to track.

5.2.2 Two electrodes shall be provided as per RDSO Drawing No. ETI/OHE/P/7020 at a distance of 1.5m±1.0m on both ends. Earthing shall be provided as described in RDSO Drawing No. ETI/PSI/0212-1 and mentioned at page no. 4 & 5 of this SMI. GI flats are preferably to be used for earthing, in view of longer life, but in case of non-availability of GI Flats, standard MS Flats can be used after painting them with two coats of Aluminium paint. Subsequently the word GI Flat will mean both the above methods.

5.2.3 Preparation of Earth Bus (Buried Rail)

5.2.3.1 The Rail (this nomenclature includes masts as mentioned in Para 5.1), duly prepared, shall be lowered in to the trench.

5.2.3.2 The connection between the Buried Rail and Earth Electrodes of respective Earth Pits on both sides shall be done through 75 x 8 mm GI Flats, by using 20 mm Φ Stainless Steel bolts as mentioned at page no. 4&5 of this SMI.

5.2.4 Preparation of Running Rail

Holes are drilled on the web of running Rail and connection to be made as mentioned on page no. 4&5 of this SMI.

5.2.5 Connection between the Running Rail and Buried Rail

Connections between the Running Rail and the Buried Rail are made with two GI Flats of size 75 x 8 mm, connected with Buried Rail with 20 mm Stainless steel bolts, as per RDSO Drawing No. ETI/PSI/0212-1 and to the Running Rail with M-12 Bolt, as mentioned at page no. 4&5 of this SMI.

MAINTENANCE INSTRUCTION No. TI/MI/00034 (Rev. 0)

SPECIAL MAINTENANCE INSTRUCTIONS (SMI'S) FOR CONTACT WIRE IN OOR OHE

1. OBJECTIVE:

To evolve maintenance procedure for arresting the failures of contact wire in Out -Of-Run (OOR) OHE.

2. BACK GROUND:

2.1 RDSO started analysis of all the cases of contact wire failures form May'97. Based on the information furnished by the Railways to RDSO, analysis of the failures upto December'98 has been carried. The study reveals that 43% of the total failures reported to RDSO (41% of the failures from May'97 to Dec.'98) have occurred at out-of-run (OOR) contact wire in anchor spans where as the extent of OOR OHE is only 13% of the total OHE. Thus failures/unit length of contact wire are 5 times more in OOR OHE compared to the failures in in-run (IR) OHE. During 1998, out of total 30 failures, 14 have occurred at OOR OHE containing 11 failures at/close to Raised Register Arm (RRA) clamp, 1 joint failure and 2 at other locations. Also these failures in OOR OHE are not related to the age of the contact wire. Details of the failures w.e.f. May' 97 are given in annexure –I with the breakup in annexure-II.

2.2 The failures have been examined critically in TI Lab and M&C directorate of RDSO. Mode of fracture as seen on Scanning Electron Microscope (SEM) indicated both overload in tension & bending. To investigate into the excessive failures taking place at OOR OHE, various locations in the field were inspected jointly by the officials of TI and M&C Directorate's.

2.3 Being not used for current collection, the OOR OHE is not subjected to the stresses and wear which the OHE in- run (IR) is subjected to. The investigations revealed that at RRA clamps, vibrations caused by movement of train, wind etc. result the edge of the clamp to dig into the wire causing considerable reduction in area & even occasional cracks on wire. During maintenance, the staff sometimes hit/hammer the RRA clamp while plumbing the cantilever assembly which results in excessive mechanical stresses/fatigue, damage to the wire at the clamp fitting. The location becomes more susceptible to failure due to bending of the wire for anchoring.

2.4 In ACTM (para 20326 and 20329, vol. II part I), in case of contact wire, maintenance of kinks/twists, PG clamps/clips and jumpers only is specified. No specific instructions for maintenance of contact wire in the OHE at OOR is prescribed. Keeping in view the majority of failures at/near RRA clamp, it is considered necessary that special maintenance be introduced at such locations to arrest these failures.

3.0 PROCEDURE:

3.1 One time inspection drive:

Before a regular schedule at the specified periodicity for special maintenance checks is followed, *it is necessary that one time special drive is undertaken* to inspect the OOR OHE thoroughly and necessary corrective measures are taken. Special attention may be paid to locations where the failures have occurred repeatedly. Maintenance checks are given below in para 3.2 below.

3.2 Checks to be carried out

I) At RRA clamp (Part No. 1370-1): -

a) Periodicity:

Annual or whenever the location of the clamp is changed.

b) Work to be carried out:

- **Open the RRA clamp.**
- **Check for cracks/damages to the contact wire and sharp edges/defect in the clamp fitting with the help of magnifying glass, check for deformation of RRA clamp.**
- **Take corrective action as required.**
- **Check for cracks/damages to the contact wire in the vicinity of RRA clamp specifically at the previous positions of the clamp. Take corrective action such as changing the contact wire/providing splice/contact wire ending clamp as deemed necessary.**

c) Shifting of RRA clamp:

Whenever there is any need for shifting the position of RRA clamp, it should be ensured that the clamp bolts are loosened properly & then only the shifting is done. *Under no circumstances, should the clamp be hit/hammered for shifting as the contact wire is liable to be damaged in the process.*

ii) G-Jumper, anti theft jumper and PG Clamps: -

a) Periodicity -

Annual or whenever the location of the clamp is changed.

b) Work to be carried out-

- **The G-jumper should properly be fixed with adequate allowance for travel during expansion/contraction of the wire. At locations near substations and liable to carry large amount of current, it should be ensured that the G-jumper are provided as per the arrangement given in RDSO Drg. No. ETI/OHE/G/05102**
- **Check for damage to the jumper wire strands & replace if necessary.**
- **Open out the PG clamps, check for damage to the jumper wire/contact wire. Check the PG clams for any corrosion/over heating/sharp edges etc. and take corrective action.**
- **Before restoring connections clean the grooves & wire properly.**
- **Tighten the clamps with the help of torque wrench to avoid over tightening.**

iii) Contact Wire ending clamp fittings (Part No. 1110-2 & 1120-1): -

a) Periodicity: During POH

b) Work to be carried out:

- **Open the clamp and check for damage to the contact wire and sharp edges/deformation in the ending clamp.**
- **Provide new ending clamp if required.**
- **If any damage to the contact wire is noticed, cut the piece of the contact wire, provide the ending clamp and adjust the OHE with the help of adjuster.**

iv) Equalizing Plate of ATD (Part No. 5191):-

a) Periodicity: During POH

b) Periodicity: During POH

- **It should be checked that the equalizing plate is in vertical position so that the tension in contact wire and catenary wires is equal. In case, its is not vertical, the adjustment should be carried out by adjusters or by cutting of conductors as required.**

Annexure –1

Sl. No	Date of failure	Year of failure	Rly/ Section	Manufacturer	Year of commission	Type of C.W	Remarks	Location	Cause of Failure
1.	13/05/97	1997	SC Rly	JME	1989	NK	OOR	Dist from support clamp 18 m	Joint failure
2.	14/06/97	1997	SE Rly	Veekay	1991	NK	OOR	Snapped at end clamp fitting	End clamp fitting
3.	24/07/97	1997	W Rly	Veekay	1985	Jointed	OOR		Parting
4	31/07/97	1997	E Rly	CDL	1997				**not due to material failure
5	09/10/97	1997	SE Rly	NICCO	1986	NK	IR	2m from swivel clip	
6	16/10/97	1997	W Rly	NICCO	1983	Jointed	IR		Parting
7	22/10/97	1997	SC Rly	JME	1989	NK	IR	Mid of span	material failure , CW snapped
8	28/01/98	1998	C Rly	NK*	1984	Jointed	IR		Joint failure
9	06/02/98	1998	W Rly	Veekay	1990	Jointed	OOR	At RRA Clamp	
10	11/02/98	1998	C Rly	NK*	1988	NK	OOR	At RRA Clamp	
11	26/02/98	1998	SE Rly	Veekay	1991	NK	OOR	At the edge of RRA Clamp	
12	11/03/98	1998	S Rly	NICCO	1992	NK	IR	6m from RRA Clamp	** Inclusion of foreign material
13	17/03/98	1998	C Rly	Veekay	1988	NK	IR		Joint failure
14	23/03/98	1998	W Rly	NICCO	1973	Jointed	OOR		Joint failure
15	11/04/98	1998	C Rly	JME	1988	NK	IR		**Joint failure
16	21/04/98	1998	C Rly	JME	1988	NK	IR		Joint failure
17	26/04/98	1998	W Rly	NICCO	1997	Jointed	OOR		Impurity in CW
18	20/05/98	1998	W Rly	Veekay	1995	Jointed	IR	Dist from support 5m	Material failure
19	23/05/98	1998	SE Rly	JME	1994	NK	OOR	At RRA Clamp	
20	24/05/98	1998	W Rly	Veekay	1987	Jointed	OOR	At RRA Clamp	
21	28/05/98	1998	SE Rly	Veekay	1995	NK	OOR	Exit point of contact ending clamp	
22	16/'06/98	1998	N Rly	Veekay	1982	Jointed	IR	2m from support	Joint failure
23	16/06/98	1998	SC Rly	NK*	1984	NK			Joint failure
24	29/06/98	1998	N Rly	Veekay	1993	Jointed			Joint failure
25	30/06/98	1998	C Rly	NK*	1994	Jointed	IR	33.5 m from support	Joint failure
26	15/07/98	1998	W Rly	NICCO	1987	Jointed	OOR	Near RRA Clamp	** no defect in material
27	20/07/98	1998	SC Rly	JME	1997	NK	IR	Mid of span	Material failure
28	28/07/98	1998	SC Rly	JME	1994	NK	IR	Mid of span	Material failure
29	14/09/98	1998	SE Rly	Veekay	1990	NK			Joint failure
30	14/08/98	1998	W Rly	Veekay	1990	Jointed	NK		**Joint failure
31	19/09/98	1998	SE Rly	NICCO	1990	NK	OOR	At the edge of RRA Clamp	** Reduction in area at RRA clamp
32	03/1198	1998	N Rly	Veekay	1994	NK	OOR	At RRA Clamp	
33	05/11/98	1998	SE Rly	BICC	1969	Jointed	OOR	5 cm from RRA Clamp	** Severe arcing , Cause not established
34	12/1198	1998	C Rly	Veekay	1984	NK	OOR	Near RRA clamp, G-jumper	**Due to heating at G jumper
35	28/11/98	1998	C Rly	Veekay	1988	Jointed	IR		Material failure
36	17/12/98	1998	C Rly	NICCO	1993	NK	OOR	At RRA Clamp	
37	31/12/98	1998	N Rly	Veekay	1982	Jointed	IR	Between 1st & 2nd dropper	Joint failure

NK– Not known **IR** – In run **OOR** – Out of run ****** Investigated by RDSO

Annexure II

Analysis of Contact Wire fafilures reported to RDSO

Year	No of failures				Total Failures
	On OOR CW		Joint Failures	Others	
	At RRA Clamp	Others			
May'97 to Dec'97	-	2	1	4	7
During 1998	11	2	12	5	30

Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow – 226011

Maintenance Instruction No. TI/MI/0035 Rev. 1

Maintenance Instruction for Provision of Pipe On Hex tie Rod Of Auto Tensioning Devices (ATD)

1. OBJECTIVE

To evolve maintenance procedure for arresting panto entanglements at crossovers, turnouts, overlap type neutral sections and at all other such locations where ATDs are provided, due to breakage of S. S. Wire Rope of auto-tensioning device of concerned ATDs locations.

2. BACKGROUND

The crossover OHE is provided with FTA at one end and BWA at another end. The tension length of this OHE is normally 750 m or less. In many cases the tension length of this OHE is much less than 750m The ATD provided at BWA carries a limiting device which is provided with hex tie rod of standard length to prevent the OHE from falling on the ground in case of breakage of stainless steel wire rope. Standard length of hex tie rod has been stipulated in the drawings to cater for taking up movement of movable pulley due to expansion or contraction of OHE conductors caused by temperature variations for maximum tension length of OHE i.e 750 m. Normally the crossover OHE has shorter length than 750 m and therefore, part length of hex tie rod becomes redundant. The crossover OHE is provided with section insulator. In the event of failure of SS wire rope of ATD, moving pulley of ATD moves away from the anchor till the spacer angle rests at the end of hex tie rod of limiting device. This causes sag in cross over OHE in such case the shorter the tension length of OHE , greater is the space for movement of movable pulley and therefore, larger the sag in OHE. In case of crossover OHE most of the sag takes place in the span carrying section insulator and therefore there is a greater possibility of disturbance of cross over OHE. Due to this phenomenon panto-entanglement takes place with OHE erected at crossover turn outs in case of breakage of SS wire rope of crossover OHE ATD.

At other locations such as neutral sections, insulated/uninsulated over lap the panto entanglemant may take place due to breakage of S.S wire rope of ATD causing sag in anchor span in such cases also the tension lengths may be shorter then 750 m. To minimise the possibility of panto entanglement in all such cases the disturbance of OHE has to be minimised which can be achieved by inserting a pipe of suitable length in hex tie rod (on the OHE side) of ATD so that redundant length of this hex tie rod is bridged

and movement of movable pulley is restricted to minimum in case of breakage of stainless steel wire rope.

In this maintenance instruction the length of pipe to be inserted in the hex tie rod of ATD has been worked out for different tension lengths of OHEs and different minimum temperatures prevailing in the regions. The separate tables have been given for winch type, 3- pulley type and 3 pulley type (modified) ATDs. The tables give values of length of pipe for standard X/Z values. Practically there may be difference in actual and standard values of X/ Z. Therefore, procedure to arrive at length of pipe to be inserted has also been given for such cases.

3. PROCEDURE

Measure actual value of X/Z of ATD, say it is z_1. Measure ambient temperature. Find out tension length of relevant OHE from OHE layout plan/records. From the relevant table given in drawing No. RE/33/G/00193 for winch type ATD, drawing No. ETI/OHE/G/00195 Rev. A for 3 pulley type (3:1 ratio) ATD and drg. No. TI/DRG/OHE/ATD/RDSO/00003/99/0 for 3 pulley type (3:1 ratio) modified ATD,evaluate standard X/Z value for the prevailing ambient temperature and tension length.Say this value is z_2. Find the difference in actual and standard values of X/Z, say this is z_3. Then, $z_3 = z_1 - z_2$, which may be positive or negative.

.

Now decide whether prevailing lowest temperature in the region is 0°C, 5°C, 10°C or 15 °C. According to this temperature and the tension length of relevant OHE find out length of pipe from the relevant tables 1 to 4 given in this maintenance instruction, say it is x mm. The actual length of pipe to be inserted in hex tie rod of ATD shall be x-z_3 mm. The pipe of this length may be inserted in the hex tie rod of ATD at the OHE end.

4. DETAILS OF PIPE

Material	-	GI
Nominal Diameter	-	20 mm.
Class	-	Medium.
Specification	-	IS: 1161 – 1979.

5. PERIODICITY OF IMPLEMENTATION OF SMI

The pipe of suitable length is to be inserted in the hex tie rod of ATDs of all locations . On new electrification projects this is to be done during installation of OHE. The condition of pipe should be checked annually and during POH of ATD and in case of doubt it should be replaced.

6. AGENCY FOR IMPLEMENTATION

Railways and RE project units.

TABLE No. 1

PROVISION OF PIPE ON HEX TIE ROD OF 2200 mm
PROVIDED WITH WINCH TYPE ATD
(REFERENCE: DRAWING NO. ETI/OHE/P/5300- Rev H and ETI/OHE/P/5350 -1 REV. C)

Tension length (m)	Length of pipe which can be provided (mm)			
	0°C	5°C	10 °C	15 °C
750	Nil	Nil	40	105
700	Nil	Nil	60	120
650	Nil	25	80	140
600	Nil	50	105	155
550	30	80	125	170
500	60	105	145	190
450	90	130	165	205
400	120	155	190	220
350	150	180	210	240
300	180	205	230	255
250	210	230	250	275
200	240	255	275	290

TABLE No. 2

PROVISION OF PIPE ON HEX TIE ROD OF 2300 mm
PROVIDED WITH WINCH TYPE ATD
(REFERENCE: DRAWING NO.ETI/OHE/P/5300 Rev H and ETI/OHE/P/5350-1 REV. C.

Tension length (m)	Length of pipe which can be provided (mm)			
	0°C	5°C	10 °C	15 °C
750	Nil	75	140	205
700	40	100	160	220
650	70	125	180	240
600	100	150	205	255
550	130	180	225	270
500	160	205	245	290
450	190	230	265	305
400	220	255	290	320
350	250	280	310	340
300	280	305	330	355
250	310	330	350	375
200	340	355	375	390

TABLE No. 3

PROVISION OF PIPE ON HEX TIE ROD
PROVIDED WITH THREE PULLEY TYPE ATD (3 : 1 RATIO)
(REFERENCE: DRAWING NO. ETI/OHE/P/5500 –1 Rev –K Sheet 1)

Tension length (m)	Length of pipe which can be provided (mm)			
	0°C	5°C	10 °C	15 °C
750	85	150	215	280
700	115	175	235	295
650	145	200	255	310
600	175	225	275	330
550	205	250	300	345
500	235	280	320	360
450	265	305	340	380
400	295	330	360	395
350	325	355	385	420
300	355	380	405	430
250	385	405	425	450
200	415	430	450	465

TABLE No.4

PROVISION OF PIPE ON HEX TIE ROD
PROVIDED WITH THREE PULLEY TYPE ATD (3 : 1 RATIO) (MODIFIED)
(REFERENCE: DRAWING NO. TI/DRG/OHE/ATD/RDSO/00003/99/0)

Tension length (m)	Length of pipe which can be provided (mm)			
	0°C	5°C	10 °C	15 °C
750	95	155	220	285
700	125	185	240	300
650	155	210	265	320
600	185	235	285	335
550	215	260	305	355
500	240	285	330	370
450	270	310	350	385
400	300	335	370	405
350	330	360	390	420
300	360	385	410	440
250	390	410	435	455
200	420	440	455	470

SPECIAL MAINTENANCE INSTRUCTION (SMI) FOR PROVISION OF INSULATED CADMIUM COPPED CATENARY WIRE UNDER OVER-LINE STRUCTURES ON 25 kV A.C TRACTION SYSTEM.

1. **OBJECTIVE**: To protect Catenary wire under overline structures, from flashover damages due to fall of foreign material, electrocution of birds/monkeys etc. by providing insulated Cd. Cu catenary cable in place of bare Cd-Cu catenary wire.

2. **BACK GROUND**: On 25, kV a.c. traction system, failures of catenary under over line structures are being experienced due to earth faults caused by foreign material and electrocution of birds/monkeys etc. Various preventive measures such as provision of PVC sleeve, PVC tube, heat shrinkable tape etc. have been tried but did not last long.

   Subsequently, Insulated Cadmium Catenary wire has been developed and extensively put on field trial in N. Rly. Based on the satisfactory performance of this Insulated Cadmium Catenary wire manufactured as per RDSO's specification No. ETI/OHE/75(4/95), it has been decided in the XVII MSG (TRD) meeting (para 6.2, item 5.2) that all Railways will provide the same under over line structures.

3. **PROCEDURE:** The arrangement/procedure for providing Insulated Cadmium Catenary wire is indicated in the sketch No. ETI/OHE/SK-570, enclosed herewith.

   The length of insulated cadmium copper catenary wire shall be selected in such a manner that the insulated catenary shall remain projected minimum 2 meters on either side of the over line structure. After providing the insulated catenary cable, the length of droppers in the span shall be adjusted to ensure that the profile of contact wire remains the same or as designed. The catenary splice (RI 1090) to be provided for joining the insulated catenary and the conventional catenary wire shall be procured as per RDSO Spec. No. ETI/OHE/49 (9/95) A&C Slip No. 1 or the latest.

4. **MATERIAL SPECIFCIATION**: The insulated Cadmium Catenary wire shall be procured as per RDSO Spec. NO. ETI/OHE/75(4/95) with A&C Slip No. 1&2.

5. **APPROVED SUPPLIERS**:

1. M/s. NICCO Corporation, NICCO House, 1&2 Hare Street Calcutta – 700 001.

Contact person:

1. Sh. A. W. Shrwty, Sr. V.P (Mkt.) Ph. 2485102
2. Sh. D. Singh, Dy. GM (MS) Fax: 2209443

2. M/s. Universal Cables Ltd., PO Birla Vikas, Satna 484 005 (MP)

Contact person:

1. Shri J.M. Gupta, President Marketing- Ph. 23561 to 23565
2. Shri. M. Gandhi, GM (Marketing) Fax: 07672 (25344)

भारत सरकार, रेल मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

सत्यमेव जयते

कर्षण संस्थापन निदेशालय
TRACTION INSTALLATION DIRECTORATE

Special Maintenance Instruction for
CONTACT WIRE AND ASSOCIATED FITTINGS
SMI No. TI/MI/0037 Rev.3

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक Principal Executive Director	
अनुशंसित Recommended by	कार्यकारी निदेशक (कर्षण संस्थापन) Executive Director (TI)	30/05/2025

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SPECIAL MAINTENANCE INSTURCTIONS (SMI) FOR CONTACT WIRE AND ASSOCIATED FITTINGS

1. **OBJECTIVE:**

In order to achieve high reliability and zero defect OHE and to ensure effective checks on the maintenance works. To specify maintenance procedures for arresting contact wire/catenary wire parting cases. These instructions are supplementary and are to be read in conjunction with the procedures already laid down in the ACTM-Vol. II(Part –I) Paras 20320 to 20330. It is applicable for 1x25 kV traction system.

2. **BACKGROUND**

2.1 For proper upkeep & maintenance of OHE, the maintenance procedures laid down in ACTM are quite exhaustive. The sequence of checks rights from foot patrolling to POH level ensures detection & rectification of defects in the initial stages itself." POH of OHE , once in 8 years, is aimed at restoration of OHE to the same condition as it was during commissioning. But, based on the reports of OHE parting case due to various reasons affecting the reliability, issuance of these special maintenance instructions has become necessary to cover few items explicitly.

2.2 The analysis has indicated that significant number of cases of OHE parting are attributed to the opening of silver brazed joints and at PG clamp locations. Few cases of parting of contact wire/catenary wire have occurred at ending clamp fitting also. During analysis of cases of parting of contact wire, it has been observed that the opening of silver brazed joints is not age related and majority of cases have occurred in known polluted areas. Regarding replacement of PG clamps during POH, decision was taken in XXII MSG (RTD) meeting held at CORE/ALD on 7/8.2.2000.

2.3 Regarding the failures of silver brazed joints, it is experienced that

- The silver brazed joints do not fail suddenly.
- Initially the tip of the joint opens and the jointing surface is exposed to atmosphere. The joint gradually looses its strength due to displacement of silver with its oxides. Fast corrosion of silver brazed joints take place in the environment having SO2 gases with moisture and aerated aqueous NH3/ammonium salts.

2.4 The maintenance instructions given in this SMI are supplementary to the one given in the ACTM.

2.5 Necessary record keeping of PG Clamp / Ending Clamp & its location etc. in line of proforma given in ACTM for other items, especially, if it is replaced before its schedule replacement time period shall be ensured.

2.6 As per the As per the Railway Board letter no. 2013/Elect(G)/148/1 dated 10.05.2019 existing periodicity of POH of OHE after 8 years with 3 IOH in between after every 2 years. POH after every 6 years in coastal and saline area with 2 IOH in between after every 2 years.

1. **PROCEDURE FOR ARRESTING FAILURES OF SILVER BRAZED JOINTS ON CONTACT WIRE:** contact wire may part due to opening of silver brazed joints. The silver brazed joints are sensitive to pollutions. It is, therefore, recommended that such contact wire should be identified through ultrasonic testing and should be replaced by Continuous cast copper contact wire.

Maintenance instructions:

1. Check by **inspection car once in three months** in identified polluted areas/sections in which repeated failures have taken place.
2. The jointed contact wire in the ***"identified polluted areas" shall be replaced with joint –less contact wire drawn out of continuous cast copper wire rods*** at the earliest opportunity on programmed basis.

2. **PROCEDURE FOR CHECKS ON OHE PG CLAMPS:**

Maintenance instructions:

a) Visual Inspection: **Once a year**
b) All the OHE PG clamps at the jumper location shall be replaced during POH of OHE.
c) -During AOH, ensure that the nuts & bolts at PG clamps are neither too tight nor too loose. Tighten to the prescribed torque as mentioned in Annexure 2.08 of ACTM Volume II, Part I) (Annexure A attached)
d) After tightening the PG clamps ensure that all joints are properly coated with thin layer of Vaseline/ Petroleum jelly.
e) **Select the correct PG clamp for provision in various conductors as given below:**

Sr. No.	*RDSO Drg No.*	*Description*	*RI (No.)*	*Description*	*Small groove*	*Large groove*	*To be used for the location*
1	ETI/OHE/P/1030-2	Contact wire	1031-2	Contact wire	i) Contact (107) or	i) Feeder (150) or	G Jumper

	AMIT KUMAR Date: 2025.05.30 11:47:18 +05'30'	GAURANG GUPTA Digitally signed by GAURANG GUPTA Date: 2025.05.30 12:08:25 +05'30'
Prepared by: SSE/ TI	Checked by: ADE/TI-2	Issued by: DIRECTOR/TI-2

	Rev D	parallel clamp large		parallel clamp large part	ii) Catenary (65) or iii) Small jumper (50)	Large jumper (105)	
2	ETI/OHE/P/1030-3 Rev A	Parallel clamp (157-65/107/150)	1031-3	Contact wire parallel clamp part	i) Contact wire 150 sqmm or ii) contact wire 107 sqmm, iii) catenary wire 65sqmm or iv) jumper 50 sqmm	i) Jumper 157 sqmm	Drop Jumper to contact and Drop Jumper to catenary
3	ETI/OHE/P/1040-2 Rev E	Contact wire parallel clamp small	1041-2	Contact wire parallel clamp part small	i) small jumper 50 sqmm or ii) catenary 65 sqmm	i) Contact wire 107 or ii) catenary wire 65	i) C jumper ii) F jumper iii) AT jumper
4	ETI/OHE/P/1040-3 Rev B	Parallel clamp (90/50)	1041-3	Parallel clamp part (90/50)	i) Small jumper 50 sqmm	i) 19/2.50 mm galvanized steel wire Φ12.5 (Anticreep wire)	Small jumper to anticreep wire
5	ETI/OHE/P/1050-2 Rev D	Parallel clamp (150-105-150)	1051-2	Parallel clamp part (150-105-150)	i) Large Jumper 105 sqmm or ii) feeder 150 sqmm	i) feeder 150	Cross feeder to feeder
6	ETI/OHE/P/1050-3 Rev A	Parallel clamp (150/160)	1051-3	Parallel clamp part (150/160)	i) HDBC CROSS FEEDER 150 sqmm	i) Large Jumper 160 sqmm	Cross feeder to drop jumper

f) Conductor and PG clamp contact surface for preparation may be cleaned by non-metallic scrubber rather than scratch brushing to remove the oxide.

g) When installing the clamp ensure that both conductor size and conductor material is compatible with the duty for which the clamp is designed.

h) Checking of ***PG clamps with thermos-vision camera half yearly in normal section and quarterly in polluted areas and first sub-sector of TSS***. The frequency of thermo vision may be revised with the approval of PCEE of the ZRs

i) Examine wires for frayed strands, overheating, pinching or corrosion, especially at suspension clamps and PG clamps. Tighten junction sleeves.

j) During AOH, open and clean the PG clamp and shift it to other location from the location where it was erected earlier to prevent the failure. Whenever nuts & bolts are opened during AOH or POH, ***ensure that washer is changed every time***.

k) Particular care should be taken when joints are made between two dissimilar metals like Aluminium and copper. ***Special bimetallic fittings should be used*** in such cases to prevent electrolytic corrosion. Connections should be such as to produce no strain on the equipment.

Note: If any crack detected Replace the fitting with a new fitting and carry out the necessary adjustment. The released fitting will not be re-used.

3. <u>PROCEDURE FOR CHECKS ON CONTACT WIRE ENDINGS CLAMP FITTINGS AS PER RDSO's DRG. NO. ETI/OHE/P/1110-2</u>

<u>Maintenance Instructions</u>

a) Visual Inspection: **Once a year.**

b) During AOH Check any melting marks/slippage/cracks. In case of cracks or melting marks/slippage/cracks replace the existing fittings.

c) AOH schedule must be carried out by inspection car. During the schedule, fittings are not generally dismantled, but all fittings which are found defective must be replaced.

d) If the integrity of the fitting is doubtful, possibility shall be explored to conduct Dye Penetrant test during AOH or on need basis . Dye Penetrant test shall be conducted to ensure absence of cracks and surface defects. The procedure and acceptance standard shall be as per IS : 3658.

e) Check contact wire ending clamp and ensure that any slipping of contact wire has not taken place. Take corrective action in case of contact wire slipping.

f) In order to watch the slippage of wire from the fittings, Red Fluroscent tape may be applied adjacent to the fittings for prevention of failure.

g) Check the position of the contact wire bent portion and it should be leaning towards to wedge.

h) Ensure the availability of correct length of snap head pin, punched washer and intactness of split pin.

i) Binocular with phone clip and tripod , low light night vision, waterproof light weight to be procured to see the ending clamp and record of photographs shall be kept

j) All the contact wire ending clamps shall be ***replaced once in 16 years or alternate POH, whichever is earlier,*** with a new fittings and carry out necessary adjustment.

k) Check for rusting / corrosion /deformation /breakage of all the components. If these are observed, then the defective components should be replaced.

Note: If any crack detected Replace the fitting with a new fittings and carry out the necessary adjustment .The released fitting will not be re-used.

4. Procedure for Checks on:

a) ***Catenary Wire Ending Clamp fittings as per RDSO's Drawing No. ETI/OHE/P/1120.***

b) ***Feeder Wire Ending Clamp fittings as per RDSO's Drawing No. ETI/OHE/P/1130.***

c) ***Large Span wire Ending Clamp fittings as per RDSO's Drawing No. ETI/OHE/P/1140***

All sub-assemblies mentioned in given drawing of ending clamps for Catenary Wire, feeder wire & Large span wire should be stamped with their respective part numbers. During assembly it is to be ensured that correct part no is used as per respective drawings.

Sr No.	Checks on clamps as per drawing	Part No.	Colour coding
1	Catenary Wire (ETI/OHE/P/1120)	1121, 1094, 1092	Nil
2	Feeder Wire (ETI/OHE/P/1130)	1131, 1104, 1102	White
3	Large Span wire (ETI/OHE/P/1140)	1131, 1143, 1102	RED

Maintenance Instructions

a) Visual Inspection –**Once a year**

b) AOH schedule must be carried out by inspection car. During the schedule, fittings are not generally dismantled, but all fittings which are found defective must be replaced.

c) In order to watch the slippage of wire from the fittings, RED Fluorescent tape may be applied adjacent to the fittings for prevention of failure.

d) If the integrity of the fitting is doubtful, possibility shall be explored to conduct DPT test during AOH or on need basis .Dye Penetrant test shall be conducted to ensure absence of cracks and surface defects. The procedure and acceptance standard shall be as per IS : 3658.

e) Position of Joint cone with respect to ending clamp body: Joint cone is shown touching Ending clamp body.

f) Position of inner and outer strands of conductor with respect to joint cone/Ending clamp body /Joint socket: strands are not touching ending clamp body and have a gap of about 2mm. strands are just beyond the joint socket.

g) Position of collar of joint socket and Ending clamp body are not touching body each other and have a gap.

h) Ensure the availability of correct length of snap head pin, punched washer and intactness of split pin.

i) Binocular with phone clip and tripod , low light night vision, waterproof light weight to be procured to see the ending clamp and upkeep of record photographs.

j) All the catenary wire, large span wire & feeder wire ending clamps fittings ***shall be replaced once in 16 years or alternate POH, whichever is earlier*** with a new fittings and carryout necessary adjustment.

Note: If any crack detected Replace the fitting with a new fittings and carry out the necessary adjustment. The released fitting will not be re-used.

5. <u>PROCEDURE FOR CHECKS ON CONTACT WIRE SPLICE AS PER RDSO'S DRAWING NO. ETI/OHE/P/1080 REV. A & ETI/OHE/P/1080-1 REV. B</u>

<u>Maintenance instructions</u>:

a) **Visual Inspection: At every foot patrolling**

b) The fittings shall be carefully visually examined for cracks, other casting defects and abnormalities. If these are found the fitting shall be replaced immediately.

c) If the integrity of the fitting is doubtful, possibility shall be explored to conduct DPT test during AOH or on need basis .Dye Penetrant test shall be conducted to ensure absence of cracks and surface defects. The procedure and acceptance standard shall be as per IS : 3658.

d) Check to see if any slipping of the ends of two contact wires has been taken place. When viewed through the top window, there should be no gap between the two contact wire ends. If gap is found on the splice shall be released & contact wire ends shall be butt together by loosening the SS studs & then tightening the studs.

e) Tightness of stainless steel studs shall be checked. If found loose they should be tightened. Over – tightening of the stainless steel studs of contact wire splice fittings is harmful. Tightening should only be done to the extent possible with a standard spanner. No extra leverage by means of a pipe etc. should be used.

Note:-Replace the contact wire splice during once in 16 years or alternate POH, whichever is earlier with the new splice. Released splice shall not be reused.

6. PROCEDURE FOR CHECKS ON INSULATOR END CONTACT WIRE ENDING CLAMP RI No. 6160 AND RUNNER END CONTACT WIRE ENDING CLAMP RI No. 6150 OF SECTION INSULATOR ASSEMBLY TO DRG. NO. ETI/OHE.P/6100 REV. B.

Maintenance Instructions:

a) **Visual Inspection: At every foot patrolling.**

b) The fittings shall be carefully examined for cracks, other casting defects and abnormalities. If these are found the fitting shall be replaced immediately.

c) If the integrity of the fitting is doubtful, possibility shall be explored to conduct DPT test during AOH or on need basis .Dye Penetrant test shall be conducted to ensure absence of cracks and surface defects. The procedure and acceptance standard shall be as per IS : 3658.

d) Check to see if any slipping of contact wire has taken place. If the slipping has taken place the contact wire shall be set right after releasing the load on section insulator assembly & loosening the stainless steel studs. The stainless steel studs shall then be tightened.

Note:-Replace the ending clamps once in 16 years or alternate POH, whichever is earlier with the new ending clamps. Released ending camps shall not be reused.

****

References:

1. Railway Board letter no. 2013/Elect(G)/148/1 dated 10.05.2019.
2. Zonal Railway's comments whichever acceptable and approved have been incorporated in SMI
3. ACTM-Vol. II(Part –I) Paras 20320 to 20330.
4. Annexure 2.08 of ACTM Volume II, Part I. (attached as annexure A)
5. RDSO's letter no. TI/OHE/FTGFE/16 dated 20.05.2021.
6. Referred SMI
   a) TI/MI/0051 (Maintenance Instruction for Installation of Ending Clamp as per RDSO Drg No. ETI/OHE/P/1120, ETI/OHE/P/1130 and ETI/OHE/P/1140 for catenary wire, feeder wire and Large Span wire respectively for 25 kV AC traction on Indian Railways)

Annexure:A

TORQUE FOR VARIOUS SIZES OF BOLTS IN kg.m

Bolt Size	Nominal Stress	Steel	Stainless Steel
10	58	4.73	5.91
12	84.3	8.25	10.31
14	115	13.14	16.42
16	157	20.61	25.61
18	192	28.18	35.23
20	245	39.96	49.95

Annexure-B

Tabular summary of all components inspection

SN	Component	Visual Check	AOH Activity	Thermo-vision	Replacement periodicity	Additional Checks	Extra Precautions
1	PG CLAMPS	Once a year	Tighten bolt as per IS req. Shift the PG clamp by 1 metre Replace washer Provide thin layer of vaseline	Half yearly and quarterly for polluted area.	At every POH	Examine wires for frayed strands, overheating. Use bimetallic strip if change of materials	If crack detected, replace the PG clamps
2	CONTACT WIRE ENDINGS CLAMP FITTINGS	Once a year	Check any melting marks/slippage/cracks Check for slipping Provide red fluroscent tape adjacent to fitting Bent portion of contact wire shall lean towards wedge Check for rusting, corrosion		16 years or Alternate POH, whichever is earlier	Released fitting not to be re-used Check intactness of split pin and availability of snap pin head	If possible DPT to be done as per IS - 3658.
3	CATENARY WIRE ENDING CLAMP FITTING	Once a year	RED Fluorescent tape may be applied adjacent to the fittings		16 years or Alternate POH, whichever is earlier	Ensured that correct part no is used as per respective drawings Check intactness of split pin and availability of snap pin head	DPT on need basis
4	FEEDER ENDING CLAMP FITTING	Once a year	RED Fluorescent tape may be applied adjacent to the fittings		16 years or Alternate POH, whichever is earlier	Ensured that correct part no is used. Check intactness of split pin and availability of snap pin head	DPT on need basis
5	LARGE SPAN WIRE ENDING CLAMP FITTING	Once a year	RED Fluorescent tape may be applied adjacent to the fittings		16 years or Alternate POH, whichever is earlier	Ensured that correct part no is used. Check intactness of split pin and availability of snap pin head	DPT on need basis
6	CONTACT WIRE SPLICE	Every foot patrolling inspection	Visually examined for cracks, other casting defects and abnormalities. No gap in contact wire Check for slipping Check Tightness of SS bolt .		16 years or Alternate POH, whichever is earlier.	Released splice not to be re-used.	DPT on need basis
7	INSULATOR END CONTACT WIRE ENDING CLAMP and RUNNER END CONTACT WIRE ENDING CLAMP	Every foot patrolling inspection.	Be carefully examined for cracks, other casting defects and abnormalities. Check for slipping SS bolt shall be tighten as per prescribed torque.		16 years or Alternate POH, whichever is earlier	Released fitting not to be re-used	DPT on need basis

108-3

Maintenance Instruction No. TI / MI / 00038 (REVISION II)

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Maintenance Instruction and Test Schedule for Traction Power Transformers

(This supersedes earlier Maintenance Instruction No. TI / MI / 00038 – Rev. I)

Dated MAY - 2006

ISSUED BY

TRACTION INSTALLATION DIRECTORATE

RESEARCH DESIGNS & STANDARDS ORGANISATION, MANAK NAGAR, LUCKNOW – 226011.

	Revised By	Approved By
Signature	05/05/06	
Designation	ADE – 1 / TI	Director- IV / TI

S. No.	Periodicity	Items to be inspected / tested	Inspection / testing	Action required / acceptance norms	Remarks
-1	**Monthly**	Tank, radiators, Conservator, bushing, oil level indicator, gauges.	Examine for crack, dirt, & deposits and leakage.	Clean the dust & deposits with dry cloth. In case of crack/leakage replace /attend.	------
A-2	**Monthly**	Oil level in OIP condenser bushing	Check oil level with reference to the oil level indicator	In case of sealed bushing, if no oil/less than minimum level indication, take shut down. Measure Tan - Delta & capacitance and compare the test values recorded earlier. In case of oil filled bushing if any leakage is observed, the same shall be attended.	Max. allowable Tan Delta and capacitance is 0.007 and 110% of the factory set value respectively.
A-3	**Monthly**	Dehydrating breather	Breather to be checked for choking due to insect build /grime. Check the intactness of gasket and colour of the active agent. Check oil level in the oil cup.	In case breather is choked, remove the dirt etc. In case gasket is damaged, replace the same. If Silica gel is pink, replace it with dry Silica gel and recondition the old Silica gel, make up oil if required, if the Silica gel is too wet check the BDV of transformer oil.	In case BDV is less than 50 kV, filter the oil till it reaches 50 kV.
A-4	**Monthly**	Check maximum temperature of transformer oil on dial indicator and reset indicator.	Compare it with the previous values.	Abnormal change in the temperature shall be further investigated.	It is suggested to use Infrared thermometer / thermo vision Camera for detecting any abnormal temperature rise.
A-5	**Monthly**	Buchholz Relay	Check for gas collection if any.	In case gas is collected the same shall be sent for DGA.	Test result shall be compared with RDSO guideline for DGA refer Annex. 2.04 of ACTM Vol II, Part I.
A-6	**Monthly**	Heater in marshalling box.	Check for proper functioning.	In case not working, the connection shall be checked and rectified.	-----
A-7	**Monthly**	Oil level in conservator (MOLG).	Check as per transformer oil temperature (OTI).	If low, top up with the filtered oil and examine transformer for leakage.	-----
A-8	**Monthly**	All external connection.	Check visually that all connection are normal without any discolourisation due to local heating	In case of any sign of heat, clean and tighten the bolts and nuts.	----

B-1	**Half yearly**	**Do all the test / schedule as indicated in schedule `A'.**			
B-2	**Half yearly**	Test oil sample with oil test kit	Test for BDV and acidity	Compare and take action as indicated in enclosed ANNEXURE-I	Sample shall be taken from moving oil.
B-3	**Half yearly**	IR of winding and Polarization Index (PI) with 2.5 kV or 5 kV megger for: HV-LV, HV-E, LV-E	Insulation resistance is to be measured for 10 sec, 60 sec and 600 sec for HV-LV, HV- E and LV- E. Calculate PI (Polarization Index) by the IR ratio of R60/R10 and R600/R60.	Insulation resistance values shall be compared with the last recorded value and there shall not be wide variation. Ambient temp & oil temp (OTI) shall be recorded. Compare PI values with values at the time of commissioning/ last recorded. PI: Insulation condition. < 1.0: Dangerous 1.0 – 1.1: Poor 1.1 – 1.25: Questionable 1.25 – 2.0: Satisfactory > 2.0: Good If PI value is less than 1.1, oil shall be filtered. In case the value does not improve even after filtration periodic overhauling shall be under taken.	Care shall be taken to ensure bushings are clean and free from moisture and temperature on which IR is recorded shall also be noted and compared. Ensure that transformer is disconnected from other associated equipment. In case of doubt, Tan-Delta of winding shall be done to confirm healthiness of winding.
B-4	**Half yearly**	Alarm and tripping devices.	Check for proper functioning	Rectification/replacement in case found defective	-----
B-5	**Half yearly**	Check PRD/ Explosion vent for any damage and presence of oil.	Connection of PRD/Explosion vent and its operation shall be checked.	The reason for operation of PRD/Explosion vent shall be investigated. In case of damage of PRD the same shall be replaced with new PRD.	-------

C-1	**Yearly**	**Do all the test / schedule as indicated in schedule `B'.**			
C-2	**Yearly**	Transformer tank, bushings, tap changer, radiator and connection joints.	Infrared temperature scanning.	Infrared temperature scanning is to be done preferably at the time of full load to find any over heating.	The IR scan results shall be compared with previous results.
C-3	**Yearly**	OIP Condenser Bushing.	Test for Tan-Delta, Capacitance and IR (Schearing bridge may be used for tan delta & capacitance)	a) Compare with earlier value for IR in case sharp fall consult manufacturer. b) Max. allowable Tan-Delta is 0.007. c) Max. allowable capacitance 110% of the factory test result. In case of deviation plan for replacement.	Bushing shall be cleaned for dust and moisture. Test shall be done on sunny day.
C-4	**Yearly**	Gasket joints for transformer.	Tighten the bolts evenly to avoid uneven pressure in case of leakage only.	In case of leakage the same shall be attended.	Tightening of the bolts has to be done in proper sequence.
C-5	**Yearly**	Rod gap setting of bushing.	Check rod gap setting as per makers drawing	Adjust it in case required.	----
C-6	**Yearly**	Oil filled bushing (not hermetically sealed)	Test for BDV and acidity.	In case low BDV & high Acidity, filter / replace oil as per supplier catalogue.	----
C-7	**Yearly**	Test oil in transformer.	Test oil as per the enclosed ANNEXURE-I, referring Annexure 2.03 B of ACTM , Vol II, Part I	The oil sample shall be tested for those values conform to IS: 1866 - 2000. In case the oil values do not meet the requirement, action will be taken as indicated.	In case of requirement, oil shall be replaced with new oil. Refer enclosed ANNEXURE-I giving Annexure 2.03 B of ACTM, Vol II, Part I. (as per latest IS: 1866-2000)
C-8	**Yearly**	Dissolved gas analysis (DGA) on oil.	Oil sample shall be taken for DGA as per RDSO guide line at Annexure 2.04 of ACTM, Vol II, Part I.	Test result shall be compared with the RDSO guideline and action taken accordingly.	Refer Annexure 2.04 of ACTM , Vol II, Part I. In case of abnormal DGA values in the past, DGA test has to be done more frequently i.e. every six months.

S. No.	Periodicity	Items to be inspected / tested	Inspection / testing	Action required / acceptance norms	Remarks
C-9	**Yearly**	Working of Tap changer switch.	Move the Tap setting switch up and down full range so that by self-wiping action good contacts are ensured.	Set the tap finally at the correct position.	----
C-10	**Yearly**	Relays, alarm & their circuits.	Examine relay and alarm contacts, their operation and fuses etc. check relay accessories.	Clean the components and replace contacts and fuses if necessary. Change the relay setting if necessary.	----
C-11	**Yearly**	Control boxes & Terminal boxes/cable	Check water tightness of boxes & terminal boxes.	If required replace gasket.	-------
C-12	**Yearly**	Temperature Indicators.	Pockets, holding thermometer shall be checked.	Oil to be replenished if required.	----
C-13	**Yearly**	Dial type oil gauge.	Check pointer for free movement.	Adjust if required.	----
C-14	**Yearly**	Earth resistance.	Measure earth resistance and record with ohmmeter.	Take suitable action if earth resistance is high.	----
C-15	**Yearly**	Buchholz Relay.	Check for operation and measure the insulation resistance by 500 V Megger and continuity test for contacts with test Lock Screw set at 5^0	(i) Values of IR shall not be less than 20 megaohm. (ii) On continuity test relay shall operate.	----
C-16	**Yearly**	Voltage ratio test with Wheat stone – bridge, Voltmeter-Ammeter.	Precautions to be taken as per normal practice being followed for measurements with Wheat stone - bridge	Compare the trends of the Ratio with reference to pre commissioning/ factory value/ earlier test.	Test should not be done for verifying exact ratio. The sudden variation in ratio from the last measured value shall call for further investigation.
C-17	**Yearly**	Winding resistance test with Wheat stone bridge Voltmeter - Ammeter.	The test conducted on principal tap by applying DC current. The measured value shall be converted to 75^0 C for conversion.	Compare the value with the pre-commissioning /factory test values. Deviation in absolute value shall be less than +/- 5%of precommissioning or factory set value.	This test shall be last test on winding to avoid DC flux remaining in core resulting erroneous value in the other test.

S. No.	Periodicity	Items to be inspected / tested	Inspection / testing	Action required / acceptance norms	Remarks
D-1	**After every 05 year**	**Repeat all the tests as indicated in Schedule `C'.**			
D-2	**After every 05 year or when needed.**	Painting of transformer tank, conservator, radiators and other exposed parts.	Clean the exposed parts thoroughly.	Transformer tank and other parts shall be painted with epoxy and poly-urethane paints as per A&C slip no. 8 to the RDSO specification no. ETI/PSI/118 (10/93).	In case of previous enamel paints, the Repainting may be carried out after 3 years polluted area. In case of previous epoxy and poly-urethane paints the repair painting may be carried out after 5 years.
D-3	**After every 05 year**	Pipe work.	--------	In case of any misalignment the pipe shall be realigned and joint made.	----
D-4	**After every 03 to 05 year**	Test oil in transformer.	Measure the inhibitor content in the oil. In the new oil it has to be within 0.25 – 0.30 % by total weight of oil.	If the inhibitor content in the oil reduces to 0.15 %, it should be re-inhibited by adding required amount of DBPC.	----
D-5	**After every 05 year**	Magnetizing Current Test with Voltmeter, Ammeter and Lamp.	To be done by applying 230 V ac supply preferably on LV side with series lamp.	Compare the value with respect to pre commissioning value. Any abnormal increase to the order of 50 times indicates that there is a fault inside.	Ensure that the comparison is done to the value taken at LV side only.
D-6	**After every 05 year**	Winding resistance test with Wheatstone bridge Volt meter, Ammeter.	The test conducted on principal tap by applying DC current. The measured value shall be converted to 75^0 C for conversion.	Compare the value with the pre-commissioning /factory test values. Deviation in absolute value shall be less than +/- 5%of precommissioning or factory set value.	This test shall be last test on winding to avoid DC flux remaining in core resulting erroneous value in the other test.
D-7	**After every 05 year or when needed**	Impedance test with Voltmeter, Ammeter.	Test to be conducted on principal tap applying 230 V single phase ac to the HV side with LV side shorted and calculate V/I and convert to percentage impedance.	Compare the value with respect to pre-commissioning value, any deviation beyond 5% calls for further analysis.	Any deviation beyond 2% from the earlier values shall be considered for keeping watch on the transformer.
E.	**After 10-12 years. POH**	**Periodic overhaul.**	Over all inspection of active parts after lifting of bell tank and replacement of gasket with new gasket.	In case of internal fault or once in 10 years.	Periodic overhaul shall be done as per schedule for periodic overhaul vide TI/MI/00039 Rev1

ANNEXURE-I

Annexure 2.03B

(Para 20207) of ACTM Vol.II Part-I

(The values from latest IS: 1866-2000 has been taken while ACTM table is having the values from IS: 1866-1983)

APPLICATION AND INTERPRETATION OF TESTS ON TRANSFORMER OIL IN SERVICE

SL. No.	*Tests*	*Value as per IS: 1866-2000 permissible limits*	*To be re-conditioned*	*To be replaced.*
	2.	3.	4.	5.
1.	*Electric strength (Breakdown voltage)* *Below 72.5 kV* *72.5 kV and less than 145 kV* *145 kV and above*	*Min.* *30 kV* *40 kV* *50 kV*	*Less than the value specifified in column 3*	--
2.	*Specific resistance (Resistivity) Ohm-cm at 90 ^{0}C*	*Above 1x 10^{12}*	*Between 0.1 x 10^{12} to 1 x 10^{12}*	*Below 0.1 x 10^{12}*
3.	*Water content* *Below 145 kV* *Above 145 kV*	*Max.* *40 ppm* *20 ppm*	*Greater than the value specified in column 3*	--
4.	*Dielectric dissipation factor, Tan delta at 90 ^{0}C*	*0.2 or less*	--	*Above 0.2*
5.	*Neutralisation value mg KOH/ g of oil.*	*0.3 or less*	--	*Above 0.3*
6.	*Interfacial tension N/ m*	*0.015 or more*	--	*Below 0.015*
7.	*Flash point in ^{0}C*	*140 or more*	*125 and above but below 140*	*Below 125*
8.	*Sludge*	*Non- detectable, Results below 0.02% by mass may be neglected*	*Sediment*	*Perceptible sludge*
9.	*Dissolved Gas Analysis (DGA)*	*Refer Annexure 2.04 of ACTM Vol.II Part-I*		

सत्यमेव जयते

Government of India,
Ministry of Railways
Research Designs & Standards Organisation,
Manak Nagar, Lucknow– 226 011

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No. TI/PSI/TRNPWR/POLICY/17/01 Issued 26/9 Dated, the 22nd 26 September 2017

To,

The Chief Electrical Engineer,

(i) Central Railway, Station Building, Mumbai CST – 400 001.
(ii) Eastern Railway, Fairlie Place, Kolkata-700 001.
(iii) East Central Railway, Hajipur-844 101.
(iv) East Coast Railway, Bhubaneshwar-751 023.
(v) Northern Railway, Baroda House, New Delhi - 110 001.
(vi) North Central Railway, Allahabad-211 015.
(vii) North Eastern Railway, Gorakhpur-273 012.
(viii) North Frontier Railway, Mailgaon - 781 011.
(ix) North Western Railway, Jaipur – 302 017.
(x) Southern Railway, Park Town, Chennai- 600 003.
(xi) South Central Railway, Railnilayam, Secunderabad-500 371.
(xii) South Eastern Railway, Garden Reach, Kolkata-700 043.
(xiii) South East Central, Railway, Bilaspur-495 004.
(xiv) South West Railway, DRM's Office, Hubli-580 028.
(xv) Western Railway, Churchgate, Mumbai-400 020.
(xvi) West Central Railway, Jabalpur- 482 001.
(xvii) Central Organisation for Railway Electrification, Nawab Yusuf Road, Allahabad- 211000.

Sub: Maintenance Instruction No. TI/MI/00039 (Rev.02) for Conditional Based Overhauling of Traction Power Transformer.

Ref: This office letter no. TI/PSI/TRNPWR/POLICY/17 dated 23.06.2017

During 28th MSG it was decided that RDSO shall circulate to Zonal Railways practices of Overhauling of Traction Power Transformer on Condition Basis. Accordingly a draft MI of Traction Power Transformer for Overhauling on condition basis was prepared by RDSO and circulated to Zonal Railways vide this office letter referred above for obtaining comments/suggestions. The issue was also discussed in 29th MSG meeting held on 3rd & 4th July, 2017 at Railway Board under Item No.28.02.

Based on the comments/suggestions received from Zonal Railways the Maintenance Instruction No. TI/MI/00039 (Rev.02) on Conditional Based Overhauling of Traction Power Transformer has been finalised by RDSO. A copy of the same is enclosed herewith.

This is for your information and necessary action please.

22-09-2017

(A. K. Sharma)
(Director –PSI)
For Director General (TI)

Encl: As stated above. O/C

Copy to: The Secretary (Electrical), Railway Board, rail Bhawan, New Delhi- 110 001 - For kind information please.

सत्यमेव जयते

Government of India
Ministry of Railways

Maintenance Instructions

for

Overhauling of Traction Power Transformer

NO. TI/MI/00039 Rev.02

	Prepared By	Checked By	Approved By
Signature	SSE/TI	ADE/PSI	22-09-2017 DTI/PSI
Date	22.09.2017	22.9.2017	

Issued by:

Traction Installation Directorate,
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

1.0 Scope:

This Maintenance Instruction covers the requirement for condition base overhauling of Traction Power Transformer on use in Indian Railway Traction Sub-station.

2.0 Background:

The earlier SMI No. TI/MI/0039 Rev.01 specifies the overhauling of Traction Power Transformer at interval of 10-12 years. To reduce the maintenance cost and to optimize maintenance requirement, time bound overhauling may be replaced by condition based overhauling. Certain parameters may be checked at an interval of 1 year after service of 10 years from the date of commissioning/ overhauling. Decision of overhauling may be taken on the basis of these recorded parameters.

3.0 TESTS TO BE CARRIED OUT

The following tests shall be conducted to check the health of Traction Power Transformer:

I) Transformer Oil
   a) Dielectric strength (BDV).
   b) Acidity.
   c) Water content (ppm).
   d) Resistivity & Tan delta.
   e) Dissolved gas analysis (DGA).
   f) Interfacial Tension

II) Transformer
   a) Measurement of winding resistance on all taps.
   b) Measurement of Insulation resistance of windings & polarization index.
   c) Measurement of tan delta and capacitance of condenser bushing.
   d) Measurement of capacitance and tan delta of winding.
   e) Sweep Frequency Response Analysis (SFRA) Test.

4.0 Parameters for deciding overhauling requirement

The overhauling of a Transformer may be undertaken when it is faulty (internal) or the test results is beyond the limit mentioned below:

S.No.	Name of Test	Specified Limit
i.	Acidity	0.2mg KOH/g (max.)
ii.	Resistivity at 90^0C	$0.1x10^{12}$ ohm-cm (min.)
iii.	Tan delta at 90^0C	0.2 (max.)
iv.	Dissolved gas analysis (DGA)	Refer Annexure 2.04 of ACTM Vol. II, Part-I
v.	IFT	0.015 N/m (min.)
vi.	Measure the insulation resistance of winding and polarization index	PI shall be 1.25(min.)
vii.	Sweep Frequency Response Analysis (SFRA) Test.	The graph should be match with the earlier SFRA graph of same unit.
viii.	Leakage of Oil	Continuous Oil seepage and leakage from Tank Gaskets.
ix.	Winding Tan Delta	0.015 (max)

It is advisable to review and analyse the periodical DGA values to check any abnormal variation and healthiness of the transformer. Overhauling of transformer may be done either at site (Traction Sub-Station) or in Traction repair shop. In case overhauling is undertaken at TSS, a temporary shed of asbestos or tarpaulin shall be constructed after removing bell tank so that the dust does not ingress by the active parts of the transformer during overhauling. In case overhauling is done in traction repair shop, the active part shall be kept under cover to protect the same from dust. The transformer should not be opened during rainy /cloudy weather for inspection/repair/overhaul.

5.0 STEPS FOR OVERHAULING

5.1 UNTANKING OF TRANSFORMER

Before commencing the work, drain out the oil, disconnect all leads and remove manhole covers, accessories, conservator,breather, radiator, fittings, HV, LV bushings and store them in a safe place. One set of gaskets of standard quality shall be available for replacement during overhauling. The bell tank shall be removed by suitable crane/winch carefully so that the bell tank does not damage the active parts during dismantling. Defects observed during inspection/ test schedule for the subject transformer shall be recorded and taken into account and defects like leakage in tank, conservators and radiators etc. shall be attended and rectified permanently during overhauling of transformer.

5.2 ITEMS TO BE CHECKED / ATTENDED

Following items are required to be checked/ attended during overhauling:

S. No.	Items to be checked/attended	Action required.
1.	Insulating oil of the transformer main tank	The insulating oil has to be checked/tested as per IS: 1866-2000 and its replacement has to be done on its condition basis. Summarized guidelines of IS: 1866-2000 are given in a table at Annexure II.
2.	Transformer windings & internal parts of transformer and tank.	The sludge on the bottom of the tank, windings and interspaces between windings should be scrapped carefully by wooden or fibre wedge without causing any damage to the windings. Traces of the sludge left in inaccessible places are removed by hot oil jets. The old surface contamination should be brushed out and washed down untill clean surface of the winding is exposed.
3.	Conservator, radiators and other metal parts including associated pipes.	These shall be cleaned with hot oil jet to remove any traces of sludge.
4.	Check the drain valve for its working condition, oil-sampling valve, filter valves etc.	Polish the valve seat and renew the gasket around the spindle for oil tightness. Valves may be replaced if required.

5.	Check insulation blocks, permaliwood packing, spacers, wedge and keyed blocks and insulating rings with securing arrangement in the winding for their displacement due to frequent & repeated short circuit during service.	In case any said part/block is shifted, the same may be realigned and refixed using the adhesive compatible to transformer oil.
6.	Check the pressure screws with belleville washers and pressure cup for its intactness along with permaliwood packing.	Pressure screws with belleville washers shall be tightened in case found loose, In case pressure screws or cup and other item are displaced the same shall be attended and aligned or changed.
7.	Check the top and bottom yoke bolts and check ferrule insulation tube and dielectric strength by 2kV ac for 1 minute.	Tighten the yoke bolts in case loose. Replace the insulation ferrule if damaged.
8.	Check electrical joints, earth connections, between core to core & tank, lead connections for tap changer and transformer for tightness and intactness.	All the electrical connections shall be properly cleaned and tightened in case found loose. In case of damage to the leads and contacts they should be replaced by a new one.
9.	Check clearances of the active part form the tank body.	Clearance shall be maintained 100 mm for bare parts and 50 mm for insulated parts from the tank/earth surface.
10.	The contacts of off-circuit tap changer.	The contacts are to be cleaned properly and tightened. Any damaged contacts are to be replaced. After contact repair/cleaning/replacement its alignment should be made.
11.	Check the operation of off-circuit tap changer.	Operation shall be smooth and it shall indicate correct tap position on indicator.
12.	Check the tightness of all fasteners, Core bolts and core with tank fasteners etc.	Retighten them properly in case required.
13.	Check the condenser bushing for correct oil level, crack and leakage, dirt deposits etc.	In case of oil filled bushing it is recommended to remove the old oil from the bushing and fill fresh oil for better result. In case of oil sealed bushing if oil level is below the minimum level indicator, the manufacturer of the bushing shall be contacted for corrective action. Tan delta (max. 0.007) and capacitance of the bushings shall be compared with earlier test values. In case of major deviation of the values, the manufacturer of bushing shall be contacted. IR value of the bushings shall be more than 10,0000 M Ohm and BDV of oil shall be more than 50 kV.
14.	Bushing CTs	Check the polarity of Bushing CTs.

15.	Transformer tank, conservator, radiators, pipe work and other associated parts.	All steel surfaces exposed to weather shall be properly descaled. The epoxy and polyurethane protective paints as per ISO/EN 12944 have to be provided for proper protection against corrosive and coastal environments and give life of approx. 12-15 years. All the external surfaces of the Transformer shall be given first coat of epoxy zinc rich (having minimum 83% metallic zinc) primer (50 micron thickness), intermediate coat of epoxy chemical and corrosion resistant High Build Epoxy Intermediate paint (100 micron thickness) and final coat of Glossy Aliphatic Acrylic Polyurethane Coating paint (50 micron thickness). The total dry film thickness of the paints shall be minimum 200 micron. The shade of paint shall be gray as shade 631 of IS: 5.
15.	Checking of control for its condition.	Control cables shall be replaced on age cum condition basis. Rubber gland should be replaced to prevent ingress of water.
16.	Nitrogen cylinder	Check the pressure of nitrogen cylinder and replace the cylinder if pressure is less.
17.	Silica gel	Silica gel breather container along with silica gel should be replaced with new one , if breather container found damaged/cracked
18.	Thermosiphon	Thermosiphon shall be checked for any leakage and replacement of alumina may be replaced.

5.3 TANKING OF TRANSFORMER

Finally put back the bell tank, assemble the bushings, check tightness of all internal connections, and provide new gaskets. The insulating oil has to be checked/tested as per IS: 1866-2000 and its replacement has to be done on its condition basis. Summarized guidelines of IS: 1866-2000 are given in a table at Annexure II. The filtration of the transformer oil is to be done by using oil filtration plant.

Check the alignment of core in the tank after tanking as under:

a. Core/yoke frame are aligned with the tank bottom placing the transformer feet at correct location aligning them with the locating pin welded in the tank bottom.
b. Core yoke is aligned /locked with the locking box provided at bell tank top through locating post welded in the yoke frame.

5.4 Drying-out/filtration of transformer

Vacuum drying of the transformer is to be done generally as per IS 1866: 2000 and at maximum temperature of 60^0C and maintaining the vacuum level at:

- At factory – pressure less than 0.10 torr (since it can be achieved in VPD chamber)
- At site - pressure less than 1.0 torr because of the limitation of tank vacuum bearing capacity.

During filtration/drying out process, the reading of temperatures and IR value shall be recorded every two hours form commencement till full operation is completed.

The filtration/ drying out shall be done as per para 20208/20210 of ACTM - Vol. II, Part I which is reproduced at Annexure-II for ready reference.

Note-

1. The oil filling/ filtration shall be done preferably by 4500 liter per hour or higher capacity filtration machine to reduce the filtration time.

2. To increase the life of insulating oil, it is advisable not to pass the Oil through filtration machine more than 10 times of complete volume of the Transformer oil.

   For Example: In case of Transformer having 20kL insulation oil maximum cycle of allowed filtration is (10x20000/4500=45 hrs)

To ensure that the moisture has been removed from the transformer, the PI value after drying has to be measured and it should preferably be achieved equal to or more than 2. The following table is to be used as guideline reference for the PI value of the windings.

Item to be inspected/tested	Inspection/Testing	Action required / acceptance norms	
IR of winding and Polarization Index (PI) with 5kV megger for: HV-LV, HV-LV,E, LV-HV,E	Insulation resistance to be measured *for 10 sec, 60 sec and 600 sec. Calculate PI as R60/R10 and as R600/R60.*	Compare with values at the time of commissioning/ last recorded.	
		PI	Insulation condition.
		< 1.0	Dangerous
		1.0 – 1.1	Poor
		1.1 – 1.25	Questionable
		1.25 – 2.0	Satisfactory
		> 2.0	Good

5.5 PRECAUTIONS

Experience has shown that tools like spanners and foreign objects like washers, pieces of cloth, etc. are sometimes inadvertently left behind in the transformer which present hazard of short circuits. It is, therefore, important that the tools, etc. used during overhauling shall be listed out at the beginning and accounted for at the end of the work.

6.0 CHECKS / TESTS AFTER OVERHAULING

After completion of overhauling of transformer test/ checks shall be done:-

i) Voltage ratio test with Voltmeter, Ammeter and Lamp/with ratio meter.
ii) Winding resistance test with Whetstone Bridge or voltmeter, ammeter method/ Winding resistance meter.
iii) Measurement of Capacitance and Tan Delta of Windings at 10kV.
iv) Magnetizing current test with voltmeter, ammeter and lamp.
v) IR of windings and polarization Index with 5 kV Megger.
vi) Tests on transformer oil for BDV, ppm, tan delta and acidity.

vii) Checking of protection equipment for their working i.e. buchholz, PRD, MOLG, WTI and OTI.
viii) All gasket joints for any leakage.
ix) Check relay and alarm contacts for their operation.
x) Check control boxes, terminal boxes etc. for water tightness against ingress of moisture and if required replace gasket.
xi) Checks dial type OTI and WTI for freedom of pointer.
xii) Check the IR value and the secondary winding resistance of bushing CTs.
xiii) Check the polarity and tan delta of bushing CTs.
xiv) Bushing: tan delta and capacitance test should be conducted to ensure its health and tallied with its prior test values. Maximum allowable value for Tan Delta of OIP Bushing shall be 0.007 and Maximum 10% of increase in factory set value of capacitance shall be allowed.
xv) OCTC is to be checked for its proper /required operation such as
(a) Manual
(b) Local operation (electrical)
(c) Remote electrical operation
xvi) (a) Check oil level in transformer tank, conservator, condenser bushing, and OCTC etc.
(b) Check OTI and WTI pockets and breather oil cup and replenish the oil if required.
(c) Arcing horn gap are as per drawing.
xvii) Check that all earthing connections of various parts/points are made properly as per diagram plate.
xviii) Check wherever provided, air delivery cooler fan are sufficient and working in right direction.
xix) Ensure silica-gel in breather active and blue and oil is upto correct level in the cup.
xx) Check the thermometer oil pockets on tank top and header etc. filled properly.
xxi) Remove/clear all the tools and other associated equipments used in the POH from transformer.
xxii) Lock the roller to prevent the movement on rail.
xxiii) Release the trapped air through air release plugs and valves.
xxiv) Sweep Frequency Response Analysis (SFRA) Test.
xxv) Check that the NIFPES system (if available) has been properly assembled.
xxvi) Ensure the proper connection of Fiber optic probes. (if available)

7.0 COMMISSIONING OF TRANSFORMER

The Commissioning of traction transformer after overhauling shall be done as per para 20905/20906/20907 of ACTM - Vol. II, Part I which is reproduced at Annexure-II for ready reference.

8.0 Conclusion

Performance of transformer after overhauling shall be evaluated by comparing the result of insulation resistance & polarization index of windings and BDV, water content (ppm), Resistivity & tan delta, acidity & DGA of transformer oil. Also, all these values shall be kept in records for monitoring the performance in service.

Each Railway shall be taking into consideration the resources available with them to carry out the overhauling & repairs of the Traction Power Transformer.

ANNEXURE-I

A) ITEMS REQUIRING REPLACEMENT WITHOUT FAIL DURING OVERHAULING OF TRACTION POWER TRANSFORMER.

1. Insulating oil

a) Insulating oil from OCTC/OLTC.
b) Insulating oil from radiator.
c) Replenishing insulating oil from (i) OTI and WTI pocket (ii) Thermometers oil pockets (iii) Breather oil cup.

2. Gasket and Rubber items

The new gasket provided should be made of single piece (i.e. without joints) irrespective of shape of the gasket. If any joint is considered necessary due to large size of gasket viz; gasket for the body of transformer, the joint should be made in such a fashion like dovetail joint, crossed joint etc. so that oil leakage and seepage can be avoided. Suitable thickness of gasket should be provided according to the place. Two gaskets should not be attached to make a thicker gasket to avoid any possibility of oil leakage/seepage.

a) Main gasket synthetic rubber cork gasket fitted between bell and bottom of the transformer tank.
b) Inspection cover gasket.
c) Gasket between tap changer flange and transformer tank.
d) Gaskets for valve flanges.
e) Gaskets for radiator valve flanges.
f) Gaskets for turret and bushings flanges.
g) Gasket between PRD and transformer tank cover.
h) Gaskets between flanges of connecting pipe line.
i) Neoprene rubber gaskets used in breather between top lead and body.
j) Rubber sealing of Marshalling box and oil rubber rings oil gland and oil seals used at various locations including cable glands.

3. Pre-compressed board used to insulate bottom of tank with active parts.

4. Silica gel.

5. Alumina of Thermosiphon Filter.

B) ITEMS REQUIRING REPLACEMENT DURING POH ON CONDITION BASIS.

1.0 Insulation Material

SL. No.	Internal parts/Items	Condition
i	Permali wood packing in coil clamping and locking box welded to tank and core packing etc.	Deshaped due to pressure / vibration
ii	Coil clamping screws and plate Belleville washer, permali wood packing used in with hydraulic jacks for clamping coil at required pressure.	Replace the unit if not maintaining required pressure for coil clamping/ or replace Belleville washers with screws (only if deshaped/cracked)to achieve the purpose .
iii	Radial paper covered insulation over leads from windings to tap changer	Changed the lead or only paper insulation to solve the purpose.
iv	Radial paper covered insulation over leads to bushing with clamping arrangement permali wood / PCP board.	Changed the lead or only paper insulation to solve the purpose. Changed the clamping arrangement if not supporting properly being worn out.
v	Radial paper covered insulation between winding sections of both legs.	Changed lead/paper insulation only as per requirement.
vi	Fibre glass ferrule and insulating core/yoke bolts with permali washers and PCP board(used to insulate yoke with core stud)	Check dielectric strength of core bolt insulation with 3 kV for 1 minute and replace if damaged.

2. Items used in Winding

SL. No.	Items used in winding	Condition
i	Locking spacers	If lose and deshaped due to vibration
ii	Plain spacers	If lose and deshaped due to vibration
iii	Keyed blocks for tapping windings	If lose and deshaped due to vibration
iv	Keyed blocks for HV and LV winding	If lose and Deshaped due to vibration
v	Core packing of PCB /Perma wood	During removal/replacement of winding coils
vi	Top/bottom common washers of PCB	During removal/replacement of winding coils. If Deshaped /unserviceable
vii	Top /bottom clamping ring of PCB	During removal/replacement of winding coils.

		If Deshaped /unserviceable
viii	Windings: a)HV winding coil b)LV winding coil c)Tapping winding coil	Shall be replaced if open circuited /short circuited or burnt due to overloading or any reasons.
ix	All pre compressed board items to windings such as spacers,blocks packing ,clamping rings ,angle rings,angle caps and washers etc.	Shall be replaced along with associated winding coils if they are replaced due to various defects.

3. Other Items

SL. No.	Other items	Condition
i	a)Cable clamps /securing arrangement b)Cable glands c)Cable lugs	Damage/worn out/deshaped
ii	Nut bolts	Thread worn out
iii	LED/Bulbs	If not glowing /fused.
iv	Relays/switches	Erratic behavior
v	Push buttons	Not working
vi	Capillary tubes with bulbs	Not working
vii	Primary bushing terminal connector(Rigid)	Deshaped due to tightening in service
viii	Secondary bushing terminal connector (expansion type) or its part such as a)Spring washer b)Bimetallic sleeve c)AAC shunt	Deshaped due to tightening in service. Flattened Deshaped cut
ix	Drain Valves	If not working.
x	Marshaling Box gasket	If found damaged
Xi	MOG, Bucholz Relay, PRD, OTI, WTI, Bushing etc. cables	If found damaged
xii	Terminal Blocks in Drive Mechanism box and Marshaling Box	If found damaged

4. Items /parts relating Tap changer(OCTC)

SL. No.	Parts	Condition
i	Bakelite phase board and selector ring	If cracked /damaged
ii	Brass slip rings	If worn out
iii	Brass fixed contacts	If worn out
iv	Electrolytic copper moving contacts	If worn out
v	Spring in moving contact holder for contact pressure	If softened/pressure disappeared
vi	Copper brush assembly	If worn out
vii	Bearing for selector shaft	If worn out

viii	Flexible braid of electrolytic copper to connect moving contact and copper brush	If strands damaged/cut
ix	Paper covered copper connection cable with socket (between fixed contact and terminal stud)	If insulation perished and copper strands damaged.
x	Epoxy moulded terminal ,bush and terminal board	If cracked
xi	Gears and bearing in driving mechanism	Teeth broken worn out noisy /sluggish operation.
xii	Operation of micro switch provided for tripping the HV & LV CBs if the tap changer is inadvertently operated while the CBs are in closed condition.	Replace if not working

5. Aircell arrangement of conservator tank. Replace if:

i. Check visually and found damage.

ii. Any leakage is there. For leakage check - Pressurise aircell for 12 hours with air at 1.5 PSI or 0.1 kg/cm2. Before pressure is applied to air cell, loosen the air release plug on conservator so that outer side of aircell will be at atmospheric pressure during test.

ANNEXURE-II

Reference para of AC Traction Manual-Volume II (Part I)

Para 20206

Traction Transformers are usually provided with off-load tap changers (operated locally or by remote control) with taps from +10% to (-)15% in steps of 5%.To decide the correct tap setting a recording voltmeter should be connected at the traction sub-station to the secondary side of a potential transformer to ascertain the pattern of voltage variation throughout the 24 hours for at least 3 typical days. Based on the readings from the recording the tap position should be fixed so that the daily OHE voltage peaks at the traction sub-station lie just below 27.5 kV but does not touch 27.5 kV. This will ensure that the OHE voltage is well above the minimum of 19 kV at the farthest point on the system even when heavily loaded. Once a year a 24 hour record of voltages available on the two sides of every neutral section should be taken to make sure that the voltage does not fall below 19 kV at any time.

Since any change in the inter-connections of the grid system would have repercussions on the voltage at the traction sub-station, the CTFO(PSI) should keep in touch with the supply authorities in regard to system changes so that he may arrange to take another set of 24- hour voltage readings if any change has taken place and to change the tap setting if required.

Para 20208

The object of oil purification is to remove all contaminants such as water, carbon deposits, dirt, sludge, dissolved moisture and gases. The most important quality to be preserved is the di-electric strength, which is affected by the presence of moisture.
The insulating materials used in the winding are hygroscopic by nature and therefore moisture is absorbed through defective breathers, gaskets and addition of untreated oil. It is essential to remove these impurities by purifying the oil when the di-electric strength goes below the permissible limits.

Para 20210

Readings of temperature and insulation resistance should be recorded every two hours, from commencement until the full operation is completed. If the readings are plotted on a graph, the appearance will be as shown in ***Fig. 2.01*** *of ACTM.*

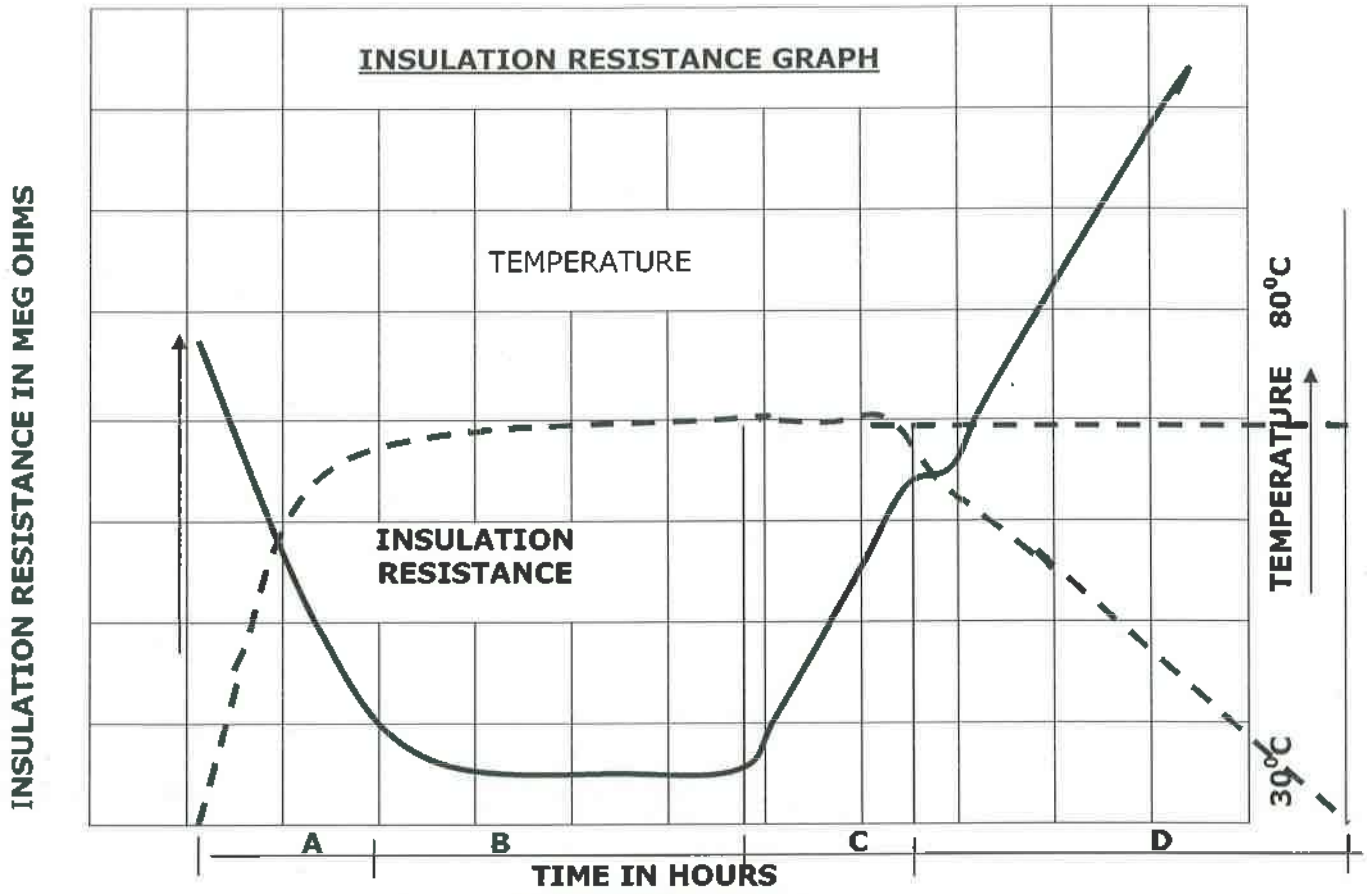


FIG. 2.01(PARA 20210)

It will be observed that there are four distinct stages:

A. *Initially the insulation resistance drops down to low value because of rise in temperature of the oil up to about 75 ^{0}C.* **(to be limited to 60 ^{0}C).**

B. *Insulation resistance will continue to remain at low level despite temperature being maintained at a high level until most of the moisture from the winding and oil has been driven out.*

C. *The insulation resistance will thereafter rise gradually and level of, indicating the all moisture has been driven out and the drying out operation has been completed. At this point oil circulation should be discontinued.*

D. *As the oil cools off, the insulation resistance will rise much above the levelling off point at the end of the stage(C). This is because the insulation resistance value doubles for a fall in temperature of about 10 ^{0} C to 15 ^{0}C.*

Para 20905

During the preparation for commissioning of transformers at traction substations in addition to manufacturer's instructions, the following steps shall be taken:

i) Drying out of transformer shall be undertaken as per the procedure laid down (Refer para 20208).

ii) Tap -changing mechanism shall be checked for being in perfect operating condition, both electrically and mechanically. Ratio test should also be done in this procedure (Refer para 20206).

iii) Transformer bushings should be paid special attention to ensure that the manufacturer's seal is intact and the bushings are in excellent condition. The insulation resistance of the bushing should be around 10,000 Meg Ohm. .

iv) All gaskets should be properly compressed and tight fitted. No leakage of oil should be visible from valves, pipe joints, gauze glass, radiators or any other parts of transformer. The welded joint should also be checked for oil seepage, if any.

v) For a substation with more than one transformer, they should preferably be identical. The polarity on both should be checked.

vi) The oil filled in transformer should be fully de-aerated to avoid false operation of Buchholz relay.

vii) The Buchholz relay should be erected as per instructions of the makers and tested for correct operation.

viii) All accessories like silica gel breather, vent pipe, explosion vent diaphragm, circulating oil pump and special cooling equipment, if any, should be checked.

ix) In addition, to Buchholz relay, (refer para 20214) other protective devices provided for the protection of the transformer (refer para 20212 , 20213) should be examined and checked carefully and tested after erection at site.

Para 20906

While working on traction transformers, the following special precautions should be taken by all the staff.:

1. *It is very important that one working on a transformer with any of its covers open should remove all loose articles from his clothing such as pens, pencils, watches, money, smoking articles, tools particularly if they are oily, as they are liable to slip and fall into the transformer in the course of work. The number of men working on top should be restricted to the minimum if tools have to be used they should be fastened by lengths of strings to the workers wrists or to the tank rim.*
2. *Moisture lowers the dielectric strength of the oil, and hence every possible precaution should be taken to prevent its entry. Sweat on hands and face should be wiped off frequently by a dry cloth and tools should be kept clean and dry, especially when coming in contact with oil. Another source of entry of moisture into the tank*

is by condensation. If a transformer is at a lower temperature than its surroundings, condensate will form on the exposed surfaces. Transformer should, therefore, be at or above the ambient temperature before being opened for work at any time.

If any cleaning or wiping is necessary, this should be done with clean dry oil using soft, non- fluffy cloth, and never by using cotton waste.

Para 20907

i) *Insulation resistance readings should be recorded with a 2500 V or 5000 V megger. The following are the minimum permitted values at an ambient temperature of 30 ^{0}C . Temperature has a material influence on insulation resistance, and therefore the tests should not be conducted when oil is hot.*

2000 Meg Ohm between EHV winding and earth.
400 Meg Ohm between 25 kV winding and earth.
2500 Meg Ohm between EHV and 25 kV windings.

ii) *Test on insulation: The test consists of applying dc high voltage (2500 V or 5000 V), with the help of a megger, continuously between winding and earth, and noting the insulation resistance at the end of 10 seconds, 60 sec. and 600 sec. To maintain constant voltage, a motor- driven megger is preferable. The polarization ratios R60/R10 and R600/R60 should not be less than 1.4 and 1.2 respectively. (R10, R60, R600 are the insulation Resistance values after 10 sec. 60 sec. and 600 sec respectively).*

iii) *Phasing out Test: This is comparatively easy, as single phase transformers alone are provided at traction sub-stations; if both the transformers installed at a substation are of identical manufacture the terminal connections will be identical. Nevertheless, the correctness of polarity should be checked by applying 400 V across the primaries in an identical manner and measuring the relative voltage between the two secondaries of transformers after connecting one terminal of one secondary with the corresponding terminal of the other.*

iv) *Oil Test: The tests on transformer oil should be done in accordance with IS- 1866 for oil in use (See Annexure 2.03B Chapter II).*

Para 20212

Alarm and trip contacts are provided to operate should the temperature of transformer windings or transformer oil exceed pre-set limits. If alarm or the trip contacts have operated, both of which are indicated at the RCC, CTFO should personally inspect the installation. If the dial settings are correct, the reason for excessive temperature rise should be investigated. Normally instantaneous overloads of over 150% are cleared by thermal protection. It is

advisable to connect a recording ammeter and get a 24 hour chart showing the current loading of the transformer in services. The shape of the load curve would give valuable clues as to corrective action to be taken.

If the alarm and trip circuits operate frequently during peak periods, attempt should be made with Operating Department to space out the trains more uniformly throughout the day so as to reduce the peak load. If, on the other hand, it is a suburban section and the peak load cannot obviously be brought down, the second standby transformer may have to be pressed into service for the duration of peak load. Such parallel operation of traction transformer may some times may also incidentally result in reduction of the total losses thereby effecting economy. Secondly, it will also result in higher OHE voltage, since traction transformer impedance is now halved, as the transformers are identical

If a substation is persistently overloaded and an adjacent sub-station is appreciably under loaded, the possibility of shifting the neutral section may be considered.

Para 20213

Apart from operation on account of internal faults in the transformer, the differential relay could also operate either because of current in-rush on account of magnetization of the core at the time of switching on or because of spill current caused by lack of perfect balance between secondaries of EHV and 25 kV current transformers. The causes for such mal- operation may be defective harmonic restraint filters or wrong CT ratios and should be eliminated.

Para 20214

The Buchholz relay assembly is provided on transformers to detect evolution of gas caused due to internal faults. After first commissioning, the upper assembly of the relay may sometimes be found to operate causing the relay to trip. Analysis of the composition of gas collected will indicate the nature of fault. If it is mere air bubbles the transformer is sound. Fir details of tests manufacturers write up may be referred to. It is always a wise policy to get the die- electric strength of the oil tested, measure the insulation resistance and carry out ratio test.

Annexure 2.03B
(Para 20207) of ACTM Vol.II Part-I
(The values from latest IS: 1866-2000 has been taken while ACTM table is having the values from IS: 1866-1983)
APPLICATION AND INTERPRETATION OF TESTS ON TRANSFORMER OIL IN SERVICER

SL. No.	Tests	Value as per IS: 1866-2000 permissible limits	To be re-conditioned	To be replaced.
1.	2.	3.	4.	5.
1.	Electric strength (Breakdown voltage) Below 72.5 kV 72.5 kV and less than 145 kV 145 kV and above	Min. 30 kV 40 kV 50 kV	Less than the value specifiied in column 3	--
2.	Specific resistance (Resistivity) Ohm-cm at 90 ^{0}C	Above 1x 10^{12}	Between 0.1 x 10^{12} to 1 x 10^{12}	Below 0.1 x 10^{12}
3.	Water content below 145 kV Above 145 kV	Max. 40 ppm 20 ppm	Greater than the value specified in column 3	--
4.	Dielectric dissipation factor, Tan delta at 90 ^{0}C	0.2 or less	--	Above 0.2
5.	Neutralisation value mg KOH/ g of oil.	0.3 or less	--	Above 0.3
6.	Interfacial tension N/ m	0.015 or more	--	Below 0.015
7.	Flash point in ^{0} C	140 or more	125 and above but below 140	Below 125
8.	Sludge	Non-detectable, Results below 0.02% by mass may be neglected	Sediment	Perceptible sludge
9.	Dissolved Gas Analysis (DGA)	Refer Annexure 2.04 of ACTM Vol.II Part-I		

REFERENCE COPY
सन्दर्भ प्रति

SPECIAL MAINTENANCE INSTRUCTION (SMI) TO MEASURE THE SEVERITY OF POLLUTION BY BRUSH WASH METHOD.

1. **OBJECTIVE:**

To specify the procedure of measuring the extent of pollution in an area in order to select 25 kV insulators of appropriate creepage distance.

2.0 BACKGROUND

2.1 Insulator failures can take place on account of flash overs due to pollution. Railways have been advised to carry out tests to measure the pollution severity & employ insulators of appropriate creepage distance. This special maintenance instruction outlines the method of measurement of severity of polloution.

3. METHOD OF TESTING

3.1 For assessing severity of pollution the method adopted is Brush Wash method. (ESDD method as mentioned in IS : 13134) as explained below.

The Brush Wash method involves measurement of conductivity of demineralised water **before and after** dissolving the collected pollutants from surface of a polluted insulator. The difference in conductivity is an indication of severity of pollution. Equivalent Salt Deposit Density (ESDD) value can be calculated by calculating associated area from where pollutants have been taken and the difference in conductivity. In order to conduct the test, conductivity meter will be required. Sources for the material and equipment are given in Annexure A.

3.2 Procedure

STEP 1: Remove the polluted insulator and pack it in a thick polythene without disturbing the layer of pollutant.

STEP 2 : Measure conductivity of demineralised water (250 ml), using conductivity meter, provided in the test kit.

STEP 3 : Squeeze the cotton provided in test kit in demineralised water and use it to scrape the surface of polluted insulator. Release the pollutant in the demineralised water by squeezing the cotton in water. Repeat till the area intended is scraped completely.

STEP 4 Again measure conductivity of water having pollutants squeezed in.

STEP 5 Calculate the pollution severity is terms of ESDD as mentioned in Annexure B

3.3 **Perodicity of Measurement.**

Measurement is to be carried out periodically every 3 months for about 1 year for assessing the change in severity due to seasonal changes. ESDD values before onset of monsoon are expected to be more severe.

3.4 **Agencies to conduct the test**

OHE maintenance depots may conduct the test and report shall be submitted to Zonal Headquarters by Divisional officer. Periodic reports are to be sent to RDSO.

3.5 **Decision regarding appropriate creepage distance.**

The following table is to be referred for ascertaining appropriate creepage distance. Use of composite insulator will be in accordance with guidelines issued by RDSO vide letter No. TI/OHE/INSCOM/GEN/04 dt. 25-11-04 (Annexure D)

Table - I

ESDD at 20^0 C	Min. Specified creepage distance.	Creepage distance to use.
< 0.10	16 mm/kV	850 mm (min.)
0.10 to 0.30	20 mm/kV	1050 mm (min)
0.30 to 0.60	25 mm/kV	1300 mm (min)
> 0.60	31 mm/kV	1650 mm (min)

4.0 References

(i)	IS : 13134 - 1992	Guide for the selection of Insulators in respect of Polluted Conditions.
(ii)	RDSO's letter No. TI/OHE/INSCOM/GEN/04 dt. 25-11-04	Guidelines for Use of Composite Insulators for 25000 Volts Ac traction .

Annexure 'A'

Probable suppliers of the Material & Equipment used in the test

A. Conductivity meter is marketted by following sources, recommended by CPRI , Bangalore.

1. M/s SIECO Test & Measurement Services Ltd., No.5, Vinayaka Layout Sultanpalya, R.T.Nagar Post, Bangalore 560 032. Ph. No. 080 - 23438362

2. M/s. Green Dot Enterprises, No.1, Next to Ajaneya Temple Street, Basavanaguddi, Bangalore 560 004. Ph. No. 080 - 26675703

B. Sources for Demineralised water

1. The railways depot/lab may be got equipped with a demineralised unit (or an R.O unit of 8 – 10 Ltrs/hr cap.)

Or

A solar still

Or

A distillation plant

1.1 Till such time above plant is to be installed, demineralised water may be procured from the market. .

Annexure B

SURFACE AREA CALCULATIONS
{ ILLUSTRATION }

Calculations :

From axis to point 1 radius is 35 mm.
From axis to point 2 radius is 46 mm.
Length between points 1 and 2 is 12 mm.

Surface area between 1 & 2 point is $\pi(35 + 46) \times 12 = 3054\ mm^2$

From axis to point 3 radius is 60 mm.

Surface area between 2 & 3 point is $\pi\ (60 + 46) \times 20 = 6660\ mm^2$

Surface area between points 3 and 4 is $\pi\ (92 + 60) \times 50 = 23876\ mm^2$

Surface area between points 4 and 5 is $\pi\ (92+102) \times 15 = 9142\ mm^2$

Total top surface area is A = 42732.10 mm^2 = 427.32 cm^2
(from point 1 to 5 only)

Conductivity of water measured without pollution is = 0.02 µS/cm
Conductivity of water measured with polluted is = 0.2 µS/cm.
Change in the conductivity after collecting pollution = 0.18 µS/cm
With temperature corrections, change in conductivity = 0.18 x 0.8252 = 0.148 µS/cm
(Ambient temperature = 29 ^{0}C) (Refer Annexure C)
Measure the surface area of insulator = A

Measure the conductivity of insulators surface with known quantity of water σ_{20} salinity is given by

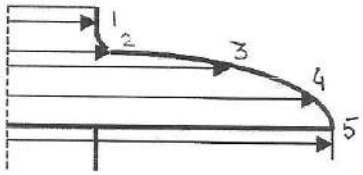
$$S_a = (5.7\ \sigma_{20})^{1.03}\ kg/m^3$$

σ_{20} = value of conductivity corrected for temperature
= σ_t x correction factor as per table enclosed
= conductivity at ambient temperature x Correction factor

Volume of water (demineralised)used (V) = 250 ml

Calculate the ESDD = $\frac{S_a \cdot V}{A}$ mg/cm^2

Salinity of the solution is : $S_a = (5.7 \times 0.148)^{1.03} = 0.839$
The salt deposit density in mg/cm^2 is;
SDD = S_a x V/A = 0.839x 250 /427 = 0.491 mg/cm^2



Annexure – C

CORRECTION FACTOR AT DIFFERENT TEMPERATURE

Temperature (^{0}C) of water at the time of conductivity measurement	Correction factor. *
10	1.28170
11	1.24867
12	1.21672
13	1.18585
14	1.15606
15	1.12735
16	1.09972
17	1.07317
18	1.04770
19	1.02331
20	1.00000
21	0.977600
22	0.955948
23	0.935038
24	0.914872
25	0.895450
26	0.876772
27	0.858838
28	0.841648
29	0.825200
30	0.809500

* **Multiply the observed conductivity with the correction factor to get the standardised value at 20^0 C**

Government of India

Ministry of Railways

Research Designs & Standards Organisation

Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION NO. TI/MI/0041 Rev. 1

Maintenance Instructions

for

Condition monitoring of Lightening Arresters provided on traction systems on Indian Railways

1. Scope:

The technical instructions compiled in this document are related to the different aspects of the condition monitoring of lightening arresters including measurement of resistive leakage current as applicable to metal oxide gapless type lightning arresters of different voltage class existing on traction system of IR.

2. Objectives :

Objective of these instructions is to develop awareness about the condition monitoring of Lightening Arresters of different voltage class

3. Introduction

3.1 Applicable standards for Lightening & surge arresters

These instructions are based on following standards, specifications and RDSO documents issued in past:

S.No.	Standard/reference	Subject
a.	IEC 60099-1, 3, 4	Different types of surge/lightening arresters
b.	IEC 60099-5	Surge arresters-selection & application recommendation
c.	IS 3070 part-3	Lightning Arresters for Alternating Current Systems - Specification - Part 3: Metal Oxide Lightning Arresters without Gaps.
d.	IS 15086 part-3	Selection & application guide
e.	RDSO specification No. TI/SPC/PSI/LCMLA/0030	for Third Harmonic resistive Current measurement equipment
f.	RDSO instructions TI/MI/0041 dated 27-09-05	Maintenance instructions for Lightening Arresters

3.2 Diagnostic Indicators of metal oxide Surge Arresters in service.

Except for brief occasions when a surge arrester is functioning as an over voltage-limiting device, it is expected to behave as an insulator therefore its insulating properties are most essential for operational reliability of the power system.

Different diagnostic methods and indicators for revealing possible deterioration or failure of the insulation properties have been tried since the introduction of surge arresters. These methods range from fault indicators and dis-connectors for indication of complete arrester failures, to instruments that are able to measure slight changes in the resistive leakage current or the power loss of metal oxide arresters.

3.2.1 Fault indicators

Fault indicators provide a clear visual indication of a failed arrester, without disconnecting the arrester from the line. They may be an integrated part of the arrester, or a separate unit installed in series with the arrester. The working principle is usually based on the amplitude and duration of the arrester current, or on the temperature of the non-linear metal-oxide resistors.

3.2.2 Dis-connectors

Dis-connectors, often used on medium-voltage arresters, provide a visual indication of a failed arrester by disconnecting it from the system. The typical working principle is an explosive device triggered by the fault current: however, the dis-connectors are not intended to extinguish the fault current. The dis-connector may be an integral part of the arrester or insulating bracket, or a separate unit installed in series with the arrester. The advantage is that the line remains in operation after disconnection of the arrester. The major disadvantage is the lack of overvoltage protection until the failed arrester has been discovered and replaced.

3.2.3 Surge counters

Surge counters operate at impulse currents above certain amplitude, or above certain combinations of current amplitude and duration. If the interval between discharges is very short (i.e. less than 50ms), surge counters may not count every current impulse. Some counters are not so sensitive and may not count the short impulse currents through metal-oxide arresters.

Depending on the operating principle and sensitivity of the counter, it may give an indication about over voltages appearing in the system, or it may provide information on the number of discharges corresponding to significant arrester energy stresses. The counter provides no specific information about the condition of the arrester.

The arrester with surge counters are equipped with an insulated earth terminal and a conductor between the arrester and counter that is insulated from earth. For safety reasons, the surge counter should be installed beyond easy reach of personnel; it shall be located where it can be read from ground level with the arrester in service. The installation should be provided with shortest length of the earth connection without reducing its cross-section.

3.2.4 Monitoring spark gaps

Monitoring of spark gaps is done to indicate the number and estimate the amplitude and duration of discharge currents through the arrester. Special experience is necessary to properly interpret the marks on the gap. Some spark gaps can be examined with the arrester in service, while other types require that the arrester is de-energized. It is required that the arrester be equipped with an insulated earth terminal. Alternatively, the device should be an integral part of the arrester. Spark gaps give no direct information about the actual condition of the arrester, but may help to make decisions about continued operation.

3.2.5 Temperature measurements

Remote measurement of the arrester temperature can be carried out by means of thermal imaging methods. The measurements are only indicative with regards to the condition of the arrester, since the temperature drop between the resistors and the housing surface may be substantial. Nevertheless, comparative measurements made on adjacent arresters or arrester units may indicate excessive heating.

Direct measurements of the metal-oxide resistor temperature may give an accurate indication of the condition of the arrester, for this it is essential that the arrester should be equipped with special

transducers at the time of manufacturing. Therefore, this method is used only in special arrester applications.

3.2.6 Leakage current measurements of metal-oxide arresters

Any deterioration of the insulating properties of a metal-oxide arrester causes an increase in the resistive leakage current or power loss at given values of voltage and temperature. The majority of diagnostic methods for determining the condition of gapless metal-oxide arresters are based on measurements of the leakage current.

The measuring procedures can be divided into two groups: on-line measurements, when the arrester is connected to the system and energized with the service voltage during normal operation, and off-line measurement, when the arrester is disconnected from the system and energized with a separate voltage source on site or in a laboratory.

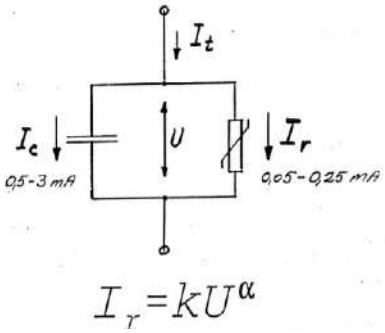
Off-line measurements can be made with voltage sources that are specially suited for the purpose, e.g. mobile ac or dc test generators. Good accuracy may be obtained by using the off-line methods, provided that a sufficiently high test voltage is used. The major disadvantages are the cost of the equipment and the need for disconnecting the arrester from the system.

Measurements carried out on-line under normal service voltage are the most common method. For practical and safety reasons, the leakage current is normally accessed only at the earthed end of the arrester. To allow measurements of the leakage current flowing in the earth connection, the arrester must be equipped with an insulated earth terminal.

Out of the monitoring methods mentioned above leakage current monitoring especially the monitoring of resistive leakage current is most popular and same has been adopted in IR and discussed in detail in Para's below.

4.0 Properties of the leakage current of nonlinear metal-oxide resistors

The ac leakage current can be divided into capacitive and resistive part, with a pre-dominant capacitive component and a significantly smaller resistive part.



- I_r: Resistive current
- I_c: Capacitive current
- U: Voltage
- k: Material dependent constant
- α: Temperature and voltage dependent.

4.1 Capacitive leakage current

The capacitive leakage current measured at the earth terminal of an arrester is caused by the permittivity of the non-linear metal-oxide resistors, the stray capacitances and the grading

capacitors, if applied. The specific capacitance of a resistor element typically results in a capacitive peak leakage current of about 0.5mA to 3mA under normal service conditions.

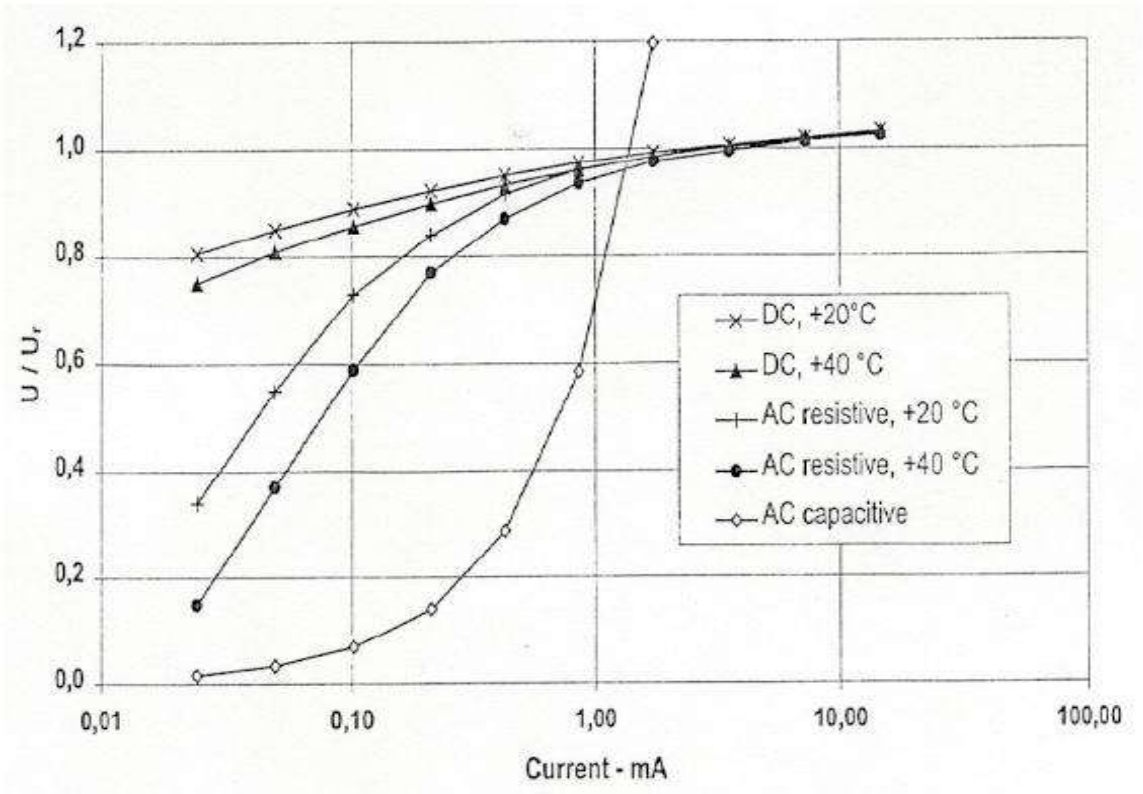
The capacitive current does not change significantly due to deterioration of the voltage-current characteristic of the non-linear metal-oxide resistors. Therefore, its measurement cannot reliably indicate the condition of metal-oxide arresters.

4.2 Resistive leakage current

At given values of voltage and temperature, the resistive component of the leakage current is a sensitive indicator of changes in the voltage-current characteristic of non-linear metal-oxide resistors. The resistive current can, therefore, be used as a tool for diagnostic indication of changes in the condition of metal-oxide arresters in service.

The resistive component under ac voltage is defined as the current level at the instant of voltage maximum ($d_U/d_t=0$). The resistive leakage current of a non-linear metal-oxide resistor is in the order of 5% to 20% of the capacitive current under normal operating condition, corresponding to about 10µA to 600 µA peak at a temperature of $\pm 20^0$C.

In the leakage current region, the resistive current depends on the voltage and temperature. Typical curve indicating voltage and temperature dependencies for different components of leakage current is shown below.



4.3 Harmonics in the leakage current

The non-linear voltage-current characteristic of a metal-oxide arrester gives rise to harmonics in the leakage current when the arrester is energized with a sinusoidal voltage. The harmonic content

depends on the magnitude of the resistive current and the degree of non-linearity, which is a function of voltage and temperature. As an example, the third harmonic content of the resistive current is typically 10% to 40%. The harmonic content can, therefore, be used as an indicator of the resistive current.

Another source of harmonics, beside negligible ones, that may considerably influence the measurement of harmonics in the leakage current, is the harmonic content in the system voltage. The capacitive harmonic currents produced by the voltage harmonics may be of the same order of magnitude as the harmonic currents created by the non-linear resistance of the arrester. This aspect is very important in case of Traction load which is a big source of harmonic distortion with predominant 3rd Harmonic contents of up to 20 % in current.

4.4 Surface leakage current

As with any other outdoor insulator, external surface leakage current may temporarily occur on the arrester housing in rain or in conditions of high humidity combined with surface pollution. In addition, internal surface leakage current may also appear due to moisture penetration. During measurements, the surface currents may interfere with the leakage current of the resistors, however, the sensitivity to external and internal surface currents may be different for the various measurement methods. The influence of the external surface leakage current can be avoided, either by performing the measurements in dry conditions, or by any other suitable method, e.g. bypassing the surface leakage current to ground.

5.0 Measurement of leakage currents

5.1 Measurement of total Leakage Current (To be adopted on IR)

The total leakage current depends mainly on the capacitive current, since the resistive part is only a fraction of the capacitive current component. Furthermore, the capacitive and resistive current components differ in phase by 90^0, therefore, a large increase in the resistive current of the non-linear metal-oxide resistors is needed before a significant change can be noticed in the total leakage current level. In addition, the total leakage current is sensitive to the installation, since the capacitive current depends on the stray capacitances.

On-line measurements of the total leakage current are extensively used in practice by means of conventional mA-meters built into the surge counters or into portable instruments, showing the r.m.s., mean or peak value of the total leakage current. However low sensitivity to changes in the resistive current level makes the measurement of total leakage current not reliable as a diagnostic indicator.

5.2 Measurement of Resistive Leakage current

As per IEC 60099-5 there are number of direct and indirect methods specified for measurement of the resistive component of the leakage current. Out of these, B-2 method involving “Third harmonic analysis with compensation for harmonics in the system voltage” has so far been recommended for traction system on IR.

Method B-2 -Third order harmonic analysis with voltage harmonics compensation

The method is based on the fact that harmonics are created in the leakage current by the non-linear voltage-current characteristic of the arrester. It is assumed that all harmonics arise from the non-linear resistive current. The harmonic content depends on the magnitude of the resistive current and on the degree of non-linearity of the voltage-current characteristic, i.e. the harmonic content varies also with the voltage and temperature of the arrester.

The third harmonic is the largest harmonic component of the resistive current, and it is the most commonly used for diagnostic measurements. The conversion from harmonic to resistive current level, if required, relies on information supplied by the arrester manufacturer or from measurements in the laboratory.

The method can be readily used for measurements in service. The main problem is the sensitivity to harmonics in the system voltage. The harmonics in the voltage create capacitive harmonic currents that are comparable in size with the harmonic currents generated by the non-linear resistance of the arrester. As a result, the error in the measured harmonic current may be considerable if the harmonic content in the voltage is high. However the sensitivity to harmonics in the voltage is greatly reduced by the introduction of a compensating current signal for the capacitive third harmonic current in the arrester. The compensating current signal is derived from a "field probe" positioned at the base of the arrester. After proper scaling, the harmonic current induced in the probe by the electric field is subtracted from the total harmonic current. The result is the harmonic current generated by the non-linear resistive current of the arrester. The conversion from third harmonic to resistive current requires additional information from the arrester manufacturer. The method is suitable for measurements in service.

6.0 Condition monitoring of lightening arresters in traction system

6.1 General recommendations to be adopted on IR

6.1.1 It is noticed worldwide that reliability of lightning arresters can be improved by taking precautions e.g. periodical monitoring of the health of arrester by checking the possible deterioration and identifying the defects in initial stages.

6.1.2 Failure of lightning arresters takes place mainly due to ingress of moisture inside lightning arresters and / or ageing of zinc oxide blocks.

6.1.3 Leakage current measurement can be done only on lightning arresters fitted with porcelain insulated base of the same mounting dimension as that of the lightning arrester.

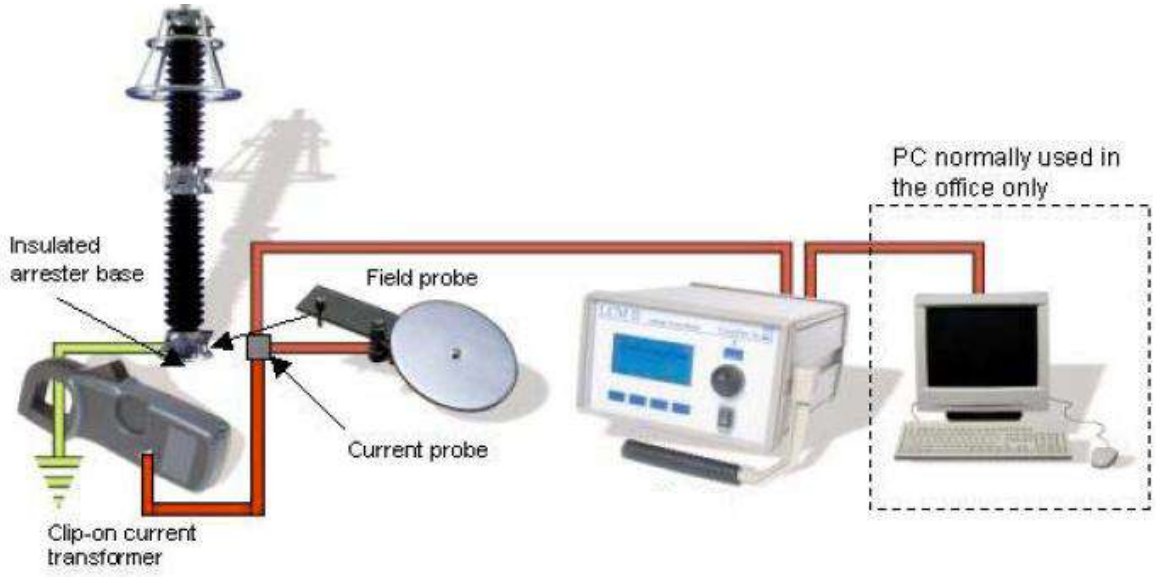
6.1.4 If surge monitors are provided for lightning arresters the connection from lightning arrester base to surge monitor unit/earth terminal should be made through a small piece of 35 mm^2, 1100 volts grade, unarmored PVC insulated copper cable to facilitate on line measurement of leakage current. For 25 kV side LAs at FP/SSP/SP, surge monitor shall be provided on the uprights of the gantries at a height of 1.5 meter to facilitate monitoring of leakage current through surge monitor and on line measurement of third harmonic leakage currents.

6.1.5 IR value of lightning arresters should be measured during annual maintenance and it should be above 1.0 G ohms (for 42 kV LAs on 25 kV side) and more than 10 G ohms (for LAs on HV side). The IR measurement should be done by 2.5/5.0 kV equipment. In the periodic maintenance, connections on HT side and earth side have to be checked and ensured in proper condition.

6.1.6 The checks and maintenance as indicated in **Annexure-I** are to be done at time of receipt, before commissioning and during maintenance of the lightning arrester.

6.2 Measurement of resistive current

6.2.1 As explained above the degradation of metal oxide lightning arresters in service can be diagnosed by estimating resistive part of the total leakage current using the third harmonic analysis with compensation for voltage distortion. Third harmonic analysis based assessment of resistive component of leakage current is recorded by sophisticated equipment. The block diagram of the measurement system is shown below.



6.2.2 Assessment of resistive component of leakage current is a very sensitive measurement due to its small value (few micro amperes) and its dependence on Voltage and temperature. Every reading recorded is also accompanied by the Voltage and temperature at the time of reading.

6.2.3 The measurements should be taken preferably under dry climatic conditions to avoid interference with surface leakage currents. It is suggested to complete one cycle of measurements prior to onset of monsoon.

6.2.4 The calibration of the equipment should be checked with the equipment manufacturer. The readings recorded should be carefully examined for consistency of results e.g. very high leakage currents for all LA's at one place or wide variations in repeated measurements needs cross verification.

6.2.5 The antenna of the equipment is to be kept at the foot of the LA base. In case LA's are provided on gantries and if at such height it is not possible to place antenna, the antenna can be placed at the base of any nearby PT or base insulator connected in the same circuit.

6.2.6 Features, operating instructions and displays of different equipment manufacturers may vary widely therefore it is suggested that end user must get proper training from the manufacturer. Generally the resistive leakage current monitoring equipment may provide:

I_t –Total leakage current (mA)
I_c – Capacitive component of leakage current (mA)
I_{3t} –Third harmonic component of leakage current (μA)
I_r –Resistive component of leakage current (μA)
I_r corr. – corrected value of I_r after considering effect of temperature (μA)

6.2.7 As pointed out in Para's 4.3 & 5.2.1, this method of measurement is extremely sensitive to the harmonic distortion present in the supply. The antenna probe picks up the harmonic distortion levels for its compensation however as traction load current contains high content of third harmonic which results in to voltage distortion also, it is observed in field that number of times the equipment fails to record any reading and may also repeatedly display an error. There are more chances of such incidences when the traction load is present. In such conditions, if possible measurements may be planned at no load/ light load condition.

6.2.8 Records of periodic maintenance and measurement of each lightning arrester should be maintained including location, rating, make, serial no., date of manufacturing, date of commissioning, date of measurement, IR value, value of resistive leakage current, total leakage current, No. of surges passed and maintenance remarks.

6.2.9 The value of resistive leakage current shall be recorded and in case of abrupt variation or very high leakage current, the concerned lightning arresters should be taken out from the service for detailed investigation. It is also suggested that some such arresters should be jointly examined with the arrester manufacturer to identify the cause of deterioration so that improvements in the design can be made. The data bank of different makes and ratings of arresters may also be made for fixing the maximum value of permissible leakage currents for each type/make.

A comparative study of results shall indicate the deterioration in the condition of arrester. RDSO has summarized the data of measurements received from Railways and based on which, it is suggested that LA's with resistive leakage currents in between 350-500 μA should be closely monitored and beyond 500 μA should not be permitted & removed from service at the earliest.

The limits prescribed above are based on limited experience of Railways & data collected from other utilities; however same shall be further reviewed based on feed backs received from Railways. It is therefore advised that proper data/statistics should be maintained by Zonal Railways, traction sub-station wise and report should be sent to RDSO in the enclosed Annexure-II for further study, review & modification required, if any.

					Annexure-I
Stage of checking	**Items to be checked**	**Type of check & Instruments to be used**	**Records and standards**	**Activities and measurements / observations**	**Remarks**
At time of receipt	Lightning arrester unit and accessories including insulating base, surge monitor	Visual check on condition of crate. Dimensional verification	Packing list/invoice Approved drawings	Check for any damage to crates, arrester units and accessories as per packing list / invoice. Item shall be as per approved drawings.	Advise firm in case of shortage, damage and mismatch in dimensions to arrester units as well as accessories.
Pre erection	Lightning arrester unit Grading rings Surge Monitors	Dimensional verification, Measuring tape, Celofin tape, Calipers Measurement of IR value 2.5 kV Insulation tester for 42 kV LAs and 5 kV megger for LAs above 42 kV. Galvanization thickness on strips using micro tester. Functional check of counter 24 V DC & 7 V rms source multi meter.	Approved drawings IS 2633, IS 6745 Approved GTP, Suppliers test certificate	Item shall be as per approved drawings. Measure and record IR values- Should be > 1 GΩ for 42 kV LAs Should be > 10 GΩ for above 42 kV LAs >65 µ for thickness between 2-5 mm >85 µ for thickness more than 5 mm Should record given pulses Should flicker at 7 V rms Should be <10 V DC	Advise firm in case of mismatch in dimensions and low IR values.
Post commissioning and annual maintenance	Lightning arrester unit	Post commissioning and periodical annual maintenance. 2.5/5.0 kV megger, Leakage current monitor to measure 3rd harmonic resistive leakage current	Records previous measurements of IR value and THRC leakage current value	Cleaning of LA housing Measure IR value and leakage current before and after cleaning of LAs IR values after cleaning should be > 1 GΩ (for 42 kV LAs) and > 10 GΩ (for above 42 kV LAs) Measurement of resistive component of leakage current after cleaning should not indicate any abrupt variation from its previous reading. Further resistive leakage current should be less than 500 µA.	In case of low IR values LA has to be taken out of service and jointly investigate with LA manufacturer. In case of leakage current between 350 – 500 µA, keep it under close observation & beyond 500 µA, remove from service and jointly examine/investigate with LA manufacturer.

Annexure-II

Measurement of resistive leakage current of lightening arrestors

Railway	Division	Name of TSS/GSS	Voltage class of LA	Make & year of manufacturing of LA	Make & Year of manufacturing of equipment used for measurement of resistive leakage current	Voltage at the time of each measurement	I_{total} Total Leakage current (mA)	I_{3t}	I_r

File No.RDSO-TI0LKO(OHE)/2/2020-O/o PED/TI/RDSO

Government of India, Ministry Railways
Research Designs & Standards
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Manak Nagar, Lucknow– 226 011

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सं./No: RDSO-TI0LKO(OHE)/2/2020-O/o PED/TI/RDSO दिनांक/Date: 25.04.2023

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3. East Central Railway, Hajipur (Bihar).844101
4. East Coast Railway, B-Rental Colony, Chandrashekharpur, Bhubaneshwar (Orissa)-751 023
5. Northern Railway, Baroda House, New Delhi - 110 001
6. North Central Railway, Block-A, Subedarganj, Allahabad 211 033.
7. North Eastern Railway, Gorakhpur (UP).220 055
8. Northeast Frontier Railway, Maligaon, Guwahati - 781011.
9. North Western Railway, Jaipur (Raj.) – 302017.
10. Southern Railway, Park Town, Chennai - 600 003 (TN)
11. South Central Railway, Rail Nilayam, Secunderabad – 500 371
12. South Eastern Railway, Garden Reach, Kolkata-700 043.
13. South East Central Railway, Bilaspur (Chhattisgarh).4950 04
14. South Western Railway, DRM's Office, Hubli (Karnataka)
15. Western Railway, Churchgate Stn. Bldg, Mumbai - 400 020.
16. West Central Railway, Jabalpur-482 001 (M.P)
17. Central Organisation for Railway Electrification, 1, Nawab Yusuf Road, Civil Lines, Prayagraj-211001.
18. Konkan Railway Corporation Limited, Belapur Bhavan, Plot No 6, Sector 11, CBD Belapur, Navi Mumbai – 400614.
19. Metro Railway, Kolkata, Metro Bhavan, 33/1, J L Nehru Road, Kolkata-700031.
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21. Chairman and Managing Director, IRCON, Room No. 505, Palika Bhawan, Sector -13, R. K. Puram, New Delhi-110066.
22. Managing Director, DFCCIL, 5th Floor, Pragati Maidan, Metro Station Building Complex, New delhi-110 001.
23. Chief Executive Officer, Railway Energy Management Co. Ltd, Ground Floor, Central Wing, Sector 29, Gurgaon-122001.
24. Director Technical, MRVC, 2nd Floor, Churchgate, Mumbai-400020.
25. ED (Electrical), RVNL, 1st Floor, August Kranti Bhavan 'B' Block, BhikaJi Cama Place, R K Puram, New Delhi-110066.
26. Chairman and Managing Director, RITES LTD, Shikhar, Plot No.01, Sector 29, Gurgaon, Haryana, India-122001.

विषय/Sub: Special Maintenance Instruction No. TI/MI/0042, Rev-01 for Testing of 25 kV Porcelain & Composite Insulators before Installation.

***

Special Maintenance Instruction No. TI/MI/0042, Rev-0 for Testing of 25 kV Porcelain & Composite Insulators before Installation was issued by RDSO in December, 2008. The same has been reviewed and revised as Special Maintenance Instruction No. TI/MI/0042, Rev-01. This supersedes the earlier issued Special Maintenance Instruction No. TI/MI/0042, Rev-0.

A copy of revised Special Maintenance Instruction No. TI/MI/0042, Rev-01 is enclosed herewith for reference and necessary action please.

This issues with the approval of competent authority.

संलग्नक: यथोक्त।

Digitally Signed by Arvind Kumar
Date: 25-04-2023 17:36:01
Reason: Approved

(अरविन्द कुमार/Arvind Kumar)
निदेशक/कं.सं-1/ Director/TI-1
कृते महानिदेशक/कं.स/For Director General/TI

Copy to: Executive Director, EEM, Railway Board, Rail Bhavan, New Delhi- 110001
-for kind information please.

सत्यमेव जयते

भारत सरकार GOVERNMENT OF INDIA

रेल मंत्रालय MINISTRY OF RAILWAYS

स्थापना से पहले 25 केवी पोर्सिलेन और कम्पोजिट इंसुलेटर के परीक्षण के लिए विशेष रखरखाव निर्देश (एसएमआई)

SPECIAL MAINTENANCE INSTRUCTION (SMI) FOR TESTING OF 25 kV PORCELAIN & COMPOSITE INSULATORS BEFORE INSTALLATION

सं. टी0आई0/एमआई0/ 0042 (04/2023), संशोधन-01
No. TI/MI/ 0042 (04/2023), Rev-01

जारीकर्ता/ISSUED BY:

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(केवल आधिकारिक प्रयोग के लिए/For official use only)

Prepared By	JE(D)/TI	Checked By	ADE/TI-1	Issued By	DTI-1

SPECIAL MAINTENANCE INSTRUCTION (SMI) FOR TESTING OF 25 kV PORCELAIN & COMPOSITE INSULATORS BEFORE INSTALLATION

1. OBJECTIVE:

To specify testing procedure of 25kV solid core porcelain insulators and Composite Insulators at site/depot before installation. Testing of Insulators before Installation is necessary to identify the defective/damaged insulators which may have been developed due to various reasons beyond Railways control.

2. BACKGROUND:

To identify the insulators which may have developed defect due to various reasons beyond Railways control. Initially, Railways were advised vide SMI No. TI/MI/O011 'Rev 0' and subsequent Revision 1 to test each insulator for routine tensile load test at site/ depot before installation. Later, Pre-installation testing of Composite Insulator testing was also included in the scope of the SMI and to This SMI No. TI/MI/O011 was superseded vide SMI No. TI/MI/0042, Rev-0 in December, 2008.

3. NEED FOR REVISION:

In the previous revision of SMI No. TI/MI/0042, Rev-0, pre-installation test is mentioned for Stay, Bracket & 9-Tonne Insulator only. Railways have been reporting that failure of Sectioning Insulators during the Installation. Further, ECoR have also proposed vide letter No. ECOR/EL/TRD/446/32 dated 10.06.2022 to include other type of Insulators in the scope of Pre-installation testing vide RDSO's SMI. Accordingly, pre-installation test for other type of Insulators i.e Post, Section & Operating Rod Insulators have also been incorporated.

This SMI supersedes the earlier SMI No. TI/MI/0042 (12/2008), Rev-0

4. TESTING INSTRUCTIONS:

4.1 For conducting the routine tensile load test on 25 KV Porcelain & Composite Insulators before Installation, Tensile Load Testing Machine as per RDSO Specification No. TI/SPC/OHE/INSTEST/0090, Rev-0 (with A & C slip 1) or latest to be used. The load shall be as per the values mentioned in the Table-1 & Table-2 below:

Tabte-1: Load to be applied for testing of 25 kV Porcelain Insulators

Specification No.	Type of Insulator	Specified SML in kgf	Routine Tensile Load (RTL) @ 55% of specified value in kgf
TI/SPC/OHE/INS/0070 & TI/SPC/OHE/INS/0071	Stay Arm and Bracket	7000	3850
	9-Tonne	11000	6050
	Post	6000	3300
	Operating Rod	2200	1210
	Section	5000	2750

Tabte-2: Load to be applied for testing of 25 kV Composite Insulators

Specification No.	Type of Insulator	Specified SML in kgf	Routine Tensile Load (RTL) @ 70 % of specified value in kgf
TI/SPC/OHE/INSCOM/1070, TI/SPC/OHE/INSCOM/1071, TI/SPC/OHE/INSCOM/1071, Rev-01 & TI/SPC/OHE/INSCOM/1072	Stay Arm and Bracket	7000	4900
	9-Tonne	11000	7700
	Section	5000	3500

Following shall also be insured before pre-installation testing of 25 kV Insulators.

- Calibration of Tensile Load Testing Machine shall be done annually.
- Suitable fixtures shall be used for testing of different types of Insulators i.e. Stay Insulator to be tested with fixture meant for Stay insulator testing and vice-versa.

4.2 It would be seen from the above that RTL has been kept different in both type of insulator. The reason being:

(a) The porcelain insulator changes its mechanical characteristics at nearly 80% of its SML. There may be few insulators which may get manufactured with a reduced SML, say 80% its specified value. If such, insulators are tested at 70% of specified SML, the resultant force shall be more than 80% of its actual SML, thus making a permanent change in the listed at porcelain & also make this insulator a suspect for failure in service due to development of stresses.
(b) In view of the above, IEC standards have been followed wherein no case, the RTL will exceed the limits which shall cause permanent set in the chemistry of the porcelain.
(c) For composite insulator, above reasoning does not apply. In these insulators, idea is to check the soundness of crimping of the metal ports with the fibre rod core and this force should be as near to the SML as possible. 70% of SML is considered to be as ideal force, hence specified.

4.3 **TESTING PROCEDURE:**

(a) Pre installation test shall be carried out on all type of Porcelain & Composite Insulators i.e. stay, bracket, 9- Tonne, Post, Operating Rod & Section insulators supplied by vendor/OHE contractor.
(b) Further, if insulators are to be erected from the available stock, they shall also be tested as per above values before installation.
(c) Ensure calibration of Tensile Testing Machine before beginning of the test with calibrated dynamometer.
(d) Make sure the fixture being used is of correct type as per Insulator being tested.
(e) Apply the routine tensile load as per Table-1 & Table-2 and maintain for one minute and then release.
(f) Check the insulators along with metal fittings for any cement crack, core pull out/ loose crimping, deformation in the metal fitting, hook etc. during the routine test.
(g) The defective insulator may be destroyed.

4.4 Insulators which have successfully withstood the specified RTL as indicated in the Table-1 & Table-2 shall only be commissioned in the OHE.

***

Prepared By	JE(D)/TI	Checked By	ADE/TI-1	Issued By	DTI-1

भारत सरकार GOVERNMENT OF INDIA

रेल मंत्रालय Ministry of Railways

निर्देश संख्या. टी आई/एम आई /0043 रिवि. 3

INSTRUCTION No. TI/MI/0043 Rev.3

8-व्हीलर टॉवर वैगनों डीईटीसी और डीएचटीसी के लिए रखरखाव निर्देश

MAINTENANCE INSTRUCTIONS FOR 8-WHEELER TOWER WAGONS COVERING INSTRUCTIONS FOR DETC AND DHTC

(August, 2024)

		Signature हस्ताक्षर
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DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

MAINTENANCE INSTRUCTIONS
FOR
8-WHEELER TOWER WAGONS COVERING
INSTRUCTIONS FOR DETC AND DHTC

INSTRUCTION No. TI/MI/0043 Rev.3

Amendment History:

Amendment Number	Date of Amendment	Total pages including Annexure.	Amendment/Revision
0	01.08.2008	49	First issue
1	22.08.2017	51	Second issue
2	28.11.2017	88	Third issue.
3	23.08.2024	274	Fourth issue

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
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	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

INSTRUCTION No. TI/MI/0043 Rev.3

MAINTENANCE INSTRUCTION FOR 8-WHEELER TOWER WAGONS COVERING INSTRUCTIONS FOR DETC AND DHTC.

OBJECTIVE: **For upkeep of Tower Wagons and all time availability of Tower Wagons in working conditions.**

1.0. **BACK GROUND**:

Tower Wagon (OHE inspection Car) has a key roll in the maintenance of OHE and for attending to breakdowns and is utilized

- for inspection and maintenance of OHE
- for restoration of damaged OHE during breakdown.
- to strung Catenary and Contact Wires to replace OHE.

Therefore, satisfactory upkeep of the Tower Wagon is of utmost importance.

Based on the recommendation for Item No. 438 of 63rd ESC meeting held at BLW/Varanasi, on 20 & 21 September, 2019, Railway Board have nominated a committee consisting EDRE/Railway Board, ED/TI/RDSO (Convener), CEDE/NCR and CEDE/NWR to deliberate upon the Tower Wagon maintenance issues, which include following:

- To develop facilities for POH of Tower Wagon other than existing Workshops and EMU Sheds
- TO review practice of " Safe to Run Examination" by Mechanical Department
- To review periodicity of POH of Tower Wagon

Further, Committee deliberated on the development of " facilities for POH of Tower Wagon other than existing Workshop and EMU Shed" and " Review of periodicity of POH of Tower Wagon" .

Further, Committee has recommended reviewing the POH schedule as under:

- Daily, Weekly and Monthly to be grouped into Minor Schedule.
- Quarterly and Six monthly scheduled is to be merged with AOH.
- Bogie running and Brake equipment overhaul to be done in 36 Monthly schedule
- 18 Monthly schedules is to removed and merged with 36 Monthly schedule and to named as IOH.

- 54 Monthly scheduled is to be merged with IOH.
- AOH, IOH and POH to grouped into Major schedule.

This special maintenance instruction has been prepared to maintain tower wagons so that its availability can be ensured all the time. Following maintenance instructions are to be followed for maintenance of various items of tower wagons.

2.0. SCOPE OF MAINTENANCE SCHEDULE:

This booklet covers maintenance schedule for different assemblies & components under different heads, as under :

PART– I: Engine and Compressor

PART– II: Hydraulic Transmission, Electrical Transmission (Traction Alternator, Power Rectifier, Traction Motor) & Controls (Driver Desk Cubicle1 & 2 Control Cubicle 1 & 2 Resistor Panel, Motor Switch Group Cubicle-MSGC), Auxiliary Alternator & RRU.

PART -III: Car body, Under frame, Bogie, Wheel and Axle, Axle Box, Brake system & Brake rigging, Air Dryer, Lifting & Swiveling platform, Cattle Guard, Rail Guard, CBC Coupler, Buffer, Ladder etc.

PART - IV: Other Items like 110V Battery, 24V Battery, 110V Battery Charger, Pantograph, 10 kVA DG Set ,3kVA/5 kVA DG set cum welding machine, CCTV camera, OHE Sensing device, Marker Light, Flasher light, Horn, Head Light, Tail Light, Search Light, Junction Box, All Coach Lights and Fans, Mobile Charging points, WRA etc.

PART - V: List of " Must Change Items during POH" for 8-Wheeler Tower Wagon

3.0 PERIODICITY OF MAINTENANCE SCHEDULE:

3.1 As per recommendation of Committee mentioned in Par-1.0 above, the periodicity of Maintenance Schedule for Part-II, Part-III and Part-IV (as mentioned in Para-2.0 above) shall be as under:

Minor Schedule (TW Depot)	Safe to Run Examination(T	Major Schedule (at Nominated Electric Loco Shed or Diesel Loco

		XR)	Shed or EMU/MEMU Car Shed or Diesel/Electric Loco trip Shed / C&W depot)		
Daily	Monthly Schedule (1 month ± 3 days)	45±3 days days/4500km whichever is earlier as per Note given below	AOH Schedule (12 month ± 15 days)	IOH Schedule (36 month ± 30 days)	POH Schedule (72 month ± 60 days)

Note:

(1.) As per Para 20317(2) of ACTM Volume-2 Part-I correction slip no. 3 dated 17.08.2023 regarding periodicity of TXR inspection for Tower wagons, " A periodic (45 days/4500Km, whichever is earlier) inspection of the bogie and running gear of each OHE inspection Car (tower wagon) shall be done by a nominated supervisor of nearest Electric Loco Shed or Diesel Loco Shed or EMU/MEMU Car Shed or Diesel/Electric Loco trip Shed / C&W depot Mechanical department" . Copy of correction slip is enclosed at **Annexure-1.**

(2.) Daily and Monthly schedule shall be carried out at Tower Wagon Depot. List of proposed Depot/Shed nominated by Zonal Railways for AOH of Tower Wagon is attached as **Annexure-3.** List of proposed Diesel Shed nominated by Zonal Railways for carrying out IOH/POH of Tower Wagon is attached as **Annexure-2.**

(3.) Details of items to be checked during Safe to Run Examination (TXR) is attached as **Annexure-12** which has been extracted from RDSO Report No. TI/REPORT/OHE/2021/00137 for TXR.

(4) Specified schedule may be carried out earlier also in case of major damage.

(5) A Summary of works done during Daily and Monthly Schedule for 8 W DETC and DHTC have been attached as **Annexure-13**. This is for the maintenance staffs as a ready reference document only, so that they can use it during maintenance. However complete SMI should be referred during complete maintenance.

3.2 The periodicity of Maintenance Schedule for Diesel Engine of CIL make engine and Compressor shall be as under:

Check	Periodicity
A Check	On Daily basis
B Check	Every 300 hours or 6 month, whichever is earlier.
C Check	Every 1500 hours or 12 month whichever is earlier.
D Check	Every 6000 hours or 24 month whichever is earlier
POH	An overhauling POH is required after 09 years or 12000 Hours whichever

	is earlier as per recommendation of M/s Cummins for NTA-855R/NT-855R.

3.3 List of Tools plant facilities to be with Maintenances Depot/Shed is attached as **Annexure-7** of this SMI. This is as per Annexure-B of Railway Board letter No. 2006/Elect (G) /170/2/Part-II, dated 26.06.2023.

4.0 REFERENCE DOCUMENTS:

The following documents are also required to be referred for further information regarding Maintenance schedule of Tower wagon and its parts:-

S.N.	Reference Document No.	Description
1.	Operation and Maintenance Manual, Bulletin No. 3243773-02 (December, 1999), Cummins India Limited.	Maintenance Manual of M/s Cummins make Engine
2.	M/s Cummins maintenance of NTA-855R Engine.	Maintenance Manual of M/s Cummins make Engine
3.	FT0050745-112 E00MUM 8 WHEELER DETC (BG) - IR	Maintenance Manual of M/s Wabtec (FTIL) make Air Brake System
4.	RDSO/ELRS/SMI/75	Scheduled Maintenance Instructions for Ensuring Proper Raising and Lowering of Pantograph Type AM12 issued by Electrical (TPS) dte. Of RDSO.
5.	RDSO/ELRS/SMI/192	Scheduled Maintenance Instructions for Periodic Maintenance/Checks For Pantograph AM12 Type And Of Similar Design issued by Electrical (TPS) dte. Of RDSO.
6.	RDSO/ELRS/SMI/198	Scheduled Maintenance Instructions for Lubrication Schedule for Improving Reliability

		of Pantograph AM-12 Type and of Similar Design issued by Electrical (TPS) dte. Of RDSO.
7.	RDSO/ELRS/201	Scheduled Maintenance Instructions for Grease Pan for Pantograph Type AM12 or Similar Design issued by Electrical (TPS) dte. Of RDSO.
8.	RDSO/ELRS/SMI/64	Scheduled Maintenance Instructions for Static Balancing Procedure For Pantograph Type AM12 and Type AM18 issued by Electrical (TPS) dte. Of RDSO.
9.	RDSO/2007/EL/TC/0094	Components to be Changed During AOH / IOH & POH of Similar Design Pantograph Type AM12, IR 01 and Pan 01.
10.	Maintenance Manual of M/s BHEL, (Issued Date: March, 2021)	Power/Traction Equipment For 700 (2 X 350) Hp Diesel Electric Tower Car With Underslung Transmission System (DETC/US)
11.	CGPISL/DETCUS/MM/02, dated 14.01.2019.	Operating & Maintenance Manual for 8-Wheeler Diesel Electric Tower Car With Under-slung Transmission, of M/s CGL propulsion system (for M/s BEML make 8W-DETC)
12.	MP – MISC.- 104 (Rev 0.00) September – 2000	Schedule Of Standard Examination Of 700 Hp Bg Diesel Electric Multiple Unit (DEMU) (Equipped With CIL Engine)
13.	Report no. MP – MISC.- 157 (Rev.-04) August-2020	Schedule of Standard Examination of 1400 HP BG DEMU
14.	Propulsion Equipments for BG DEMUs: Traction Sales Division, BHEL Limited.	Maintenance Manual for M/s BHEL propulsion Tower Wagon

15.	Operating Instruction and Maintenance Manual 30 CFM	For ELGI Air Compressor Assembly model: TRC – 1000 LPM.
16.	INDIAN RAILWAYS: Maintenance Manual for BG Coaches, December (1995)	Issued by IRCAMTECH, Gwalior for BG Coaches.
17.	Railway Board letter no. 2006/Elect(G)/170/2/Pt-II E-3422660, dated 17.08.2023	Advance Correction Slip No. 3 to Railway Manual of AC traction (ACTM) Vol-II part-1 Para 20317 (2) with regard to Periodicity of TXR inspection of Tower Wagon.
18.	No.201 9/M (PU)/1/38(E) Pt.1, dated 25.10.2023	Production Program of 8W-DETC for the year 2023-24 &2024-25.
19.	Railway Board letter No. 2006/Elect (G)/170/2/Part-II	Machine and Plant to be available for undertaking POH of the Tower Wagon and nominated diesel shed.
20.	Maintenance Manual of M/s BEML,	Operating & Maintenance Manual for 8 Wheeler Diesel Electric Tower Car With Under-slung Transmission.
21.	Maintenance manual of Himalayan power Machine MFG. Co.	Operating & Maintenance Manual of Himalayan power Machine MFG. Co. for 5kW Portable Genset cum Welding Machne.
22.	Maintenance manual of M/s BAMCO Jacking system Pvt. Limited.	Operation and maintenance manual for lifting & swiveling Plateform of M/s BAMCO Jacking system Pvt. Limited.
23.	Maintenance Manual of 12KW alternator for DETC application.	KERALA ELECTRICAL & ALLIED ENGG. CO. LTD., KUNDARA make 12KW alternator for DETC application.
24.	Operation and Maintenance Manual of 8KW, 125V, 64A Brushless alternator with rectifier regulator unit	KERALA ELECTRICAL & ALLIED ENGG. CO. LTD., KUNDARA make 8KW, 125V, 64A Brushless alternator with rectifier regulator

		unit as per ICF specification ICF/MD/SPEC/300
25.	M/s HBL(TRIUMPH-RX) instructions manual	M/s HBL(TRIUMPH-RX) make battery maintenance free valve regulated lead acid battery instructions manual
26.	Installation and operating instructions for Diesel loco starter batteries	M/s Celtek Batteries Pvt. Ltd. Bangalore Make C8 VT 450 AH Battery
27.	Operational and Maintenance manual of Battery charger	M/s Signotron make IGBT based static battery charge/discharge circuit panel (155 V /25 Amp) Type Battery charger.
28.	Operation Manual CRT 5000 series	OEM manual (M/s AVTEC Hindustan Transmissions) for DHTC with Allison CRT 5633 Series.
29.	RDSO' s Instruction No. RDSO/2011/CG/CMI01, Amendment No.1	Instructions for Corrosion repairs of ICF/RCF built BG Coaches.
30.	M/s Govik Industries Pvt. Ltd., Doc. No.TM-DES/F/01/10 Rev.0 (2024-2025)	Operating & Maintenance Manual for 8-Wheeler Diesel Electric Tower Car (DETC) with under slung Transmission for Indian Railway Applications.

4.1 **Training for Tower Wagon Staff:** The detailed training for TW staff to be conducted on checking of various assemblies and sub-assemblies, emphasizing proper working and leakages including under gear checking in pits at the Tower Wagon Shed. A training module for supervisors and artisans engaged in Tower Wagon should be prescribed by Zonal Railways/CAMTECH.

PART– I

MAINTENANCE SCHEDULE FOR ENGINE AND COMPRESSOR

5.0 MAINTENANCE SCHEDULE OF ENGINE

Cummins model No.

(i) MODEL N-855-R

(ii) MODEL NT-855-R MODEL -NTA-855-R

(iii) MODEL NT-855-R BC

(iv) MODEL VTA-1710-L

(v) MODEL N-743-L

(vi) MODEL KTA-19-R

Note: For any other make engine, refer OEM' s maintenance manual.

5.1 A-Check: On daily basis

(i) Check previous days engine log book & attend defect if any.

(ii) Fuel water Separator-Drain.

(iii) Lubricating oil level- check

(iv) Coolant level-check

(v) Air intake restriction – check the red band indication.

(vi) Water pump and alternator drive belts: Check belt tension and condition of belts for cut, fretting, cracking etc.

(vii) Level of oil in hydraulic Tank- check

(viii) Radiator Core leakage or Choke- Check

(ix) Air Tanks and Reservoirs- Drain.

(x) Check leakage of Fuel, Lube oil, Hydraulic Oil, Water, exhaust air supply and rectify wherever is required.

(xi) Fuel oil level: Check and top-up

(xii) Fuel tank: Check for leakage

(xiii) Check cables and connections of 24V starter battery

(xiv) Check and record battery cranking voltage

(xv) Check for any loose nut, bolt or fastener. Tighten those if required.

(xvi) The engine shall run at rated speed for at least 30 minute.

(xvii) Check gauge and indicators for engine speed, ammeter, lube oil temperature, lube oil pressure, water temperature indicator and fuel indicator in driver' s cab

(xviii) Clean the engine after shut down and cooling down fully.

(xix) Ensure that any hose/conduit/wiring should not be in contact with hot surface of engine and its accessories

5.2 **B- Check: Every 300 hours or 6 month, whichever is earlier**.

(i) Repeat all maintenance steps of A-Checks.
(ii) Fuel Filter-Change
(iii) Sediments from Fuel Tank-Drain
(iv) Lubricating oil filter change
(v) Lubricating oil bypass- Change
(vi) Lubricating oil-change
(vii) Lube oil Pressure - Record
(viii) Engine mounts- check
(ix) Water pump-check
(x) Coolant concentration-Check
(xi) Belts-Check and adjust, if required.
(xii) Coolant Pipes condition-Check, if required replace.
(xiii) Crank case Breather- Clean
(xiv) Crank case Breather Element- Check, if required change.

5.3 **C- Check: Every 1500 hours or 12 Months whichever is earlier.**

(i) Repeat all maintenance steps of A-Check & B-Check
(ii) Injector and valves-adjust
(iii) Air cleaner Element- Change
(iv) Radiator/oil cooler- clean externally
(v) Water Pump Idler- Check
(vi) Air cleaner Evacuator valve-Check & Change, if required.
(vii) Alternator charging voltage-Check.
(viii) Hydraulic Filters – Replace
(ix) Hydraulic Oil – Replace

5.4 D- Check: Every 6000 hours or 24 Month whichever is earlier.

(i) Repeat all maintenance steps of A Check, B Check & C Check

(ii) Fuel Pump and injector calibration-Check, if required calibrate.

(iii) Cooling system-Flush and fill up with fresh premix Fleet guard Complete EG 50:50.

(iv) Vibration Damper, Viscous-Check.

(v) Air compressor-check-Air outlet piping-Clean

(vi) Air Retention time-record

(vii) Water pump and Alternator Drive Belts-Replace.

(viii) Turbocharger-inspect

(ix) Turbocharger radial bearing clearing-inspect

(x) Turbocharger axial clearance-inspect

(xi) Vacuum indicator-change.

(xii) Engine cylinder Head should be examined after dismantling.

(xiii) All rubber gaskets and metal connector should be replaced.

Note:

(i) After an initial adjustment at 1500 hours, it is recommended that the valves and injectors not be adjusted again prior to injector calibration at 6000 hours or 24 months interval.

(ii) Hydraulic oil and hydraulic oil filters should be changed at every 2000 Hours or 7 months interval When the Red band appears on the indicator, Change the air filter primary element. The safety element to be replaced at the time of the 3rd replacement of primary Element. In case of Parker Hydraulic System - Initially, replace Return Filter Element at first 50 hours and at 500 hours, replace both Return Filter and Boost Unit filter and at 1000 hours, change both the filters again. Please ensure Porta Trolley method while replacing Hydraulic oil for Parker Hydraulic system.

(iii) Cummins recommended Engine Oil API 15W40 CH4 or higher grade of CH4 oil.

(iv) Cummins recommended Hydraulic Oil Anti-Wear VG 68.

(v) Cummins recommended Coolant Premix Fleet guard Complete EG 50:50.

(vi) Do not intermix different brands or grades of oil or coolant.

(vii) Spares Parts list of M/s Cummins India Limited make Engine is mentioned in **Annexure-4.**

(viii) M/s Cummins Guidelines for Engine Storage Procedure & preventive measure is mentioned in **Annexure-5.**

(ix) Maintenance manual submitted by OEM of Engine shall be followed for different make and model of Engine is mentioned in **Annexure-6.**

(x) Contact nearest M/s Cummins Authorized Service office for any clarification. Contact Details of nearest M/s Cummins Service manager is mentioned in **Annexure-14.**

5.5 MAINTENANCE SCHEDULE OF COMPRESSOR:

The maintenance schedule of compressor shall be similar as of engine as mentioned above as compressor is engine mounted.

Compressor shall be replaced during the POH of Cummins make engine model N-series, NT- series and NTA-series, KTA-19-R (except Cummins engine model VTA-1710-L).

Note: Engine and compressor are overhauled in AMC through OEM in POH in every six year by the nominated diesel loco/EMU car sheds during POH schedule. OEM dismantles and cleans engine and replace items on condition basis during overhauling in POH. After completion of overhauling, joint Note between shed and contractor (authorized dealer as per Annexure-13) is prepared for satisfactory work.

PART– II

MAINTENANCE OF TOWER WAGON- HYDRAULIC, ELECTRICAL TRANSMISSION & CONTROLS SYSTEM:

6. MAINTENANCE OF TOWER WAGON- ELECTRICAL TRANSMISSION & CONTROLS SYSTEM:

6.1 Daily Schedule:

(i) 8-WHEELER OHE Car:

(ii) Cumulative km.:

(iii) Date :

S.N.	Details of work to be carried out
1	i. Inspect visually for any abnormal odor due to short circuit or fault. ii. Check loose connection of cable and wiring. iii. Check normal function of major and safety component. iv. Check if any part/equipment is isolated and record in log book. v. Check if any safety is bypassed and record in log book. vi. Clean all the parts specially Driver Desk, Lookout glass, Windows glass etc. vii. Check the Batteries for any leakage viii. Clean dirt or any oil on top of battery. ix. Clean all the ventilators so that air circulation remains good. x. Check the suspension and securing nuts after every round trip. xi. Inspect the terminal box of Auxiliary alternator for water tightness. xii. Check for the proper application of SA9 Valve, A9 valve, Standby Brake

	Valve and Parking brakes. Car has to be moved only after these checks. xiii. Check that the Head light, Tail light, Flasher Light and Marker Light are functioning. xiv. Press the Lamp test switch Signal lamps light up simultaneously to indicate healthy filaments. xv. Check initial charging time of the main reservoir (MR). It should take around 10 minutes. If it is unusually long, check the air brake piping for leakages. xvi. Check Main Reservoir (MR) pressure, Brake pipe (BP) pressure, FP, PB(Parking Brake) pressure. xvii. Check the functioning of the SA9 valve, A9 valve and D-1 Emergency Brake, Emergency Push Buttons. xviii. Check the operation of wipers, Horns and sand valve function by brief application and releases. xix. Check operation of OHE sensing devise, Pantograph and Search light. xx. Check operation of CCTV camera, if provided. xxi. Functioning of Speedometer to be checked in every schedule.

6.2 Monthly Schedule (With Engine stopped):

S.N.	Item	Details of work to be carried out
1.	Contactor and Relays	(i). Inspect visually. (ii). Manually operate contactor to check operation. (iii). Check interlock of contactors. (iv). Check operations of contactors. (v). Clean contactors (vi). Check contactors contact tips for pitting.

2.	Resistor & blocking diode	Check the condition and function of all resistors and diode and record it.
3.	High and low voltage circuit	Check for ground & record insulation resistance of power Circuit.
4.	Master controller	Clean and inspect contact, fingers. Check mechanical Interlock.
5.	Control equipments shunts.	Check condition and flexibility; replace worn frayed broken or corroded braided shunt.
6.	Control equipments	Check terminal connectors & connections and tighten if required. (i) Clean contactors. (ii) Replace contact tips if worn or pitted.
7.	Engine RUN/STOP switch	Check and clean contact
8.	Batteries	i) Clean dirt or any oil on top of battery. ii) Clean all the ventilators so that air circulation remains good. iii) Keep all terminal tight, clean and apply Vaseline petroleum jelly. iv) Check the batteries for any water leakage. v) Check the batteries connection vi) Ensure that vent plugs with float guide is clean and not broken. vii) Check specific gravity of electrolyte and maintain at 1.245±0.005. viii) Check the water level for topping up with DM water. Top up the DM water as per the requirement i.e. twice in summer season and once in winter season in a month based on the float guide indicator. ix) Check the battery Voltage in off line at no. load. Battery voltage shall be above 2.1 V/cell or 8.4 V per mono black, if less, then charge the batteries.
9.	Cable Connections	Check for loosening adjoins on terminal board and equipment.
10.	Load Ammeters	Check operation and check for loose connection.

11.	Traction Motor	(i) Brush off loose dust or dirt before removing commutator cover. (ii) Clean the commutator – V-ring. (iii) Remove any copper beads from the commutator surface with fine caborandum cloth. Deposits from dirty or greasy hands should be removed by a solvent. (iv) Examine the brush gear and clean the insulating rod & support pin insulator. (v) Check that the brush springs sits correctly on the brushes and that the springs are in good condition. (vi) Check carbon brushes for wear. (vii) Fit new brushes in place of worn out carbon brushes or any one which are unlikely to last until the next inspection. See technical data for minimum length and brush grade. (viii) Bed all new brushes to the curvature of the commutator. (ix) Check the brushes for mechanical damage, breakage of flexible, etc. Fit new brushes if necessary. (x) Check that the flexible are firmly secured to the brush holder. (xi) Check brushes for freedom in the brush-holder and if stick ring cleans both the brush and the brush-way in the holder. (xii) Do not soak the brush, as solvent will eventually ooze out, affecting the commutator and causing the brush to jam in the holder. (xiii) If the brush appears to be excessively slack in the brush-holder, check the brush size and discard the brush or the holder as the case may be. (xiv) If brush holders have to be removed from the machine, slip thin; clean press board between each brush□holder and the commutator to avoid damaging the commutator surface. (xv) On replacing brush-holders check the clearance between the underside of the brush-holder and the commutator. See Technical Data. (xvi) Look carefully for any signs of flash over, overheating, loose connections or damaged insulation.

		(xvii) Top up Gear case to the level of gear oil filler unit. See Technical Data for Grade of lubricant. (xviii) Top up axle suspension bearing lubrication oil and cardium compound in traction motors, gearbox. xix) Check the temperature of pinion. xx) Check the Armature Bearing & Suspension Bearing of Traction Motor by thermo vision camera. xxi) Blow out machine using clean dry compressed air. xxii) Take particular care to direct air under the commutator in order to remove dirt lodged in the armature core ducts. xxiii) Check tightness of all brush gear bolts. xxiv) Check tightness of bolts securing axle caps/Suspension Tube and gear case. xxv) Check air inlet bellows for cracking, tearing or collapsing. Renew, if necessary. xxvi) Check for leakage from the Gear case and Axle caps. Top up the bearings with the recommended quantity of bearing grease. Top the roller suspension bearing with grease. xxvii) Top the armature bearing with grease. Refer to the recommended quantity of the bearing grease. xxviii) Check all external leads for chaffing. xxix) Measure Insulation Resistance, it should not be less than one Mega ohm. xxx) Clean the grease escape drain from P.E. outer bearing cap and P.E. end shield. xxxi) Check for any unusual sound in every schedule. xxxii) Check all terminal connections.
12.	Traction Alternator	CGL make Traction Alternator model C1009A1: At the outset, it may be emphasised that the routine maintenance of Traction Alternator is much simpler due to the absence of Commutator and its brush-less arrangement. Routine maintenance of Traction Alternator therefore, mainly includes periodic cleaning and inspection of the machine.

		It is recommended that the period of inspection should be more frequent in the initial period of service, and schedule can be subsequently relaxed based on experience. Brush off loose dust or dirt before removing cover. i) Brush off loose dust or dirt before removing cover. ii) Check tightness of connections. iii) Check for any loose hardware especially on the rotating rectifier assembly. iv) Wipe offs loose dirt on the outside surface of the alternator with clean filter free cloth. v) Remove stubborn accumulation of dirt using xylem. vi) Clean all ventilating parts with filter and compressed air at pressure of 1.75 to 2.8 kg/Cm^2 . vii) Clean inside of alternator using dry compressed air of a pressure of 1.75 to 2.8 kg/Cm^2 . viii) Check for any unusual sound. ix) Normal functioning of Traction Alternator to be ensured after every schedule. x) Check all terminal connections. Note: For other make, similar instructions may be followed as per their OEM manual.
13.	Power Rectifier (Ruttonsha)	Except for blower, the rectifier unit as such is static equipment with no moving parts, hence little maintenance is required. However, regular inspection is necessary if trouble free operation is required.
		Check for any unusual sound.
		Open the side panels and clean the dust & soots collected on panels and within the unit with dry compressed air or any other suitable means.
		Check all electrical connections and mechanical assemblies. If found loose, refit it.
		Check air speed at outlet of each rectifier duct. It should be minimum 5 to 6 mts./ second at outlet.
		Check healthiness of rectifier fuses. Failure of fuse will be indicated by ejected plunger of corresponding Trip Indicator Fuse.

		If found blown, replace both main and trip indicator fuse after rectifying cause of fuse failure.
		Clean the Insulators with cloth/brush.
		Check conditions of resistors and capacitors. Replace if found damaged. **Note:** It is to be noted that there is possibility of loose connection, if terminal of components are disconnected from circuits, hence, only one terminal of component (lug/nut-bolt) should be disconnected at a time to measure the value of capacitor and resistor by using Digital Multimeter carefully. After measuring the value, the opened terminal should be reconnected properly/tightly, then open/disconnect one terminal of another component. Do not disconnect all the terminal of the all components at a time so as to avoid possibility of wrong connection inadvertently.
		The fan is brushless type hence it does not need any specific maintenance.
		In case of failure of diode, please follow following removal & refitting procedure.
		Removal of Diode: Unscrew the lead of diode from busbar. Remove the diode by removing the Allan bolts using suitable key. Clean the diode with clean cloth. Check its healthiness. If found defective, use new one to replace it.
		Mounting of Diode: Clean the base of diode with clean cloth. Apply a thin layer of silicon oil or good quality contact grease. Clean the surface area of heat sink on which diode is to be placed. Using same/same size Allan bolts refit the diode. Initially tighten bolts alternately half to one turn at a time so that diode is clamped with equal force all over. Finally, using torque wrench complete tightening of the bolts. The specified torque limit is 1.7 to 2 KN. Connect the end of lead on busbar. Note: For other make, similar instructions may be followed as per their OEM manual.

14.	Auxiliary Alternator (for charging of 110V battery)	A) Alternator: 1.0. Check the suspension and securing nuts after every round trip. 2.0. Inspect the terminal box for water tightness. B) Regulator Box (RRU) : 1. See that all securing fasteners are held properly. 2. Keep the cover tightly closed. Ingress of water and dust in the regulator box will damage the equipment beyond repair. **1.** Do's and Don'ts for the equipment: A. Alternator: 1. Open up the terminal box and clean up the dust if any accumulated in it. 2. Check up the tightness of connection. 3. Keep the terminal box tightly closed. 4. The field connection on the alternator terminal box should not be reversed. 5. Use cable sockets and cable glands for connections. 6. Never give separate excitation to the field. It will damage the regulatorcomponent. It will damage the regulatorcomponent. **B.** Regulator: 1. Please Don't disturb the setting on the voltage potentiometers. 2. Please Don't open the regulator box unless a defect is observed. 3. Please Don't use a megger to test the components. Use a multi meter. 4. If earth resistance is to be measured, disconnect the leads from alternator andload. Short circuit

		all the seven terminals, before using a megger. 5. Please Don't reverse the field terminal connections. 6. Use only HRC fuses in phase and field circuits.
15.	Charging Alternator (for charging of 24V battery)	Maintenance of the charging system is limited to simple tasks designed to keep the system in good shape by eliminating the buildup of dirt and corrosion. The diodes in the alternator function as one-way valves and the transistors in the regulator operate as fast switches, both are accurate and sensitive. They do not wear and never require adjustment but because they are sensitive to voltage change and high temperature the following precautions are vital to prevent them being destroyed. i) Keep the alternator reasonably clean with a cloth wet in kerosene (paraffin) or white spirit. Ensure that ventilation slots or air spaces are clear and run obstructed. ii) Keep the regulator housing clean and ensure that cooling air pass freely over the housing. iii) Ensure that the driving belt on the alternator has correct tension as, too slack will cause belt to slip and too tight will shorten the life of the belt. iv) Check the mounting bolts for tightness. v) Always identify a lead to its correct terminal when disconnecting or reconnecting. Any lead short circuit or wrong connection giving reverse polarity will immediately and permanently ruin the transistors and diodes. vi) Never connect a battery in to the system without checking for correct polarity and correct voltage. Short circuiting or reverse polarity no matter how brief will cause immediate and permanent damage to transistors and diodes, besides possible damage to the loads. vii) Never disconnect a lead without first stopping the alternator and turning any switches in the circuit to the ‘ OFF’ position. viii) Never disconnect the battery while the alternator is running. This will cause a voltage surge in the charging system that

		will immediately ruin the diodes or transistors. ix) Always ensure that the regulator is mounted with the terminals vertically down. x) Always ensure that the regulator mounting is such that it is not subjected to direct water splash. xi) Always ensure that the alternator is not mounted close to the exhaust manifold without any protection. xii) Brush off loose dust or dirt before removing cover. Note: For detailed description OEM manual may be followed.

Note: Functioning of Speedometer to be checked in every schedule.

6.3 AOH: Yearly Schedule (With Engine Stopped):

S.N.	Item	Detail of work to be carried out
1.	All mentioned in Monthly Schedule and other items	Repeat all checks followed in Monthly check with following additional schedules.
2.	Contactor and Relays	(i) Repeat Monthly schedule. (ii) Remove the connection and check on test bench and adjust if required.
3.	Resistor & blocking diode	Repeat Monthly schedule. Check values and function of all Resistor & blocking diode.
4.	High and low voltage circuit	Repeat Monthly schedule. Check & record insulation resistance of power Circuit and control circuit.
5.	Master controller	Repeat Monthly schedule.
6.	Control equipments shunts.	Repeat Monthly schedule.
7.	Control equipments	Repeat Monthly schedule.
8.	Engine RUN/STOP switch	Repeat Monthly schedule.

9.	Batteries	Repeat Monthly schedule. Remove boxes from tower wagon and Check for any damage if any rectify Clean & repaint.
10.	Cable Connections	(i) Check for loosening adjoins on terminal board and equipment. (ii) Check for insulation damage also.
11.	Load Ammeters	Repeat Monthly schedule. Check calibration.
12.	Traction Motor	Repeat Monthly service including following additional schedules:- (i) Lubricate commutator end bearing. (ii) Clean the grease escape drain from pinion end (PE) outer bearing cap and P.E. end shield. (iii) Clean all pinion and gear wheels check for tooth wear. (iv) Clean lubricant from each gear case to ensure that it is not cracked and the seals are in good condition. (v) Check the carbon brushes. (vi) Clean the commutators. (vii) Ensure proper spring tension (3.5Kg/Cm²) (viii) Check the Pig tails. (ix) Check the gap between holder and commutator (1.5 - 2.5mm) (x) Check the inspection cover and its gasket. (xi) Check the leather bellows. (xii) Blowing and cleaning air filters. (xiii) Check for flash over, solder throwing, broken fan, any damages to commutator.
13.	Traction Motor suspension Gear, Gear case & Pinion	(i) Change oil. (ii) Change wick lubricator if damaged. (iii) Check bearing cap bolts for tightness. (iv) Check wear on motor suspension and nose suspension. (v) Check suspension bearing suspension. (vi) Check for the leakage from gear case and axle caps. Check for the leakage from the suspension bearings. (vii) Top up the roller suspension bearing with the recommended quantity of bearing grease. Ensure the lids of the axle

		suspension bearing oil wells fit correctly. (viii) Top the armature bearing, with grease. Refer to the recommended quantity of the bearing grease. (ix) Replace felt seals if necessary (x) Clean the grease escape drain from P.E. outer bearing cap and P.E. end shield (xi) Clean all pinion and gear wheels check for tooth wear. (xii) Clean lubricant from each gear case to ensure that it is not cracked and the seals are in good condition.
14.	Traction Alternator	CGL make Traction Alternator model C1009A1: At the outset, it may be emphasised that the routine maintenance of Traction Alternator is much simpler due to the absence of Commutator and its brush-less arrangement. Routine maintenance of Traction Alternator therefore, mainly includes periodic cleaning and inspection of the machine. It is recommended that the period of inspection should be more frequent in the initial period of service, and schedule can be subsequently relaxed based on experience. (i) Maintenance of the charging system is limited to simple tasks designed to keep the system in good shape by eliminating the buildup of dirt and corrosion. The diodes in the alternator function as one-way valves and the transistors in the regulator operate as fast switches, both are accurate and sensitive. They do not wear and never require adjustment but because they are sensitive to voltage change and high temperature the following precautions are vital to prevent then being destroyed. (ii) Keep the alternator reasonably clean with a cloth moistened in kerosene (paraffin) or white spirit. Ensure that ventilation slots or air spaces are clear and run obstructed. Keep the regulator housing clean and ensure that cooling air pass freely over the housing. (iii) Ensure that the driving belt on the alternator has correct tension as, too slack will cause belt to slip and too tight will shorten the life of the belt.

		(iv) Check the mounting bolts for tightness. (v) Always identify a lead to its correct terminal when disconnecting or reconnecting. Any lead short circuit or wrong connection giving reverse polarity will immediately and permanently ruin the transistors and diodes. (vi) Never connect a battery in to the system without checking for correct polarity and correct voltage. Short circuiting or reverse polarity no matter how brief will cause immediate and permanent damage to transistors and diodes, besides possible damage to the loads. (vii) Never disconnect a lead without first stopping the alternator and turning any switches in the circuit to the OFF' position. (viii) Never disconnect the battery while the alternator is running. This will cause a voltage surge in the charging system that will immediately ruin the diodes or transistors. (ix) Always ensure that the regulator is mounted with the terminals vertically down. (x) Always ensure that the regulator mounting is such that it is not subjected to direct water splash. (xi) Always ensure that the alternator is not mounted close to the exhaust manifold without any protection. Brush off loose dust or dirt before removing cover. (xii) Check tightness of connections. (xiii) Check for any loose hardware especially on the rotating rectifier assembly. (xiv) Wipe offs loose dirt on the outside surface of the alternator with clean filter free cloth. (xv) Remove stubborn accumulation of dirt using xylem. (xvi) Clean all ventilating parts with filter and compressed air at pressure of 1.75 to 2.8 kg/Cm^2 . (xvii) Clean inside of alternator using dry compressed air of a pressure of 1.75 to 2.8 kg/Cm^2 .

		Note:- 1. Check for any unusual sound in every schedule. 2. Normal functioning of Traction Alternator to be ensured after every schedule. 3. Check all terminal connections in every schedule. 4. Cable insulations should be checked as per periodicity recommended by Manufacturer. 5. For other make, similar instructions may be followed as per their OEM manual.
15.	Power Rectifier	Repeat all Monthly schedule.
16.	Auxiliary Alternator (for charging of 110V DC battery):	Repeat all Monthly schedule.
	A) Alternator:	a.) Clean and regrease the bearing after removing the bearing from the bearing housing. The bearing is designed for regreasing in workshops at long intervals of 5000 hours in operation. However, it is recommended that during POH, the bearing should be re-greased. Before using new grease, the bearing should be thoroughly cleaned with white spirit. 24 gms. of lithon 2 should be used for refilling. b.) Over greasing of the bearing of the alternator should be avoided. c.) The bearings should be changed as per procedure, if it is found defective during inspection. d.) Clean the mating surface of the end shield. Before assembly, the surfaces shouldbe coated evenly with gasket shellac. e.) While removing and placing the rotor, care should be taken to see that the rotordoes not rub over the field coils. f.) If any grease has crept into the stator surface, clean it before assembly. g.) If stator/rotor parts are found rusty, clean and slightly coat with insulatingvarnish.
	B) Regulator	Repeat the monthly schedule.

	Box:	If no failure or defect has been observed, clean and tighten all components and ensure that all joints and connections are properly tight. If rectifier regulator box is defective, follow the procedure laid down in fault analysis as per manual of OEM.
	C) Removal of Rotor & Bearings:	The following procedures should be adopted for dismantling alternator. a) Using a puller, remove the flange from the shaft. b) Bend back the lock washer MB 11. c) Unscrew the lock nut KM 11. d) Remove the bearing cover on the driving end. e) Remove the fan cover on NDE side. f) Remove the split pin and castle nut on NDE side. g) Remove the washer and fan. h) Remove all the end shield fixing screws from the non-driving end. i) Locate the two tapped holes on the end shield on NDE along with the rotor and bearing on NDE and screw in two M8 screws. The two screws should be turned in equally. As the screwing progress the end shield comes out gradually along with the rotor and bearings on NDE. The end shield and bearing on DE remain in its place. j) Gently pull out the rotor from the stator. Care should be taken to see that the rotor does not pull over the stator coils. k) After removing the end shield fixing screws from DE, remove the end shield by screwing in two M8 screws in the tapped holes on the end shield. l) The end shield on NDE now lies along with the rotor. Remove the bearing covers. m) Hold a steel disc blocking ball bearing with the axis of bearing puller on the steel disc and arms on the end shield circumference, pull the end shield from the shaft. The end

		shield will come out leaving the bearing on the shaft. n) Use the same puller for removing the bearings also. Engage the axis of the puller directly on the shaft end, and arms on the internal bearing cover. Care should be taken to apply the pull on the inner sleeve of bearing. The bearing now comes out. o) From the driving end also, the inner race of the roller bearing can be removed using the same puller as mentioned above, but engaging the arms on the recess provided between the spacer and the inner sleeve. The inner race of the roller bearing can also be removed by slightly heating the inner race alone with a hotoil stream. The ring comes out of the knocking. p) The outer sleeve of the roller bearing can be pushed out of the end shield by applying a small but uniformly distributed pressure on the bearing using a hydraulic press and wooden block.
	D) Assembly:	Assembly of the alternator can be proceeded on the reverse way with special care on the following points. i) The inner race of the bearing should be heated in an oil bath at about 800 C to 900 C before insertion on to the shaft. ii) The end shield should be heated in an electric oven to about 1200 C before locating the bearing it. The Bearing should not be pressed in with a Hydraulic Press. iii) In order to seat the bearing properly internal bearing cover should be fixed on to the end shield before heating the end shield. iv) Assembly of pulley should be made with extreme care. See that the pulley bore mates exactly with the tapered shaft. v) Gasket shellac should be applied evenly on all the mating surfaces of bearing cover and end shield. vi) While removing and fixing the SKF lock nuts use a hook spanner. Never use any other tools for this purpose.
17.	Charging Alternator	Repeat Monthly schedule.

	(for charging of 24V battery)	
18.	Gauge and meters	Repeat Monthly schedule. Remove the connection and calibrate if required.
19.	Electro pneumatic	Add drops of light machine oil (Teflon pickings do not require lubrication change neoprene bucket).
20.	Warning lights (indication light)	Clean and check.
21.	Engine hour meter	Remove the connection and clean and calibrate.
22.	Engine Governor	Check setting as per OEM instruction.
23.	Safety devices (i) Cooling water temperature temp switch (ii) Engine over speed switch	Remove the connection and check on test bench and adjust if required.

Note: 1. All rubber items should be replaced on condition basis during AOH/IOH also.

2. Calibration of speedometer to be done in every year.

3. Functioning of Speedometer to be checked in every schedule.

6.4 IOH Schedule (with Engine Stopped):

S.N.	Item	Detail of work to be carried out
1.	All mentioned in AOH Schedule	Repeat all checks followed in AOH schedule with following additional schedules:
2.	Contactor and Relays	Repeat all AOH schedule.
3.	Resistor & blocking diode	Repeat all AOH schedule.
4.	High and low voltage circuit	Repeat all AOH schedule.
5.	Master controller	Repeat all AOH schedule.

6.	Control equipments shunts	Repeat all AOH schedule.
7.	Control equipments	Repeat all AOH schedule.
8.	Engine RUN/STOP switch	Repeat all AOH schedule.
9.	Batteries	Repeat all AOH schedule.
10.	Cable Connections	Repeat all AOH schedule.
11.	Load Ammeters	Repeat all AOH schedule.
12.	Gauge and meters	Repeat all AOH schedule.
13.	Electro pneumatic	Repeat all AOH schedule.
14.	Warning lights (indication light)	Repeat all AOH schedule.
15.	Engine hour meter	Repeat all AOH schedule.
16.	Engine Governor	Repeat all AOH schedule.
17.	Safety devices (i) (Cooling water Temperature v) Engine over speed switch	Repeat all AOH schedule.
18.	Traction Motor	Repeat AOH service including following additional schedules:- IOH OF TRACTION MOTOR: An overhaul is required after three years (in IOH schedule) of service or if the performance is satisfactory the same can be done during POH (6 years schedule) of Tower Wagon. Maintenance of TMs can be done at Diesel/Electric loco Sheds/workshops and MEMU/EMU Sheds.
		a. Remove as much dirt as possible particularly around the

		commutator covers, the axle-cap filler pipes and the armature bearing caps.
		b. Check the lateral and diametrical clearances of the axle suspension bearings; fit new bearings if the existing bearings are worn beyond the limits recommended (see data as given in the manual).
		c. Remove the motor from the bogie and using the oil-injection equipment, remove the pinion.
		d. Before dismantling the motor, give it a light run at 1500-2000 rev/min to check that the bearings are not noisy and that the vibration is not excessive.
		e. Dismantle the motor (see under dismantling & reassembling). Clean the armature thoroughly, also the interior of the frame. Bake each at 90^0 C to remove moisture. (See workshop manual). After drying out, check the hot insulation resistance of the traction motor & if found more than 1 Mega ohm applies a high voltage test at 1.5 kV.
		f. Apply a commutator bar to bar comparison test to check for open or short circuited coils. Remove and clean the brush holders. Examine each brush holder for brush clearance, for brush spring pressure, for damaged insulators, for spring-hub wear, for loose or defective support pin insulation and burnt sports. Recondition as necessary. Fit new brushes if necessary. Examine all cables.
		g. Check the wear plates on the nose suspension for wear, check the axle ways and the axle caps for wear, distortion and cracks. Examine all cables, fit a new cable in place of any that is chafed or otherwise damaged.
		h. If the field coils and the connections are tight, dry and are in good condition, repaint the whole of the interior with silicone gray finishing paint.
		i. If field coils have to be removed, recondition them individually and on reassembly, refill the counter bores around the top pole studs with Tar Compound, Class-IV (Supplied by M/s

			Shalimar India) to exclude moisture.
		j.	Inspect all other motor components for wear, distortion or other defects. Fit new bearings if necessary.
		k.	Inspect the shaft for damage to threads, bearing and pinion fits and ensure that the Shaft is straight. Further inspect the armature for loose bands, solder throwing or other defects. Recondition the armature as necessary.
		l.	Treat the reconditioned or repaired armature with solventless polyester (GE702 or equivalent) insulating varnish. (For procedure, see Workshop Manual). The number of such treatments will depend upon the condition of the armature, but normally, twice will be sufficient.
		m.	Remove Traction Motors from the bogies for overhaul and run on no load at about 1000 rpm and check for noisy bearing rough commutator, vibration and brush chatter.
		n.	Dismantle the motor and clean the armature and field system. Dry out to remove any detrimental moisture.
		o.	After drying out, check the hot insulation resistance of the traction motor & if found more than 1 Mega ohm applies a high voltage test at 1.5 kV.
		p.	Check the armature for open and short circuits by a commutator bar-to-bar test at 600 V.
		q.	Remove the brush holder from the machine. Clean and inspect for brush clearance in the holder-spring pressure and damage Recondition as necessary.
		r.	If the field coils and connections are in good condition then dry paint the interior of machine with insulating varnish such as E-233 red of Dr. Beck or equivalent. If the field coils require repair, remove and recondition individually. Check the armature bearing details for damage & renew as necessary.
		s.	Inspect the shaft for damages to pinion and bearing seating and ensure that it is straight.
		t.	Inspect the armature for loose bands, solder throwing etc. Recondition as required. If the commutator is worn or damaged, skim the commutator and undercut the mica. It

		should be ensured that the Commutator is turned only upto the safe wearing depth diameter i.e. 260 mm 9. Varnish impregnates the repaired or reconditioned armature with the polyester VPI Resin FT2005 of Dr. Beck.
		u. Inspect the axle bearings for wear, distortion and cracks. Also ensure the intactness of the suspension tube bolts.
		v. At the end, dynamically balance the armature ensuring that the maximum unbalance does not exceed 3gm-mm, reassemble the machine and paint the exterior of the machine.
		w. Run the machine on no load at about 1000-RPM for 120 minutes to ensure correct operation of the bearings. When installing the motor in the bogie ensure that all bolts are tightened to the specified torque values. Fill the Gear case with the correct lubricant to the maximum specified level.
		x. After assembly with the bogie, run the motorized bogies for 240 minutes to ensure proper alignment of the gears and proper seating of gear case felts over axle.
		y. Initially, it is expected that the temperature of the areas near to the felts will go upto 100°C but, after excess felt has been worn off, the temperatures of these areas will return back to normal temperature zone of 50-60° C.
19.	Traction Motor suspension unit, Gear, Gear case & pinion	Repeat all AOH schedule. Clean pinion and gear wheel and check for tooth wear. Before fitting the gear case, clean out old lubricant to avoid the possibility of gear running subsequently in contaminated lubricant
20.	Traction Alternator	At the outset, it may be emphasized that the routine maintenance of Traction Alternator is much simpler due to the absence of Commutator and its brush-less arrangement. Routine maintenance of Traction Alternator therefore, mainly includes periodic cleaning and inspection of the machine. It is recommended that the period of inspection should be more frequent in the initial period of service, and schedule can be

		subsequently relaxed based on experience. i. Brush off loose dust or dirt before removing cover. ii. Check tightness of connections. iii. Check for any loose hardware especially on the rotating rectifier assembly. iv. Wipe offs loose dirt on the outside surface of the alternator with clean filter free cloth. v. Remove stubborn accumulation of dirt using xylem. vi. Clean all ventilating parts with filter and compressed air at pressure of 1.75 to 2.8 kg/Cm2 vii. Clean inside of alternator using dry compressed air of a pressure of 1.75 to 2.8 kg/Cm2 . viii. Check for any unusual sound. ix. Normal functioning of Traction Alternator to be ensured. x. Check all terminal connections. xi. Cable insulations & IR test of Rotor and Stator to be checked. xii. Check for the grease in Bearing, if less, re-greasing to be done as recommended by Manufacturer. Note: For detailed description OEM manual may be followed.
21.	Power Rectifier	Repeat all AOH schedule. Diode: 1) Dust cleaning. 2) Visual Check. 3) Ensure tightness of electrical contacts. *Refer Note below Fuses: 1) Dust cleaning. 2) Visual Check. 3) Ensure tightness of electrical contacts . 4) Continuity Test. Bus bar joints: 1) Dust cleaning. 2) Visual Check. 3) Ensure tightness of electrical contacts. Snubber Resistors & Snubber Capacitors: 1) Dust cleaning. 2) Visual Check. 3) Check for intactness of

		electrical terminals. 4) Resistance multimeter test 5) Capacitance meter test A.C. Terminals: 1) Tightening of electrical joints. D.C. Terminals: 1) Tightening of electrical joints. Display Panel: 1) Dust cleaning. 2) Ensure tightness of screw terminals of display panel. * **Note**:- Diodes being a solid state device, it doesn't require any maintenance/test for at least five years. After five years multimeter test can be carried out on diodes to check its healthiness. 1. Check for any unusual sound. 2. Check all terminal connections. 3. Cable insulations should be checked Note: For detailed description OEM manual may be followed.
22.	Auxiliary Alternator (for charging of 110V DC battery):	Repeat all AOH schedule. Note: For detailed description OEM manual may be followed.
23.	Charging Alternator (for charging of 24V battery)	Repeat AOH schedule. Note: For detailed description OEM manual may be followed.

Note: 1. All rubber items should be replaced on condition basis during AOH/IOH also.

2. Calibration of speedometer to be done in every year.

3. Functioning of Speedometer to be checked in every schedule.

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

6.5 POH Schedule (with Engine Stopped):

S.N.	Item	Detail of work to be carried out
1.	All mentioned in AOH Schedule	Repeat all checks followed in IOH schedule with following additional schedules:
2.	Contactor and Relays	Repeat all IOH schedule.
3.	Resistor & blocking diode	Repeat all IOH schedule.
4.	High and low voltage circuit	Repeat all IOH schedule.
5.	Master controller	Repeat all IOH schedule.
6.	Control equipments shunts.	Repeat all IOH schedule.
7.	Control equipments	Repeat all IOH schedule.
8.	Engine RUN/STOP switch	Repeat all IOH schedule.
9.	Batteries	To be replaced on condition basis (if not replaced during last IOH/or 4.5-years), codal life of battery 4.5 yrs, check with the lug date and replace if life is over
10.	Cable Connections	Repeat all IOH schedule.
11.	Load Ammeters	Repeat all IOH schedule.
12.	Gauge and meters	Repeat all IOH schedule.
13.	Electro pneumatic	Repeat all IOH schedule.
14.	Warning lights (indication light)	Repeat all IOH schedule.
15.	Engine hour meter	Repeat all IOH schedule.

16.	Engine Governor	Repeat all IOH schedule. To be replaced on condition basis
17.	Safety devices vi) Cooling water temperature temp switch (ii) Engine over speed switch	Repeat all IOH schedule.
18.	Traction Motor	Repeat all IOH schedule.
		POH overhaul is required after three years of service or if the performance is satisfactory the same can be done during POH (6 years schedule) of Tower Wagon. Note: For detailed description OEM manual may be followed.
19.	Traction Motor suspension unit, Gear, Gear case & pinion	Repeat all IOH schedule.
20.	Traction Alternator	Repeat all IOH schedule. 1. Check for any unusual sound. 2. Normal functioning of Traction Alternator to be ensured after every schedule. 3. Check all terminal connections in every schedule. 4. Cable insulations should be checked. 5. Check for the grease in Bearing, if less, re-greasing to be done.

21.	Power Rectifier	Repeat all IOH schedule. 1. Check for any unusual sound. 2. Normal functioning of Traction Rectifier to be ensured after every schedule. 3. Check all terminal connections. 4. Cable insulations should be checked.
22.	Auxiliary Alternator (for charging of 110V battery)	Repeat all IOH schedule. Auxiliary Alternator to be replaced on condition basis as per codal life.
23.	Charging Alternator (for charging of 24V battery)	Repeat all IOH schedule. Charging Alternator to be replaced on condition basis.

Note: - All rubber items should be replaced during POH.

Note: - OEM (M/s CGL) recommended Spare Parts for Propulsion system items is given in **Annexure-9.**

7.0 MAINTENANCE OF DHTC:

7.1 MAINTENANCE OF FINAL DRIVE

Here, instructions for maintenance, assembly and disassembly of final drives for OHE for DHTC are described. The details and specifications are given in technical data.

The final drive consists of high quality cast steel housings which are precision machined. The gears and shafts are manufactured out of superior quality alloy steel (Carburized, Hardened and ground) and are assembled into the housings. Anti friction bearings of adequate capacity have been used for having long trouble free service. The final drives have forced lubrication. The lubricating pump is driven by the bevel pinion shaft. The final drive is mainly an axle mounted gear box with reaction member fastened to the bogie frame.

7.2 TECHNICAL DATA OF FINAL DRIVE:

Model No	2625
Application	8 W OHE
Reduction Ratio	3.2824: 1
Weight of axle drive with axle and wheels including oil	1,800 kg
Sump capacity	App. 30 liters
Type of Oil	EP 90 or HP 90

Note: The fasteners used in the final drive have been torque tightened.

7.3 MAINTENANCE SCHEDULE OF FINAL DRIVE:

Sr.No.	SCHEDULE	DESCIPTION
1.	Daily	Check oil level with dipstick. The oil level must be between the maximum and minimum limits marks on the dip stick. The oil level to be topped up if necessary Clean the Axle drives to check for any leakages from the pipe joints and other places and correct them.
2.	Monthly (15000 Kms Whichever is earlier)	Tighten all the fasteners (external) including the fasteners for cardan shaft torque arm and if there is any excessive loosening, investigate for the reason. Clean the breather and re-fit.
3.	**AOH Yearly** or Approximately 90,000 Kms whichever is earlier	Change the Oil during yearly schedule (AOH)
4.	**Three Years (IOH)** Approximately 3,00,000 Kms whichever is earlier	Clean the strainer. Remove the final drives from the car disassemble the gears, shafts and sub assemblies. Inspect the gears and bearing. The defective components must be replaced before reassembly.

	OIL CHANGE OF AXLE DRIVE	Whenever new axle drive / newly assembled axle drive has been put into service the first oil change is to be made after 50 hours of service (or 2,500 Kms).The next subsequent oil change is to be made as given in half yearly maintenance schedule.
	OIL LEVEL OF FINAL DRIVE	A dipstick has been provided for checking the oil level in the final drive. Oil level must be maintained within maximum and minimum limits marked on the dipstick.

7.4 MAINTENANCE SCHEDULE OF DHTC (BEML):

Manual of OEM M/s Avtec for Hydraulic Transmission for DHTC CRT 5000 Series is attached as **Annexure-10 A** and instructions for Transmission Oil for DHTC with CRT 5633 Series provided by OEM M/s AVTEC Hindustan Transmissions is attached as **Annexure-10 B** for details of Maintenance for Hydraulic transmission of DHTC.

Manual of OEM M/s Voith for Hydraulic Transmission for DHTC CRT 5000 Series is attached as **Annexure-11.**

7.4.1 Daily Maintenance:

7.4.1.1 Transmission, FinalDrive, Gear Box and Cardan Shaft (in Engine Stopped condition):

(i) Check flexible coupling fasteners for tightness.

(ii) Check Cardan Shaft / Final Drive for any visual damage

(iii) Check transmission-mounting fasteners for tightness.

(iv) Check for all leakages especially at Final drive Gearboxjoint faces and axle oil seal.

(v) Check oil level in final drive and top up if necessary

7.4.1.2 Transmission, FinalDrive, Gear Box and Cardan Shaft (in Engine Running condition):

(i) Check torque converter / transmission oil cooler &pipelines for visual defects & leakages. Rectify if necessary.

(ii) Check oil level in sump at idle (full throttle without load) and top up if required.

Hot check - The transmission oil level should be checked while the engine is running at 1000 rpm after normal operating temperature (180 to 200 ° F (82 to 93°C) is reached.

The transmission should be in neutral, and the vehicle should be standing on a level surface.

The oil in the transmission sump should be level with the full petcock or plug or rear of the transfer gear housing . If the oil is not at full level, add sufficient oil to bring the level up to the full point . In the hot check if the oil is above the full level drain the excess oil

(i) Check the TC oil control pressure and record. If the pressure at low idle speed is out of range 8.5 – 10.5kg/cm², stop the engine. Check & top up oil if required. Carry out the check again. (If the record pressure is out ofrange, investigate and rectify.)

Check the transmission main oil pressure when the transmission is in the normal operating temperature range of 180 to 200°F (82 to 93 °C) the transmission pressure should be checked at 1500 rpm of engine at output stalled the pressure range should be between 9 to 10.5 kg/cm² (If the recorded pressure is out of range invetigate and rectify).

Note:- The Transmission oil used in the transmission is very critical as it

1. Provides the working medium for the torque converter , controls , and clutch application
2. Transfers heat from the transmission to the cooler
3. Serves as a lubricant which carries rust inhibiting chemicals throught the transmission
4. Carries contaminant to the filter.

7.4.1.3 Torque Arm (in Engine Stopped condition):

(i) Check visually - all parts for visible defects, damages, fasteners, linkages, etc.

(ii) Check the tightness & locking offasteners.

7.4.2 Preventive Maintenance:

Note: - Repeat Daily maintenance and follow the preventive maintenance

7.4.2.1 Lubrication, Fuel System, Air intake, Cooling system ,

(a) at Every 300 Hours or Every 6 months(next AOH) (in Engine Stopped condition):

(i) Change Marine Gear Oil

(ii) Check Aneroid Oil

(iii) Check Hydraulic Governor Oil

(iv) Check Throttle Linkage

(v) Lubricate Ball joints of the throttle linkage of HydraulicGovernor

(vi) Check Air Piping

(vii) Check Heat exchanger Zinc plugs

(b) at First 1500 Hours check (every 1 year) (in Engine Stopped condition):

(i) Repeat Daily maintenance and above Check i.e. 300 Hours checks.

(ii) Change Hydraulic Governor Oil

(iii) Change Aneroid Breather

(iv) Check Aneroid Breather

(v) Replace Aneroid Breather (if required)

(vi) Clean Fuel tank from inside

(c) At every 6000 Hours (every 2 year or next IOH) check (in Engine Stopped condition):

(i) Repeat Daily maintenance and above Check i.e. 300 Hours checks & 1500 Hours check

(ii) Clean and calibrate injectors if required

(iii) Replace rocker cover gaskets

(iv) Replace fuel pump filter screen and magnet

(v) Check fuel pump calibration

(vi) Replace aneroid bellows & calibrate

(vii) Check Heat exchanger Zinc plugs

(viii) Check Vibration damper

(ix) Check Air Compressor

(i) Check Safety Controls

7.4.2.2 TRANSMISSION , TORQUE ARM AND FINAL DRIVE:

(a) Transmission checks at 250 Engine Hours period (in Engine Stopped condition):

Replace filter element, gasket and sealing rings ofthe filter body.

(b) Transmission checks (Gear Box, Cardan Shaft) at 3000 Engine Hours period (in Engine Stopped condition):

Remove and recondition. (Note: The major overhaul of the equipment will depend on the standard practice of maintenance, usage etc., and hence the work may be planned after assessment of the condition and the wear & tear of the component.)

(c) Final Drive: checks at 250 Engine Hours period (in Engine Stopped condition):

(i) Clean final Drive breather element and change if necessary.

(ii) Change oil after first 50 hours of engine operation

(iii) Tighten all external fasteners including those of connected cardan shaft, If there is any excessive loosening, carry out investigation and rectify.

(iv) Check oil sample for any impurities / contamination / ingress of water. Change the oil if required.

(d) Final Drive: checks at 1500 Engine Hours period (in Engine Stopped condition):

(i) Change oil (first changing after 50 Engine hours)

(e) Final Drive: checks at 2500 Engine Hours period (in Engine Stopped condition):

(i) Change oil (first changing after first 50 Enginehours).

(f) Torque Arm: checks at 250 Engine Hours period (in Engine Stopped condition):

(i) Spring disc to be checked physically, if founddamaged replace it.

(ii) Pre-compression of spring disc to be maintained for the specified value by torque tightening thecastle nut at one end of torque arm.

(iii) Spherical joint and bushes are checked fordamages.

(iv) Cir clips and split pins if failed, replace them.

7.5 AOH of DHTC

Maintenance of Hydraulic Transmission (BEML)	(i) Transmission oil change interval – First 50 hours and after that every 1000 hours or 6 months whichever is earlier (ii) Transmission filter change interval – First 50 hours and after that evry 200 hours and during oil change (iii) Cooler lines should also be cleaned while maintenance is being

	carried out. (iv) Check for any leakage - If found arrest the leakage. (v) Check whether all transmission related mountings are properly mounted or not. (vi) Check for manual selector lever, it should move easily and give a crisp detent feel in each position.
General Trouble Shooting Steps:	(i) Check the oil level and ensure that oil is up to the level, if not take necessary action and bring the oil to level. (ii) Check for oil colour and smell. (iii) Check for transmission oil main pressure. (iv) Check for Individual clutch pressures. (v) Check for any leakages. (vi) Check for shift lever linkages to control valve body.
Oil Level Checking Procedure:	(i) **Location of oil level check plug:-** Oil level check plugs are provided in the rear right hand lower side of drop box when viewed from rear side.
	(ii) **Before starting the engine-** (a) Fluid level plugs (b) Remove FULL plug oil should be flowing from this plug which indicates the equipment can be started for further check.
	(iii) **After starting of the engine**- Fluid level plugs
	Cold Check:- (iv) Remove the ADD plug, oil level must be at the ADD plug (dripping from this hole).Add or drain oil to bring it to this level.

	Hot Check:- Remove the FULL plug, oil level must be at the FULL plug (dripping from this hole).Add or drain oil to bring it to this level.
Maintenance schedule of Final Drive	As mentioned in clause 7.3 (3) above.

7.6 IOH of DHTC

Repeat AOH schedule and as mentioned in clause 7.3 (4) above.

7.7 POH of DHTC

Repeat IOH schedule.

Transmission is overhauled through authorized dealer of OEM AVTEC / VOITH /KIRLOSKAR. OEM dismantles and cleans transmission and replaces items on condition basis during overhauling in POH. After completion of overhauling, joint Note between shed and contractor (authorised dealer of OEM) is prepared for satisfactory work.

PART-III

MAINTENANCE SCHEDULE OF CAR BODY, UNDER FRAME, BOGIE, BRAKE SYSTEM, BRAKE RIGGING, LIFTING & SWIVELING PLATFORM etc.

8.0 Maintenance Schedule of Car Body, Under Frame, Bogie, Brake System, Brake Rigging, Lifting & Swiveling Platform Etc.

8.1 Daily Schedule:

(i) 8-WHEELER OHE Car:

(ii) Cumulative km.:

(iii) Date :

No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
1.0	8-WHEELER OHE CAR			
1.1	Fill water in lavatory overhead tank.			
2.0	Brake System			
2.1	Drain condensate from automatic drain valves of brake system.			
2.2	Drain the moisture manually on daily basis.			
2.3	Drain condensate from all the air reservoirs, and filter through cut off cocks.			
2.4	Check the leakage of air pressure, if any, rectify the same.			
2.5	Check the brake application and relieving before leaving the depot. Also check parking brake application/release function.			
3.0	Horn, Oil levels, Radiator Water etc.			
3.1	Check the working of horns during starting.			
3.2	Check the oil level of axle drive, if found less, add upto maximum mark.			
3.3	Check the Transmission oil level in the oil tank, if found less, add upto maximum mark.			

No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
3.4	Ensure correct level of radiator water, lube oil in ADGB & fuel in tanks.			
3.5	WRA (Water Raising Apparatus) functioning			
4.0	**Bogie**			
4.1	**Bogie frame**			
4.1.1	Examine visually the condition of bogie side frame, transom, longitudinal, bolster etc. at all welded locations.			
4.1.2	Examine rubber stopper/stop screw of axle box crown for damage/ missing /loose.			
4.1.3	Inspect brake hanger brackets for damages.			
4.1.4	Inspect safety brackets for brake hanger pins.			
4.2	**Primary Suspension**			
4.2.1	Visually examine axle box springs for breakage/damage.			
4.2.3	Check oil leakages in dashpot through defective seals/vent screws.			
4.2.4	Visually examine axle box clearance.			
4.3	**Secondary Suspension**			
4.3.1	Visually examine bolster springs breakages/damages.			
4.3.2	Examine vertical shock absorbers for damages.			
4.4	**Brake rigging**			
4.4.1	Check brake-rigging arrangement for any defects/deficiencies.			
5.0	**Draw gear**			
5.1	Check conditions of the screw coupling and its components and replace if required.			
5.2	Examine visually draft key locking pins.			
6.0	**Buffing gear**			
6.1	Visually examine buffer plungers for damage/drooping/stroke length.			
7.0	**Running gear**			

No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
7.1	Examine visually axle box for grease oozing out, warm axle box if any.			
7.2	Visually inspect axle box covers.			

8.2 MONTHLY SCHEDULE:-

(Car Body, Under frame, Bogies, Brake System, Brake Rigging, Lifting & Swiveling Platform etc.)

(i) 8-WHEELER OHE Car

(ii) Cumulative km.:

(iii) Date :

S No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
1.0	**Repeat all items of Daily Schedule**			
2.0	**Car Body**			
2.1	Car body should be washed both from outside and inside.			
3.0	**Shell**			
3.1	Visually check body panels/end walls for damages.			
3.2	Visually inspect window bars for damage/missing.			
3.3	Examine body side doors for proper working/damages.			
3.4	Inspect door handles for damages/missing.			
4.0	**Under frame**			
4.1	Check condition of head stock/sole bar.			
4.2	Visually inspect center pivot cover.			
5.0	**Bogie**			
5.1	**Bogie frame**			
5.1.1	Examine oil level in side bearer oil-bath and oil-filling cap replenish oil if needed.			
5.1.2	Inspect axle box safety straps/ loops for damage/breakage/ missing.			

S No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
5.1.3	Inspect bolster safety straps/loops for damage/ breakage /missing.			
5.1.4	Check visually BSS hanger brackets.			
5.2	**Primary Suspension**			
5.2.1	Visually examine axle box springs for breakage/damage.			
5.2.2	Visually examine dashpot oil filling special screw for deficiency.			
5.2.3	Check oil leakages in dashpot through defective seals/vent screws.			
5.2.4	Add specified grade of oil in dashpot.			
5.2.5	Visually examine axle box clearance.			
5.3	**Secondary Suspension**			
5.3.1	Visually examine bolster springs breakages/damages.			
5.3.2	Visually examine Bolster lower spring beam.			
5.3.3	Visually examine BSS hangers, hanger blocks, BSS pins.			
5.3.4	Visually examine equalizing stay rods and pins (small and big).			
5.3.5	Visually check rubbing plate.			
5.3.6	Visually examine Equalizing stay brackets.			
5.3.7	Examine and attend safety loops of bolster.			
5.3.8	Check and attend safety loops of Equalizing stay rod.			
5.3.9	Examine vertical shock absorbers for damages.			
5.4	**Brake System**			
5.4.1	Externally clean the brake system pneumatic pipes and check for leakages. If required tighten the end fittings. Check the mounting fasteners of Air reservoir/ Distributor valve/ relay valve magnet valve and			

S No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
	other brake system equipments			
5.4.2	Check and attend brake block adjuster.			
5.4.3	Examine and attend brake levers.			
5.4.4	Examine and attend brake hanger lever brackets.			
5.4.5	Check functioning of Parking Brake			
5.5	**Brake rigging**			
5.5.1	Check brake-rigging arrangement for any defects/deficiencies. and check tread brake wherever tread brake units are provided.			
5.5.2	Examine brake beams breakages/ damages.			
5.5.3	Check and attend brake beam safety wire ropes/safety straps.			
5.5.4	Check and attend brake shoe head and key and replace if necessary.			
5.5.5	Check and replace worn brake blocks.			
5.5.6	Visually inspect brake hangers, brake gear pins and cotters/split pins and replace if necessary.			
5.5.7	Visually inspect damaged/missing brake gear bushes and replace if necessary.			
5.5.8	Examine lever hanger pins.			
6.0	**Draw gear**			
6.1	Check and replace damaged/missing split pins/ cotter/rivets.			
6.2	Examine draw hook, draw bars and rubber pads for damages.			
6.3	Check conditions of the screw coupling and its components and replace if required.			
6.4	Check condition of draw beam and locating pins on it.			
6.5	Examine visually draft key locking pins.			
7.0	**Buffing gear**			
7.1	Visually examine buffer plungers for			

S No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
	damage/drooping/stroke length.			
7.2	Examine buffer mounting bolts and attend if necessary.			
7.3	Examine visually buffer casing for cracks/damages.			
8.0	**Running gear**			
8.1	Examine visually axle box for grease oozing out, warm axle box if any.			
8.2	Visually examine wheel tyre profile and thickness of tyre and check with tyre profile gauge if they appear to be near condemning limit.			
8.3	Visually inspect axle box covers.			
8.4	Inspect wheel tread for shattered rim, spread rim, shelled tread, thermal cracks, heat checks.			
9.0	**Seats and berths**			
9.1	Disinfect the seats and frames.			
9.2	Examine the holding/securing brackets for seats and berths and attend if necessary.			
9.3	Examine and repair damaged upholstery cushions and curtains.			
9.4	Seats and frames should be cleaned.			
9.5	Cushion should be cleaned with duster. Oil or head stain and dirty spots if any should be cleaned with mild soap solutions and wipe dry.			
10.0	**Doors**			
10.1	Examine doors for proper functioning and securing with hinge pivots. Doors should not graze with floor or doorsill plates.			
10.2	Examine door locks, latches firmly secured with correct sized screws and properly/smoothly engaging in their slot. The tongue of gravity type latch should be in proper alignment with its slot plate.			

S No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
10.3	Visually examine window shutters for smooth working and proper locking.			
11.0	**Windows**			
11.1	Check window-balancing mechanism for proper function.			
11.2	Examine window safety catches for proper engagement in their slots.			
11.3	Check lavatory banjo shutters for damage/missing.			
11.4	Window bars should be provided and fixed in prescribed manner and replaced if damaged.			
12.0	**Interior fittings**			
12.1	Examine laminated panels and moldings for damage/cracks.			
12.2	Examine tower bolts of backrests for proper working.			
12.3	Examine ventilation grills for damages.			
12.4	Examine racks/bunks for breakage.			
13.0	**Lavatory and lavatory fittings**			
13.1	Intensive cleaning of lavatory pans and commode with cleaning agent			
13.2	Check lavatory hinge door for proper function			
13.3	Examine lavatory door latches/ tower bolts for proper function			
13.4	Examine push cock and flush valve for proper function			
13.5	Check and attend leakage in pipes, pipe fittings.			
13.6	Clean drain grills and drain holes in bathroom and wash basin if found chocked			
13.7	Check and replace damaged/missing mirrors / shelves / soap dishes			
13.8	Examine squatting pans and foot rest for damages			

8.3 AOH (YEARLY SCHEDULE):

(Car Body, Under frame, Bogies, Brake System, Brake Rigging, Lifting & Swiveling Platform etc.)

(i) 8-WHEELER OHE Car

(ii) Cumulative km.:

(iii) Date :

No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
1.0	**Repeat all items of Monthly Schedule**			
2.0	Intensive cleaning of OHE Car			
3.0	**Lavatory and lavatory fittings**			
3.1	Thorough flushing of water tanks			
4.0	Ultrasonic Testing of wheel set (wheel & axle).			
5.0	Overhaul all Brake equipments, except brake cylinder.			
6.0	Replace rubber kits during yearly repairing of pneumatic valves.			
7.0	**Under frame**			
7.1	Examine trough floor and other under frame members from underneath for corrosion.			
7.2	Examine center pivot mounting bolts. Attend if needed			
8.0	**Shell**			
8.1	Thoroughly clean and remove dust, rust accumulated at underframe and pillars with coir brush and compressed air.			
8.2	Examine for corrosion of sole bar and other under frame members with torch light or inspection lamp.			
8.3	Touch up damaged paint both inside and outside.			
8.4	Check roof ventilator for damages.			
9.0	**Bogie**			
9.1	**Bogie frame**			
9.1.1	Repeat monthly schedule.			
9.2	**Primary Suspension**			

No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
9.2.1	Repeat monthly schedule.			
9.2.2	Check axle box clearance with gauge.			
9.3	**Secondary Suspension**			
9.3.1	Check bolster clearance.			
10.0	**Draw gear**			
10.1	Ensure that wear on screw coupling shackle pins, trunion pins, shackle/link holes and draw hook holes should not exceed 3mm.			
10.2	Ensure that wear at any section on draw hook should not exceed 10mm.			
11.0	**Buffing gear**			
11.1	Ensure that buffer projection/ length shall not be less than 600 mm and shall not be more than 635 mm			
11.2	Inspect buffer plunger false plate for wear and profile.			
12.0	**Running gear**			
12.1	Check with wheel distance gauge for loose or tight wheel.			
13.0	**Flooring**			
13.1	Inspect and attend damaged/cracked flooring.			
13.2	Examine and attend opened joints.			
13.3	Examine Drain holes in trough floor for accumulation of water due to clogging if noticed. Inspect affected area for corrosion.			
14.0	**Brake System & Brake rigging**			
14.1	Repeat monthly schedule.			

Note: 1. All rubber items should be replaced during POH.

2. All rubber items should be replaced on condition basis during AOH/IOH also.

8.4 IOH (THIRTY SIX MONTHLY SCHEDULE):

(Car Body, Under frame, Bogies, Brake System, Brake Rigging, Lifting & Swiveling Platform etc.)

(i) 8 WHEELER OHE Car

(ii) Cumulative km.:

(iii) Date :

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	**Repeat all items of AOH Schedule**			
2.0	**Brake System**			
2.1	Overhaul the safety switch.			
2.2	Clean the chokes, exhaust plugs, mesh filters in the distributor valves and check proper functioning of all sub-assemblies.			
2.3	Overhaul the drivers brake valve. Replace all the rubber items, clean filters.			
2.4	Check for proper functioning of relay valves and replace the damaged/ worn out items. Check the Distributor Valve sub-assemblies and entire assembly for proper functioning, replace rubber items, chokes and springs only if required. Entire distributor valve does not need overhauling for 6 years.			
2.5	Replace rubber-sealing washer of air brake hose coupling. Replace all hose assemblies if not done so far.			
2.6	Check all the hose assemblies of brake system for damage or over ageing replace if required.			
2.7	Replace all the rubber items and choke in the brake system equipments like safety valves, Auto Drain Valves Drivers Brake valve, Relay valve Tread brake Block units, Isolating cocks, Dust collectors, Angle cocks, filters etc.			
3.0	**Bogie**			

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
3.1	Run out the bogies and attend all the items as mentioned in Clause No.13.0 (Bogies).			
4.0	**Bogie frame**			
4.1	Examine condition of side bearer wearing piece and wearing plate.			
5.0	**Primary Suspension**			
5.1	Check and attend axle guide assembly, if necessary			
6.0	**Secondary Suspension**			
6.1	Repeat AOH schedule.			

Note: 1. All rubber items should be replaced during POH.

2. All rubber items should be replaced on condition basis during AOH/IOH also.

8.5 POH (SEVENTY TWO MONTHS)

(Car Body, Under frame, Bogies, Brake System, Brake Rigging, Lifting & Swiveling Platform etc.)

(i) 8 WHEELER OHE Car

(ii) Cumulative km.:

(iii) Date:

No.	Details of work to be carried out	Condition/ Action	Sign.	Remark
	The following sequence of work should generally be followed during POH of OHE Car			
1.	Verification of deficiencies.			
2.	Pre-inspection and Lifting of OHE Car body			
3.	Stripping			
4.	Body repair.			
5.	Fitting of Water Tank, Plumbing & Leakage testing			
6.	Repair of internal panels			

No.	Details of work to be carried out	Condition/ Action	Sign.	Remark
7.	Fitment of shutters			
8.	Fitment of doors			
9.	Fitment of berths and seats			
10.	Repair, maintenance & fitment of screw coupling.			
11.	Painting and finishing			
12.	Repair and maintenance of bogie			
13.	Repair and maintenance of brake system including overhauling of Distributor valve.			
14.	Repair and maintenance of Axle Box Guide Arrangement			
15.	Repair and maintenance of rolling gear			
16.	Lowering of coach body on bogies.			
17.	Brake Testing			
18.	Testing of branch wiring			
19.	Testing of electrical equipment			
20	Final Inspection & Dispatch			

Note: For Brake Overhauling, OEM manual (recommended by M/s Wabtec) is attached as **Annexure-8** for further details. In this manual, the legend for the Maintenance of Brake as per OEM manual is as follows:-

E	Visually examine for loose fastenings, leaks or other damages
C	Clean
X	Renew material/Item Replacement
T	Operate and / or Check Performance
T*	Operate and / or check performance as part of the brake equipment system
O	Overhaul
H	Hydrostatic Test

9 Maintenance of Axle drive (of DHTC):

Three years or (approx. 3,00,000 kms whichever is earlier.	Remove the final drives from the car disassemble the gears, shaft & sub-assembly and inspect the gears and bearing. The defective components must be replaced before re– assembly.

10 Maintenance of torsion rod assembly (torque arm assembly):

During maintenance of transmission system, torque arm assembly must be thoroughly examined for its healthiness such as check for any crack etc. Any non-destructive test like ultrasonic examination or DPT test may be carried out and ensure its healthiness before reinstallation.

1	Check the tightness and locking of fasteners. Replace on condition basis.
2	Lubrication of spherical joint to be done as and when required.
3	Spring disk to be checked physically, if found damage replace it
4	Pre– compression of spring disk to be maintained for the specified value by tightening the castle nut at one end of torque arm.
5	For torque tightening value of fasteners refer the manual of manufacturer.
6	Spherical joints and bushes are checked for wear.
7	Irclips and split pins if failed, replace them.
8	Refer relevant drawings for parts list & installation.

11 Maintenance of Lifting and Swiveling platform:

11.1 Daily Maintenance:

1	Check Hydraulic oil level and top up ifnecessary
2	Check oil level in gear box. Top up if required
3	In case, OHE car is not in use for longtime, check for all operations ten times, before deployment in actual service. Also check manual operation.

11.2 Monthly Maintenance:

1	Repeat all Daily schedule
2	Lubricate bearing housing
3	Check and tighten if necessary all holding bolts of outer telescopic structure, cylinder flange, tilting head, gear ring, pinion, bearing housing, gear box, slewing

	motor, bearing housing supports, etc.
4	Clean telescopic railing squarepipes and apply light film of grease / oil for smooth up and down motion. Also check railing locking arrangement for smooth functioning. Oil if necessary.
4	Check electrical cable insulation
5	Apply grease on all Nylon pads
6	Apply grease on gear & pinion aftercleaning the teeth and surface

11.3 AOH (Yearly) Maintenance:

1	Repeat all Monthly schedule
2	Replace suction strainer on condition basis
3	Replace return line filter element
4	Drain oil tank, clean it and change oil
5	Clean the suction strainer if the equipment is in regular use
6	clean return line filter element if irregular use

11.4 IOH Maintenance (3-Yearly):

1	Repeat all AOH (Yearly) schedule
2	Replace seals of Hydraulic cylinder
3	Replace guiding pads betweentelescopic structures

11.5 POH (6-Yearly) Maintenance:

1	Repeat all IOH (3-Yearly) schedule
2	At 72 months replacing guide pads between telescopic structures and replacing seals of hydraulic cylinder constitute a part of major over haul.
3	RDPT (Red Dye Penetration test) test of Gear box Pinion and main gear of boom.
4.	Pressure line hoses to be replaced during POH. Control panel and hydraulic motor of Lifting platform to be checked and replaced on condition basis.

Note: 1. All rubber items should be replaced during POH.

2. All rubber items should be replaced on condition basis during AOH/IOH also.

12 MAINTANANCE GUIDELINES AND SCHEDULE (CARRIAGE PART) OF 8 -WHEELER OHE INSPECTION CAR:

12.1 BODY REPAIRS

(i) Inspection and repair of body members are done after the Tower Car body is lifted off the wheels and axles are placed on trestles

(ii) All furnishing and other components from coach shell, which are stripped, are to be sent to the respective sections for maintenance.

(iii) For major repairing work all the equipments (under slung, onboard and roof mounted) shall be removed from the tower wagon.

12.2 INSPECTION OF UNDERFRAME

(i) The under frame members should be thoroughly inspected for locating cracked/bent/corroded members. Corrosion is indicated by flaking of paint of metal, pitting and scale formation. Components like sole bar and trough floor which are not visible from both sides should be examined by tapping with a spiked hammer, proper illumination will be required to carry out the check. A component will require repair / replacement if it has lost more than 20% of its thickness

(ii) The under frame and shell members are categorized as vulnerable and not so vulnerable areas for corrosion.

(iii) Particular attention should be paid to the vulnerable members and locations listed below: -

- Sole bar, body pillars, and trough floor.
- Sole bars, body pillars above lifting pads.
- Sole bars and pillars behind the door pockets.
- Sole bars and pillars at the door corners.
- Head Stock.
- Sole bars and pillar.

(iv) Procedure for inspection of under frame members for corrosion attention is laid down in RDSO technical pamphlet No RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" ..

12.2 SOLE BAR, BOBY PILLAR AT LAVATORY AREA

(i) Examine visually supplemented by tapping with a spiked hammer sole bars, body pillars in the bays under after removing the accumulated dirt and cleaning the surface.

(ii) If incidence of corrosion is noticed in the bottom half of the sole bar, the trough floor should be cut to a width of 300 mm and requisite length for examination of inside top half.

(iii) If heavy corrosion is noticed, the sidewall should be cut to a height of 500mm from the bottom of covering sufficient length and all the exposed parts, after scraping and cleaning should be examined to determine the extent of corrosion.

12.3 SOLE BAR AND PILLAR ABOVE THE LIFTING PADS

(i) Examine the above members in the same manner as described in clause 12.2 above.

(ii) If signs of corrosion are noticed, the sidewall sheet above the lifting pads should be cut to a height of 500mm. above and to a length of half meter, on either side of lifting pads. Scrape the structural members, clean and examine minutely to ascertain the extent of corrosion.

12.4 SOLE BAR AND PILLAR AT THE DOOR CORNERS

Examine the above locations visually. If corrosion is noticed, cut to a width of half meter from the door corner. Remove accumulated dust. Structural members should be thoroughly scraped, cleaned and examined to assess the extent of corrosion.

12.5 SOLE BAR AND BODY PILLAR AT LOCATIONS OTHER THAN DESCRIBED ABOVE

(i) Examine visible portion of sole bar through the end from above of the underframe.

(ii) Remove the accumulated dust and scrape structural members to the extent possible. If corrosion is noticed, sidewall sheet in the area of corrosion should be cut to a height of 450mm from the bottom of covering for sufficient length for thorough examination.

12.6 HEAD STOCK

(i) Examine visually inner headstock, outer headstock, stiffening immediately behind the buffers and the junction of the sole bar at the headstock for incidence of corrosion.

(ii) Examine carefully the base of buffer assembly as corrosion has been primarily noticed at this location.

(iii) Examine carefully the buffer base of headstock by chalk test or sound test for cracks and dents. Buffers fixing holes should not be elongated and no minor cracks to be allowed. Replace headstock if the wear is more than 4 mm i.e. when the thickness is below 4mm.

12.7 TROUGH FLOOR

i. Examine the trough floor in the bays adjoining the lavatories and from below for signs of corrosion, supplemented by tapping with a spiked hammer.

ii. If signs of corrosion are noticed in the above examination, the part should be thoroughly cleaned by scraping and an intensive inspection should be carried out to detect the extent of corrosion in the trough floor.

iii. Flooring in the lavatories and bays adjacent to lavatories of all coaches over six years old should be broken and trough floor thoroughly examined for incidence of corrosion.

12.8 TUBULAR FRAME BELOW LAVATORIES

(i) Examine visually the tubes and joints for incidence of corrosion.

(ii) Corroded tubes shall be replaced. If corrosion is extreme, entire tubular frame should be replaced.

12.9 CORROSION REPAIRS TO UNDERFRAME MEMBERS

(i) Corrosion repairs shall be carried out as per instruction laid down in RDSO technical pamphlet nos. RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" ..

It is essential to use corrosion resistant steel sheets for corrosion repairs of coaches. Welding electrodes and paints should be of the prescribed quality conforming to the relevant IS/IRS specifications.

Corrosion resistant steel sheet for trough floor, pillars, sidewall and roof to IRS M-41.

- Electrode: MMAW electrode Class D to IRS: M-28 shall be used. MIG/MAG welding wire class-IV to IRSM-46 may be used.
- Paints ready mixed paint, air Drying Red Oxide, Zinc Chromic, priming- Specification to IS: 2074/1992, second Revision (Reaffirmed 2002) with additional requirements of ICF/MD/Spec-052 issue status: 02, revision no. 01 date 26.05.2006 by Brush/Spray so as to get Dry firm thickness(DFT) of 40 microns min. Bituminous Anticorrosive solution to IRS P-30-2007 solution type, brushing quality.

(ii) Where the corrosion noticed is of a very minor nature and has just started, there is no need to renew the parts. In those areas, the paint and the rust should be thoroughly cleaned to reach the bare metal and the surface treated with two coats of ready mixed paint, Air Drying, Red Oxide, Zinc Chrome, Priming Specification to IS: 2074/1992, second revision (Reaffirmed 2002) with Additional requirements of ICF/MD/SPEC-052 issue status: 02, Rev. No.1 date 26.05.2006 by brush/Spray so as to get Dry film Thickness (DFT) of 40 microns, min in addition, under-frame members should be given two coats of bituminous solution.

(iii) Where the corrosion repairs are carried out on the under frame or its paint coat is damaged, the under frame should be painted with two coats of ready mixed paint, Air Drying, Red Oxide, Zinc Chrome, Priming Specification to IS: 2074/1992, second revision (Reaffirmed 2002) with Additional requirements of ICF/MD/SPEC-052 issue status: 02, Rev. No.1 date 26.05.2006 by brush/Spray so as to get Dry film Thickness (DFT) of 40 microns, min followed by the four coats system of Anticorrosive Bituminous Paint.

(iv) For carrying out corrosion repairs to under frame members, the coach body should be lifted off the bogies and kept on trestles. For repairs to sidewall and end wall, no lifting is required.

12.10 **HEAD STOCK**

For replacement of headstock, the following parts need to be stripped first:

i) Side buffers
ii) Compreg board and Aluminum chequered sheet flooring
iii) End partition and electrical wiring
iv) Draw gear assembly
v) End portion of BP/FP

Before the corroded portion is cut off, the auxiliary headstock and the two sole bar ends should be firmly supported on trestles. The corroded headstock is then replaced as per RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .. Only corrosion resistant steel (IRS M-41 or IS:2062 Fe 410 Cu WC) should be used for head stock repairs.

12.11 **SOLE BAR**

For carrying out repairs to sole bar, it is necessary to strip first the interior fittings, laminate paneling and window frames. Before cutting off the corroded portion of sole bar, both the adjacent ends should be supported on trestles. The new sole bar piece should be welded from outside and inside. To facilitate welding from inside, the coach body should be lifted and kept on trestles.

12.12 **CORRISION REPAIR OF SOLE BAR**

Repairs to sole bar for replacement of corroded portions at the locations mentioned below should be carried out as per RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01

AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" ..

12.13 **SIDE WALL MEMBERS**

For repairs to side and end wall sheets, the interior fittings, laminate paneling and window frames should be stripped first. Corrosion repair of side/end wall sheets and body pillars should be done as per RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .

12.14 **TROUGH FLOOR**

For replacement of trough floor, first Compreg board and Aluminum chequered sheet flooring needs to be stripped. Corrosion repairs to trough floor should be done as per the RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .

12.15 **ROOF**

(i) **Roof repairs**

Tower car, roof should be checked for corrosion. Special attention should be paid at location where gutter mouldings are welded and ventilators bolted. Corroded roof should be repaired according to the instructions given in RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .

(ii) **TRA type roof ventilators repairs**

Examine the roof ventilator for damage or corrosion or leakage. If no corrosion is observed then seal the joints and crevices with waterproof sealing agent as per IS/IRS Specification. Ventilators found beyond repairs should be replaced as per RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .

After repairs and refitting, ventilators should be tested for water leakage at their base joints at the time roof testing.

(iii) **Roof testing**

Tower car after POH repairs should be tested under water spray for roof leakage before they are finally turned out from the workshop. For this purpose, a fixture designed to simulate monsoon conditions should be provided in the workshop.

12.16 REPAIRS TO DOOR HANDLES

Examine the door handle for breakage, damages. If the fixing bolts are loose or missing, tighten the bolts. Replace the door handles, which are found beyond repairs.

12.17 REPAIRS OF BODY SIDE DOOR

The body side doors shall be repaired as per RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .

12.18 REPAIRS TO DOOR PIVOTS

Examine the door pivots for corrosion, breakage or wear by cutting the bottom portion of outer panel. Cut the corroded portion of the door pillar (Z molding) and weld new piece joining the door pivot pin. If the female socket is worn or damaged beyond repairs then replace it. Replace the bush provided in the socket.

12.19 REPAIRS TO PARTITION WALL SEAT PILLAR/MOUNTING PLATE

Examine seat pillar/mounting plate for corrosion or breakage, etc. at bottom ends. If found corroded, repair the same as per RDSO INSTRUCTION NO. RDSO/2011/CG/CMI01 AMD. NO. 1 " INSTRUCTION FOR CORROSION REPAIRS OF ICF/RCF BUILT BG COACHES" .

12.20 REPAIRS TO DRAW AND BUFFING GEAR SUPPORT STRUCTURE

(i) Examine the draw gear support structure for corrosion, breakage, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or gusset plate with new support angle.

(ii) Similarly examine the buffing gear support structure for corrosion, breakage, etc. if the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or stiffeners.

12.21 REPAIRS TO BODY BOLSTER

Examine the body bolster for corrosion, breakage, wear, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakage or

wear are beyond repair, replace the body bolster. Check the area surrounding centre pivot pin mounting holes for cracks.

12.22 REPAIRS TO CENTRE PIVOTS

Clean and examine the centre pivot for bent, wear, cracks. Cracks shall be detected by doing chalk testing or magnaflux dye penetration test. If the centre pivot is found cracked or worn beyond repair, it should be replaced. Check the mounting bolts for loose or missing. Tighten and lock the bolts with locking plate.

12.23 WATER TANK SUPPORT STRUCTURE

Examine the water tank support structure for corrosion, breakage, wear, etc. if the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded angle with new angle of suitable size as per the requirement. Replace the rubber/wooden packing if perished or damaged.

12.24 REPAIRS TO THE FLOOR CHANNEL

Examine the floor channel for corrosion, breakage, wear, etc. by cutting open the Compreg board and Aluminum chequered sheet flooring where the corrosion is suspected. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded channels with new channel of suitable size as per the requirement.

12.25 GENERAL

(i) All repairs of cracks should be carried out by gauging and welding by suitable electrodes.

(ii) CAUTION: No electric welding on the coach should be carried out without proper earthing from near the portion being welded. And in no case the earthing through the bogies and rails shall be permitted. In the absence of such earthing, the return current passes through axle roller bearings causing pitting of rollers and bearing failure in service.

(iii) Distorted and bent parts should be heated and straightened.

(iv) The parts used for repairs should be given proper surface treatment and applied with protective paint. Relatively thick sections such as sole bars, cross bearers, etc. should preferably be grit blasted and immediately thereafter given a protective coat of red oxide zinc chromate primer paint.

(v) Welders Qualification: Welders deputed to carry out welding work on coaches and coach components should be only those tested and certified as adequately skilled for welding work on coaches and coach components.

12.26 **LIST OF TOOLS AND PLANTS**

Lifting shop	Corrosion repair shop
1. EOT cranes	1. EOT cranes
2. Trestles for coach body	2. Trestles for coach body
3. Inspection torches	3. Gas cutting plants
4. Spiked hammers	4. Multi-operator welding plants
5. Ball peen hammers	5. CO_2 welding plant
6. Goggles for inspection staff	6. Electrical angle grinders
7. Measuring tape	7. Pneumatic hand grinders
8. Measuring scale	8. Component painting equipment
	9. Phosphating plant

12.27 Examination and repair practice in maintenance depot shall be as per Clause 8.0 and its sub clauses.

Schedule of Standard Examination of Bogies of 8-Wheeler OHE Car

13.0 **BOGIES**

13.1 BRIEF DESCRIPTION OF BOGIES

Bogies currently being manufactured for OHE CAR are of light weight welded box section construction. Axles for these bogies with their self aligning spherical roller bearings mounted inside cast steel axle boxes are rigidly guided by telescopic dash pots and axle guide assemblies. Helical springs working in parallel with dashpots/hydraulic shock absorbers are used for both primary and secondary suspensions. Coach body is supported on two side bearers located 1600 mm (for BEML Bogie) and 1200mm(for ICF Bogie) apart on a floating bolster which in turn rests on two pairs of nested helical springs supported on a spring plank hung through swing links from bogie frame, Side bearer consists of metal slides immersed in oil baths well protected from dust ingress. The oil filling arrangements for side bearers have been provided similar to that of ICF bogie.

No weight is transferred through bogie pivot, which is located in the centre of the bolster. The pivot acts merely as a centre of rotation and serves to transmit acceleration and retardation forces and incorporates a resilient silent block bush which isolates noise from track and offers certain amount of constrain for nosing of bogie.

In case of BEML bogie the floating bolster is secured in the longitudinal direction to bogie frame by means of two anchor links with silent block bushes, located diagonally

opposite to each other and transmit draw and braking forces between bogie frame and coach body through centre pivot. Rubber buffer have been provided on floating bolster beam to limit lateral swing.

Following are leading particulars of bogie:-

SN	Description	BEML	ICF
1	Rigid wheel base	2896 mm	2896 mm
2	Diameters of wheel on tread	915 mm	952 mm
3	Axle load	16 tonnes	20.32 tonnes
4	Supporting arrangement for coach body	Through side bearers	Through side bearers

13.2 FEATURES WHICH CONTRIBUTES IMPROVED RIDING COMFORTS

Rigidly guided axles mounted on self aligning spherical roller bearings, with practically no play in the longitudinal and lateral directions, helical springs working in parallel with dashpots/shock absorbers of specified characteristics, the diagonally opposite anchor links (in case of BEML bogie) for guiding the bolster and near ideal distribution of the total deflection between primary and secondary suspension obtained for these bogies have all contributed to superior riding comforts. It is therefore essential to ensure that these features are well maintained in service so as to obtain the desired performance throughout the life of these bogies.

Riding comfort offered by a bogie depends exclusively on above design features and unless bogies are properly maintained and attended to during periodical, overhauls, riding deteriorates leading to subsequent heavier and costly maintenances.

13.3 OVERHAULING

OHE inspection car bogies are designed for good riding comforts with the help of self-aligning spherical roller bearings, hydraulic shock absorbers, and helical springs for

suspensions. Proper handling & maintenance of these will result in longer life and satisfactory service.

The Bogies are required to be given proper maintenance as per the schedule mentioned in 8.0 and its sub clauses.

13.4 LIFTING THE CAR BODY OFF THE BOGIES

Coach body can be lifted off the bogies either by:

Two electric cranes with suitably designed swings and cradles; or four electrical, lifting jacks simultaneously operated by one control switch. OHE Car should not be lifted from any other point but from lifting pads Four screw jacks each applied at four lifting pads provided in the body for this purpose, under no circumstances a lifting jack or sling should be applied on a bogie frame or at any other location except on lifting pads in the workshops or depots.

Cranes or jacks used for lifting should be operated uniformly and simultaneously without jerks, before lifting the coach, following components should be disconnected.

13.5 DYNAMO BELT ON NON-POWERED BOGIE

Cotter cover housing, split pin and cotter from centre pivot.
Lavatory chutes situated over the powered bogie.
Cordon shaft coupling connecting axle drive with transmission on powered bogie.
Air hose connecting brake pipe on under frame to the piping on bogies.
Parking brake chain.
Hose connection for sanding gear on powered bogies.
Earthing cable connections.
Speedometer cable connection on powered bogie.
Before finally lifting coach body, steel/wooden blocks of requisite thickness should be inserted in the recess in between the bolster and bogie frame. So as to keep the bolster springs compressed to avoid the bolster hitting the bogie frame and straining silent block bushes in anchor links.

Coach should never be lifted from one end only as the centre pivot and the dashpot guides are likely to suffer damage and dents may occur on body panel near the body bolster.

Air vent screw on the bogie frame above dashpots should be unscrewed completely after cleaning the area around the air vent hole properly. This is done to release the air locked in the dashpots.

13.6 DISMANTLING OF BOGIES

Before dismantling, these bogies should be thoroughly cleaned all over and particularly near the air vent screw above the dashpot by using brush or scraper if necessary. Steel brushes should not be used for cleaning, as they are likely to damage the paint on bogie frame. Dismantle the cordon shaft by removing bolts connecting cordon shaft and axle drive. Also dismantle torque arm connected to transom. Support the axle drive with wooden blocks. Bogie frame with bolster may be lifted by means of a crane till all the 8 guide bushes disengage the lower spring seats and wheels rolled out. Bogie frame along with bolster assembly can then be put on trusses. The bolster may then be dismantled from bogie frame, after disconnecting shock absorber and anchor links, by compressing the bolster springs to relieve the load on the swing links and hanger pins.

13.7 ATTENTION TO BOGIE COMPONENTS

Following attention should be paid to bogie components during POH before assembling them.

13.7.1 BOGIE FRAME

Bogie frame should be checked thoroughly after cleaning for any possible cracks, particularly at places where bolster suspension brackets, brake block brackets are welded and at dashpot guide flanges. Threads on dashpot guide should also be checked for damages. Normally squareness and alignment of dashpots does not require checking. If biased wheel flange wear or wear in the rear cover of the roller bearing axle box have been observed, the squareness of guides and their alignment should be checked thoroughly with the help of alignment gauges. Wheelbase may be checked with the help of gauge. In the event of misalignment of dashpot guides or damaged guides which require replacement. Following procedure may be adopted.

Whenever a dashpot guide is damaged, it is to be replaced. Alignment of axle box guides should be measured with reference to bolster spring suspension bracket. (hereafter referred to as BSS). Therefore, it is necessary to ensure that BSS are in proper alignment between themselves and the centers should form a rectangle within permissible tolerances as per Design bogie (ICF and BEML).

Centre punch mark should be made at centre of each BSS and measurements taken, if they are within the tolerance. There is no need to relocate these brackets and their centers taken as reference points for further rectification. Normally, these brackets are in correct alignment and do not require any attention.

If BSS do not lie within the tolerances, the transverse centre line of bogie frame between headstocks should be marked and deviations on BSS from this line measured. Then one or more BSS should be cut out and re-positioned with correct alignment.

After ensuring that BSS are in correct alignment, the location of axle box guides from BSS are measured and checked with ICF bogies and BEML for this purpose guide caps with the centre hole blocked and marked with centre punch should be used.

Where the measurements of guides from BSS show a deviation from the dimension. The concerned pair of guides should be cut and re-welded in position. Guide should always be cut in pairs as the adjacent guide distances are to be maintained as per their respective drawings. Judicious selection of guides to be cut will minimize rectification work and normally 4 out of 8 guides on each frame need be cut and repositioned. These 4 guides could be either of those on one side of the frame or in two pairs of guides diagonally opposite to each other on either side.

While cutting out guides, care should be taken that only the weld metal is cut and guide flange or bogie frame are not damaged. The work calls for special skill and welder should practice cutting out welds on scrapped fabricated components before starting guide cutting.

Guides, which are cutout, need not be scrapped but the flange periphery should be built up by welding wherever spoiled or pitted by gas cutting and ground to shape. Care should be taken not to damage the threads of the guide cap.

13.7.2 For re-welding dashpot guide.

Locate new guide with the aid of setting gauges with reference to other guides. Two gauges, one giving the longitudinal and other diagonal location in relation to other guides are sufficient to locate it. However, a third gauge be used as a counter check with ICF bogie and BEML bogie.

Tack weld the guide to bogie frame taking care to see that oil hole of the guide is in alignment with that of bogie frame flange.

Remove the gauge and complete the welding.

Allow the frame to cool off.

Check the dimension of the guide in relation to others with the aid of master gauge.

Check also the height of the guide in relation to other guides with a straight edge.

Any discrepancy in location is rectified by suitable local heating to the frame.

Use low hydrogen electrodes of approved brand for welding (Electrodes under IRS Class A3/A4 may be used).

Important dimensions to be checked after rectification should be as per design bogie (BEML & ICF).

Bogie frame should be thoroughly checked for any cracks particularly at bolster suspension brackets and brake block brackets. The wear on the bush for the bolster suspension bracket should also be checked and if more than 0.5 mm, the bush should be changed.

The clearance between the bolts and the axle box should be as ICF bogie and BEML bogie. The stop screw should be adjusted every time the timber packing' s are inserted between the lower spring seat and the lower rubber washer to compensate tyre wear so as to obtain the prescribed clearance between axle box crown and the stop.

Bogie frame should be given one coat of anti-corrosive black paint.

13.7.3 WHEELS AND AXLES (BEML Bogies)

The leading dimensions of powered wheels and axles set should be checked for single engine version, double engine version and for non powered wheel and axle as per drawings. These wheels are clearly marked with their axle capacity and should not be interchanged with other wheels under any circumstances.

The wheel profile should be checked and re-turned to standard profile as per RDSO/SK-91146 (latest alteration) and tread should be machined to machining standard N11 while tyre turning. The axle box covers, speedometer with cover and earthing assembly with cover should be removed after cleaning the axle box and replaced with special covers, (with a hole in the centre) secure this in position by using 4 axle box bolts before mounting the wheel set on lathe for tyre turning to prevent entry of any foreign matter in the bearing.

Variation in the tread circumference of the wheel on the same axle should not exceed 1.6 mm i.e. 0.5 mm in diameter. Large variation in wheel diameter will lead to biased flange wear. Under the same bogie, the variation in wheel diameter between one pair of wheels and the other should not exceed 5 mm and that between two bogies under the same car, the maximum variation should not exceed 13 mm.

Wheel gauge should be within the tolerance of +1/-1mm.

Under no circumstances, wheels, which have reached the condemning, limit, as indicated by grooves on the wheel rim/tyre should be used.

In case any wheel is de-wheeled and repressed on, the pressing on pressure maintained as per the values shown in BEML drawing No. 901-81003,902-81003 & 901-81004 for powered single engine version, powered double engine version and for non powered wheel sets respectively, should be strictly adhered to and a record of wheel pressing on pressure maintained.

Earthing arrangement has been provided in the front cover of the axle box.

Unscrew screws connecting housing and front cover of axle box.

Dismantle the housing, earthing spring and earthing piece.

Check for the condition of the spring

Check for the wear of earthing piece. If there is any cracks or broken or if the length 65 mm is less than 50 mm it should be replaced with a new one.

13.7.4 WHEELS AND AXLES (ICF Bogies)

The OHE are provided with composite design of wheels consisting of rolled steel wheel centers with renewable tyres. The tyres of TC bogies are fastened to the wheel disc with glut rings and 4 locking keys to ensure more positive securing.

Tyre profile

a)The new/re-turned tyre profile shall be as per RDSO sketch no.91146 (latest revision/alteration).

b)The condemning limits for the flange wear, roof wear, deep flange, sharp flange, hollow tread wear and flat surface on tyre shall be as per the condemning gauge shown in plate 45 of IRCA, Part-IV.

c)Wheel gauge should be within the tolerance of +1/-1mm.

WHEEL DIAMETER

New	Condemning	Last shop issue size
952mm	877mm	885mm

d) Permissible variation on wheel tread diameter.

i) The permissible variation in tread diameter of wheels at the time of tyre turning or wheel replacement are as follows:-

Wheels of the same axle	0.5mm
Wheels of the same bogie	5.0mm

Wheels between two bogies under the same coach	13.0mm

ii) No separate service limits are specified as the above figures have been fixed to allow for the differential wear likely to develop between successive tyre turnings/wheel changing. It is therefore, not necessary to withdraw OHE car stock from service specifically for restoring the differential between wheel diameters to be within the prescribed limits.

Material specification for wheel and axle

The material specification applicable to the wheels and tyres are as follows:

a) Tyres IRS specification R-15/95

b) Axle IRS specification R-43/92

Note: Weld reclamation of Axle should never be done.

13.8 ROLLER BEARINGS

These bogies have been fitted with double row self-aligning spherical roller bearing. These bearings are mounted directly on the axle as per design Bogie (BEML & ICF).

13.8.1 LUBRICATION OF ROLLER BEARING

The quantity of grease required to be filled in axle box during renewal is given below:

SKF bearing	2 Kg
FAG bearing	1.5 Kg

List of approval brand of grease is given below:

Supplier of grease	Type of bearing	
	SKF	FAG
I.O.C.L.	SERVOG EM 3	SERVOGEM 3
H.P.C.L.	---	LITHON 3
B.P.C.L.	---	POLYPAK 3

The different types of grease should not be mixed together.

13.8.2 INSPECTION OF ROLLER BEARING

Thoroughly clean the exterior of axle box and then remove the front cover from the body casting. Examine the grease, if it is discolored fully, bearing should be dismounted and thoroughly inspected. If the grease is in good condition, bearing need not be dismounted, but be washed and cleaned in position with petrol or white spirit.

When dismounted scoop out all accessible grease from the front by the hand and by using a rubber scraper take out all grease. Wash the bearing with spirit or petrol.

Ensure that tracks, rollers and cages of bearing are free from damage. Measure the bearing clearance using a feeler gauge. If the roller and tracks are not pitted or flaked and cage is not worn, that is rollers do not fall out when the outer ring is swiveled at an angle, the bearing is in good condition. Maximum bearing clearance of 0.33 mm is permissible.

13.8.3 DISMANTLING

Roller bearing can be dismounted as described below:-

Straighten the folded tabs of the triangular locking plate, unscrew the hexagon head screws holding the securing cup. Remove the securing cup, then push the injector adapter ring on the journal against the bearing and clamp it firmly against the bearing inner ring. Connect the oil injection pump capable of developing a minimum pressure of 740 kg/sq.mm to the adaptor ring and pump in thick cylinder oil IS: 1589-60 Type I Gr-3, so that a film of oil is formed between the bearing and the axle journal. Remove the adapter ring as soon as the oil film is formed. Fit the withdrawal tool over the bearing outer ring, then push the locking ring forward, so that the claws of the sleeve engage the inside face of the bearing outer ring. Due to oil film between the journal and the inner ring the bearing can be easily dismounted by turning the withdrawal screw.

After removing the bearing, remove the rear cover and the sealing ring.

Wash and examine the bearing and other components.

13.8.4 FELT SEALING RING

The felt sealing ring should be examined and if found damaged, replaced. However, it is advisable that every alternate POH, the felt ring is renewed.

Felt used should have the following properties:

Density - 0.36 gm/cm3

Oil absorbing power for the felt should be such that after it is immersed in oil at 29oC, its weight is increased by 130 to 150 %.

13.8.5 MOUNTING OF ROLLER BEARING & ASSEMBLING OF AXLE BOX

Soak felt ring in cylinder oil to IS: 1589-60 Type I Gr-3 heated to 40° C to 50° C for 30 minutes and fit in the groove in rear cover.

Clean and examine journal and ensure that threaded holes for locking screw are perfect.

The collar should be shrunk fit on axle journal after heating the collar in a neutral oil bath. With the help of a mounting sleeve. Make sure that the collar firmly butts against journal shoulder.

Fit the rear cover with four bolts along with rubber ' 0' ring and felt sealing ring in position. Fill in the ' V' grooves and the cavity in the rear cover upto the face of the ring with approved brand of grease.

Heat the roller bearing in a hot oil bath and slide it over the journal carefully with the help of a mounting tool. Push the bearing forward till it firmly butts against the ring. The stamped face of the bearing should be kept outwards while fitting the bearing so that the stamping can be seen during inspection. After the bearing cools off, remove the mounting tool and pack the bearing with grease.

Assemble the required securing cup and lock plate with hexagon screw. The securing screw is locked by bending over the tabs provided in the locking plate against flat of bolt heads.

13.8.6 Check that the axle box can be rotated freely by hand.

The working space for mounting and dismounting of roller bearing must be absolutely clean and the table on which roller bearings are cleaned must be free from iron fillings, dust, etc. Kerosene oil may be used for cleaning the roller bearing and journals. The cleaning bath should be changed every time to keep it free from dust and foreign matter. Steel trays with lids should be used for cleaning roller bearing.

13.8.7 AXLE BOX HOUSING

Double row self-aligning direct mounted spherical roller bearings are housed in accurately machined cast steel axle boxes. The axle boxes are also provided with light alloy front and back covers secured by four bolts. Axle boxes and covers should be thoroughly cleaned and checked for cracks particularly at the bolt holes of the covers which have shown proneness to failures. The bolts should be examined for worn threads, straightness, etc., before reuse and should be well-tightened and locked by spring washers and split pins to ensure that the covers and the axle box housing form a water tight assembly and protect bearing from dust and moisture.

13.8.8 AXLE BOX SPRINGS

Axle box springs are of helical type manufactured as per RDSO specification WD-01-HLS (latest revision/amendment). from centreless ground Chrome Vanadium steel rods. These springs are also shot-peened to obtain high fatigue life. It is necessary to check these springs for cracks and measure their free height to ensure that they meet the design requirements.

All the springs shall be grouped in categories and used on bogies as per instructions detailed in RDSO technical pamphlet no.C-8419 (latest revision/amendment).

For BEML bogie the axle box spring shall be as per BEML drawing No 901-81027.

13.8.9 LOWER SPRING SEAT

Lower spring seat on axle box wing in which, guide bush of dashpot moves up and down does not wear in service. In the absence or inadequate quantity of oil in the dashpot, the inside surface is likely to wear. If the surface is worn more than 0.4mm in diameter or if the surface is scored or otherwise damaged, the lower spring seat should be replaced. All lower spring seats should be carefully checked for cracks before reuse.

13.8.10 DASHPOTS AND AXLE GUIDE ASSEMBLIES

Axle box guides are accurately machined hollow forgings welded to the bogie frame to ensure that the wheels set are rigidly guided in parallel. These guides are fitted with bronze bushes at the lower end to give the close guidance of wheel set both in lateral and longitudinal direction. The lower spring seat is filled with oil and the assembly is sealed with rubber ring to make it oil tight. Holes on the bogie side frame above each guide are provided to top up the damping fluid when required as shown.

13.8.11 Following components which form the dashpot assembly, should be thoroughly examined and renewed as indicated: -

SN	Description of Component	For ICF	For BEML	Renew, if component
1	Guide	EMU/M-0-3-005 (with guide cap) EMU/M-0-3-094 (with circlips	922-83014	Bottom thread worn or cracked at the root of radius.
2	Upper spring seat or protective tube.	EMU/M-0-1-001	EMU/M-0-1-001	Damaged, dented or cracked
3	Dust shield spring	T-0-1-012	T-0-1-012	Distorted or broken or otherwise defective.
4	Dust shield	T-0-1-619	411-81114	Examine at every POH and change if required.
5	Guide ring	T-0-1-640	411-81162	Cracked, broken or worn.
6	Rubber packing ring	T-0-1-632	411-81147	Replace at every POH.
7	Guide bush	EMU/M-0-1-023	EMU/M-0-1-023	Worn out more than 1.2m in diameter.
8	Spring clip	T-0-1-614	411-81160	Distorted or broken.
9	Guide cap	EMU/M-0-1-021	922-83014	Threads damaged or worn,

				holes blocked.

In case of the total diametric clearance more than 1.6mm between the guide bush and the lower spring seat based on maximum bore diameter and minimum bush diameter, the part shall be renewed. These measurements should be taken with micrometer so that clearance can be assessed accurately.

It should be ensured that the spring clip item 8 above, should be made from steel to IS:727 C-60 Gr.3.or Material specification mentioned in respective drawings.

The rubber-packing item 6 (For BEML Bogie) above should be made of acrylonitrile rubber an oil resisting quality of rubber or Material specification mentioned in respective drawings. 5% of the lot received should be tested as follows, before accepting the same for use.

1.8.11.1 **Hardness 80-90 shore A (ASTM D 676-89 T)**

Accelerated ageing test in accordance with ASTM Spec. No. D 573-53. Maintain the ring at 70 degree centigrade for 7 days. The ring should not show more than 10 points increase in hardness.

13.8.11.2 **Oil resistance test:**

This should be carried out in accordance with ASTM-D 471-59 T . A piece of ring when immersed in dashpot oil at 100 degree centigrade for 70 hours shall not show any reduction in volume and increase in volume shall not be more than 10% of the original volume.

The holes in guide caps should be thoroughly cleaned at every POH.

13.8.11.3 Following are the approved brands of oil for use on the dashpot.

Supplier	Brand name	
I.O.C.L.	SERVOLINE	100
H.P.C.L.	YANTROL	100
B.P.C.L.	BHARAT UNIVOL	100

13.8.11.4 Approximately 1.7 liters of oil is required per dashpot. The level of the oil in a dashpot can be ascertained in service by unscrewing the bolt provided for topping oil on bogie frame and using a flexible wire dipstick inserted through the vent hole on bogie frame. The level of oil when vehicle is empty should be 97mm for ICF Bogie 85mm for BEML

Bogie from guide cap inner surface and should be topped up when the level is less than this. It is necessary to ensure that the bolt on leather washer is tightened well to avoid ingress of dust through the hole, which will lead to scoring of dashpot bronze bush. Oil spilt over the dashpot while replenishing should be wiped clean so that the leakage of oil. If any, subsequently may be detected easily.

Hole provided in the vent screw should be blocked and leather washers should be used as permissible alternative to copper asbestos washers.

13.8.12 BOLSTER SPRINGS

(i) The bolster spring shall be as per RDSO specification WD-01-HLS (latest revision/amendment).

(ii) Bolster spring for BEML bogie shall be as per their drawing No 901-82029

13.8.13 SPRING PLANKS (LOWER SPRING BEAM)

All springs planks should be carefully checked for cracks, etc. before reuse.

13.8.14 SHOCK ABSORBERS

Hydraulic shock absorbers which are set to offer resistance of ±600 kg at a speed of 10 cm/sec have been fitted to work in parallel with bolster springs. These shock absorbers normally give trouble free service and require no attention in between two POHs.

However, a shock absorber which is found either leaking or physically damaged should be renewed. As the resistance of these shock absorbers is likely to deteriorate in service. The shock absorbers be got overhauled from their respective manufacturers, tested and renewed as and when required.

13.8.15 RUBBING PLATE

Nylon rubbing plate has to be fitted to the bolster which serves as cushion between the bolster and bogie frame. Initial clearance of 1mm on each side has been provided between the nylon rubbing plate and steel plate. During POH this clearance must be maintained by fitting steel packing of suitable thickness. During service this clearance should not exceed 3mm on each side.

13.8.16 EQUALISING STAYS

Equalising stays connecting the spring plank and bolster, pin jointed at both ends have been provided on these bogies to prevent lateral thrust on bolster springs. It is necessary to remove the pins at every POH, clean and oil them to ensure that they are free to rotate when reassembled, a restricted movement at these joints is likely to prevent free movement of bolster. The free movement of the pins can be ensured by greasing the assembly periodically.

The pins should be provided with washers and split pins to ensure that they do not fall out in service.

13.8.17 CENTRE PIVOT (BEML Bogie)

The centre pivot arrangement is not designed to transmit any vertical load and all that it does is transference of tractive and braking forces.

In case the silent block bush requires removal. It should be removed carefully by means of a Tubular, dolly registering on the outer ring to avoid damage to the rubber bush. Under no circumstances should force be used either on the rubber or on the inner bush for removing silent block bush.

Rubber sealing used on centre pivot should be carefully examined to ensure that it is not torn or perished to avoid foreign matter coming in contact with the silent block bush.

The type of fit as per IS:919 Part 1and Part 2 between the silent block and sleeve is H7-u8 and the tolerance on the pivot pin is c9. This requirement should be met.

Centre pivot is secured to underframe by means of four bolts with nuts and spring washers.

The nuts being tack welded to body bolster .It should be ensured that all bolts are correctly tightened with spring washers.

The silent block sleeve is secured to bogies by means of two studs with nuts and spring washers. It should be ensured that these fasteners are correctly provided.

13.8.18 CENTRE PIVOT (ICF Bogie)

The body bolster of the under frame is provided with a bush of inner Dia 90mm in top and 150mm Dia hole at the bottom and the centre pivot pin, when fitted to the body bolster, perfectly fits into these holes . Any wear due to bogie rotation is taken up by the upper and lower bushes between the centre pivot pin and the bolster. While fitting the centre pivot to body bolster, it should be ensured that:

(i) The clearance between the centre pivot pin and guide bush in the body bolster is H7-e8.

(ii) Centre pivot pin plate has a machined surface so as to bear squarely on the body bolster.

After fitting the pivot pin to the body bolster, there should be no clearance between the centre pivot pin plate and body bolster. The bolts for securing the pivot plate to the body bolster do not transmit any tractive or braking forces. These are meant only for securing the centre pivot while the force from the centre pivot to the body bolster are transmitted through the mating surfaces between pivot pin and body bolster. It is, therefore, extremely essential to ensure that the design clearance between the pivot pin and the body bolster guide bush are maintained. The lower and the upper bushes should be replaced when the total diametrical wear exceed 1mm. Before lowering the centre pivot the bogie bolster, the pivot bearing of the bolster should be filled with 3 litres of oil.

13.8.19 SIDE BEARERS

(i) Side bearers consists of a hard wearing ground steel plate immersed in an oil bath with a floating bronze wearing piece which has a self aligning spherical top surface on which the body rests and transmits the vertical load. The oil well is provided with a cover to prevent ingress of dust. The hard ground plate and the spherical bronze-wearing piece are likely to wear in service.

(ii) The hard ground plate should be renewed when the wear exceeds 1.5 mm i.e. the thickness is less than 8.5 mm or ridges are observed on the plate. The bronze-wearing piece should be renewed when the wear on the mating surface reaches 3 mm i.e. when the height reduces to 42mm or damages occur to the oil grooves. Sharp edges, which are known to develop at the periphery of the wearing piece, are likely to impair lubrication and should be rounded off, if any, before re-using.

(iii) The oil well wall is welded on to bolster. Oil may leak out of the well due to porous welding and the vehicles continue to be in service without oil. Absence of oil, apart from causing excessive wear, leads to undue constraint for bogie rotation on curves and produces screeching noise. It is necessary the porous welds are gouged and rewelded, and the oil well is filled with the requisite quantity of oil. Any of the following oils can be used for the side bearer and the quantity required per side bearer is 2.5 liters.

SUPPLIER	BRAND NAME
1. I.O.C.L.	SERVOLINE 100
2. H.P.C.L.	YANTROL 100
3. B.P.C.L.	BHARAT UNIVOL 100

(iv) It is important to ensure that dust seal cover on the side bearer sits effectively all over without any gap on the oil well and the sleeve slides freely on the guide to ward off dust and moisture coming in contact with the oil.

(v) If side bearers are not properly maintained. It is likely to cause grating noise. It is, therefore, advised that following precaution should be taken during POH in shops.

- The top cover should be properly fitted to the oil container, and the cover sleeve should be able to slide freely on the guide.
- The oil and the sliding surfaces should be free from dust and other contamination.

- The mating surface of the convex bronze bearing piece, and the concave surface of the guide, and the wearing surface of the plate should be smooth and properly bedded together.
- When the oil is contaminated, it should be removed and the housing thoroughly cleaned and 2.5 liters of fresh approved brand of oil should be filled in.
- The bronze wearing piece should be provided with 1 mm. relief over the periphery and the sharp edges of the oil grooves to be rounded off.

13.8.20 ANCHOR LINKS (For BEML Bogie)

(i) Anchor links should be carefully examined for cracks at weld as these have shown proneness to occasional failures. The rubber in silent block should also be carefully examined for deterioration. Appearance of fretting on edges of rubber is an indication of deterioration of rubber. Whenever a silent block is to be replaced. It must be from those that have been duly tested and received from Railway/RDSO approved sources to avoid preloading of the anchor link while assembling on bogie, ensure that the assembly can be done without forcing the link into position. This can be done conveniently after lowering the body on the bogies.

(ii) OHE car should not be permitted to run with broken anchor links as this is the only medium to transfer the draw and braking forces from the body to the bogie and vice versa.

(iii) Test for silent blocs: Five percent of the purchased silent blocs for centre pivot and anchor links should satisfy the following test before accepting the lot.

13.8.21 ANCHOR LINK SILENT BLOCKS

(i) Torsion test: Specimen is held in a specially devised gadget and the pin subjected to torsion until it undergoes a deflection of 8 degrees about the axis of the pin. This test is repeated 10 times on either direction and the load is noted. The silent block bush is considered suitable if this deflection takes place with a torque of 5000 kg cm, and the permanent set is not more than 0.5 degree.

(iii) Side swing: The specimen is held in the above gadget and the torsional force in a plane the axis of the pin is applied. Torque to attain a twist of 8 degrees should be 4000 kg cm and a permanent set of 0.5 degree is acceptable.

(iv) Radial load test: A radial force of 4.5 tonnes is applied and the deflection is noted. A deflection of 1.5 mm has been accepted although 1 mm is considered good.

13.8.22 CENTRE PIVOT SILENT BLOCK

(i) Torsion test: Specimen is held in a specially devised gadget and the inside sleeve subjected to torsion until it undergoes a deflection of 7 degrees about the axis of the sleeve, the silent block is considered suitable if this deflection takes places with a minimum torque of 25000 kg cm.

(ii) Radial load: Max. deflection of 1.5 mm at 9000 kg load.

13.8.23 HANGER AND HANGER BLOCKS

(i) Hanger and hanger blocks for BEML Bogie and ÷ for ICF bogie, should be thoroughly cleaned after dismantling and examined carefully for cracks/wear/and other damages. The extent of permissible wear on these components is indicated below:

Description of component	New size mm	Condemning mm	Wear in mm	Shop issue size mm
Hanger	BEML ICF 384.0 246.0	387.0 249.0	3.0 3.0	386.0 247.5
Hanger block, top and bottom	BEML ICF 9.5 9.5	8.0 8.0	1.5 1.5	8.5 8.5
Pin	BEML ICF 37.0 45.0	35.5 43.5	1.5 1.5	36.0 44.0

(ii) The wear on the hanger cannot be made good by welding as it is made of class-I steel case carborised. The wear on the hanger block can however, be built up by welding with matching electrodes after preheating to 250 Deg C as it is made of class-III steel. The hanger block should then be normalised and machined to the dimensions shown on drawings.

13.8.24 BOGIE BRAKE GEAR

(i) Maximum radial clearance of 1mm between the brake gear pins and bushes is permitted. If the clearance is more the worn out part should be replaced and standard clearance maintained.

(ii) Brake block should be replaced when they wear out to the thickness of 16mm by removing the looped key from the brake head.

(iii) An adjusting palm pull rod with holes at regular intervals is provided in the brake rigging to take up slack in rigging due to wear. Adjusting should be done by relocating the pin in different holes on the palm pull rod.

13.8.25 ACTION TO BE TAKEN BEFORE REASSEMBLING THE BOGIE

After attending to the various components as detailed in Para 13.6 above, the bogie may be reassembled taking into consideration the following aspects. The two wheel and axle sets selected for the bogie should not have variation of more than 5 mm on tread diameter. The difference in tread diameter between wheel sets under two bogies of a coach shall not be more than 13 mm. The axle box spring selected for tower car should be of same group of spring as detailed in C-8419 (latest revision/amendment). The two pairs of axle box springs selected for each axle should not vary in their free height by more than 3 mm and their load deflection characteristics should be as per RDSO specification WD-01- HLS (latest revision/amendment). Wooden packing of requisite thickness to be selected for use on lower spring seat for taking up the wheel wear and maintaining buffer height. Top and bottom rubber pads on the axle box spring should not be used again if they are not in good condition. The two pairs of bolster spring sets selected for bogie shall not vary in free height or more than 3 mm and their load deflection characteristics should be as per RDSO specification WD01 HLS (latest revision/amendment). Mating surfaces of the convex wearing piece and the concave surface of side bearer and the wearing surface of the wearing plate should be smooth and properly bedded.

13.8.26 SEQUENCE OF REASSEMBLING THE BOGIE

Assemble the bogie bolster, spring plank, equalising stays, bolster spring sets, to the bogie frame with the help of a chain and jack. Assemble the roller bearing and axle boxes as detailed and ensure that the bearing is effectively secured. Place axle box helical spring on the lower spring seats with rubber rings and wooden packings and fill in the dashpot with any of the approved brand of oils up to specified levels. Insert rubber pad, upper spring seat, dust shield spring, dust shield, rubber packing ring and guide bush and the axle box guide and lock the bush in the position and ensure that the bush sits tight

against the rubber packing ring and the 2 mm hole in the guide is in alignment with that on the bush via the groove in guide bush. Lower the bogie frame with the bolster assembly on the wheel and axle sets taking care to ensure that all the 8 guide bushes engage in lower spring seat and the bogie frame is set evenly on the 4 axle boxes. Insert the cotter in the centre pivot, then lock it with split pin. After inserting the cotter, fit the bottom centre pivot cover housing. Assemble dynamo belt on non powered bogie. Fit lavatory chute. Engage bolster strap. Engage axle box strap. Connect air hoses connecting brake pipe on underframe to the piping on bogies. Connect parking brake chain. Connect hoses for sanding gear on powered bogie. Connect speedometer cable. Connect earthing cables to axle boxes & under frame.

13.8.27 RUNNING CLEARANCES

After assembling bogie and lowering car body. The clearances between the top of bogie bolster and bottom of bogie frame above bolster springs and the clearance between top of the axle box casting are checked with the dimensions shown in BEML bogie & ICF bogie.

13.8.28 ATTENTION REQUIRED FOR BOGIES ON OPEN LINES (DEPOTS)

Lifting the body of the bogies: Instruction contained in Para 13.4 above should be strictly adhered to while lifting the body off the bogies.

Dismantling of bogies: Instructions contained in Para 13.5 above should be strictly adhered to while dismantling the bogies.

13.8.29 ATTENTION TO THE BOGIE COMPONENTS

Car Depots should not try to weld a damaged axle box guide or replace the same. The bogie should be sent to workshops for welding the guide and checking the alignment. The bogie frame should, however, be checked for cracks, particularly at the bolster suspension brackets and brake block brackets.

The instructions contained in conference Rules, Part-IV for the examination of wheel profile, axle should be strictly adhered to. Wheel sets showing biased flange wear, i.e. one flange wearing faster than the other should be with drawn from service and sent to shops for examination and rectification. OHE CAR have been provided with 16 tonnes and 20 tonnes wheel and axle sets. Which are marked clearly on the wheels. It is important that these wheels are not mixed up with wheel assembly which are used on

other stocks. Maximum permissible flat on wheels of these coaches should be limited to 50mm.

Roller bearing should not be attended to in Car Sheds. All that would be necessary in service is to feel the axle boxes for any tendencies on their part to get overheated. If any axle box shows to tendency to run hot. The wheel set which run hot should be replaced in sicklines and the damaged wheel sets sent to shops for attention.

Four bolts securing the rear and font cover of the axle box shall be examined to ensure correct assembly with spring washer and split pins.

Whenever a spring is to be replaced, it should be done in accordance with RDSO Spring Maintenance Manual No. C-8419 (Latest Revision).

Free height of all the Axle box and bolster springs for OHE CAR should be within the tolerance as shown in C-8419 (Latest Revision).for used spring and as per RDSO Specification No. WD-01-HLS (Latest Revision) for new springs.

Whenever dashpots in primary suspension show signs of oil leakage through sealing rings, the bogie should be lifted and the rubber sealing ring checked and replaced if need be. In the event, the diametrical clearance between the guide bush and the lower spring seat should also be checked and if more than 1.6 mm the components worn out should be replaced.

Level of oil in dashpot should be checked at intervals of one month with the help of a dip stick. It is important that oil level is checked after vehicle has been standing for at least 30 minutes as otherwise froth in dashpot oil formed when the vehicle is running may give wrong indication. The oil level should not be less than 85 mm for BEML Bogie and 97mm for ICF Bogie. from the top surface of the guide cap.

If hydraulic shock absorbers used on secondary suspension show any sign of oil leakage or other damages, the same should be replaced with a shock absorber completely overhauled. For this purpose, the sicklines should maintain " imprest" for use as unit change assemblies. Leaky shock absorbers should be sent to the workshop for overhauling. The shock absorbers should be checked to ensure that four securing studs are properly tight.

The brake blocks should be replaced when worn out to a thickness of 20 mm for BEML bogie and 16mm ICF bogie. The maximum diametrical Clarence between brake pins and bushes should be limited to 2mm.

Oil in the side bearer should be checked at an interval of one month and oil replenished through the side bearer oil filing arrangement. If it is found that the oil leaks through the weld, the weld should be gauged and re-welded properly. The bronze wearing piece and

the hard ground steel plate should be replaced, if need be, i.e. when the bronze piece has worn out by 3 mm or has developed sharp edges. The permissible wear on the steel plate is 1.5 mm. Whenever bogies are run out, a checks as indicated in Para 13.6.15 should be made on side bearers. This will avoid grating noise on curves.

The safety straps for brake beam and equalizing stay should be checked for proper securing arrangement. Straps for the bolster and axle boxes, should be checked for proper securing arrangement. Straps for the bolster and axle boxes should be checked for adequate running clearances. If hard wooden packings are required to be used on lower spring seats for taking up the wheel wear, the packings of proper thickness should be used.

It should be ensured that the screw for the vent hole are properly tightened with leather washer and locked with steel wire. If a silent block is observed to have fretting on edges, whether on anchor link or on centre pivot, it should be removed and replaced with a new one. The securing studs for the anchor link should be examined for proper fastening. The four bolts securing the centre pivot to the under frame should also be examined for proper assembly with spring washer and nuts being tack welded. Under no circumstances wheels which have reached the condemning limit indicated by the grooves on the wheel rims/tyres should be used. OHE CAR should not be allowed to run in service with a broken dashpot or a broken spring. OHE car should be immediately sent to shops/depots for replacing the broken dashpot guides or broken springs. Equalising stays should be carefully examined to ensure the correct assembly with washers and split pins. All welds and the body of the equalising stays should also be examined for cracks. Bogies with bent, cracked or broken stays should not be allowed in service.

Equalising stays have been provided with grease nipples. These should be lubricated periodically to ensure its free movement. The bolster assembly should be examined in position to ensure that the hanger blocks, pins and shackles are in good condition. Dashpots and side bearers of these bogies should be checked for possible oil leaks and in the event of signs of leakage, the level of the oil should be checked and replenished. Before replenishing oil in side bearer a flexible wire 3 mm diameter should be inserted through the hole to ensure that the hole is not blocked.

PART-IV-
OTHERS ITEMS

14 8/10KVA DG -SET MAINTENANCE:

Maintenance of DG set shall be done as per recommended relevant OEM' s maintenance manual.

15 3kVA/5 kVA PORTABLE DG SET CUM WELDING MACHINE:

Maintenance of DG set shall be done as per recommended relevant OEM' s Maintenance Manual.

16 BATTERY CHARGER (110V DC):

Battery charger for charging batteries of 110V, 120Ah capacity Lead Acid Maintenance free storage battery ia provided with Tower Wagon as per RDSO' s Spec. No. RDSO/PE/SPEC/AC/0008 (Rev.2) or latest, Inspect the condition and electrical continuity/output Voltage/LED indication of the Battery charger. Replace if damaged or defective.

- Clean serviceable covers using a cleaning solution suitable for acrylic materials.
- Check the hinged covers of the unit always tightly closed.
- Check HRC fuse links of correct rating.
- Clean the tightness of all connection.
- Clean the heat sinks.
- Cheek the tightness of fixing nuts & bolts of the unit.
- Check the under voltage LED and its input fuse and trip indicator fuse of correct rating..
- Check the Output fuse failure LED indication and its output fuse of correct rating.
- Check output MCCB and replace if defective.
- Maintenance of Battery charger shall be done as per recommended relevant OEM' s Maintenance Manual.

17 PANTOGRAPH MAINTENANCE:

Pantograph maintenance shall be done as per following RDSO maintenance instructions:

SN	SMI No.	Description
(i)	RDSO/ELRS/SMI/64	Static Balancing Procedure For Pantograph Type AM12 and Type AM18

(ii)	RDSO/ELRS/SMI/75	Ensuring Proper Raising and Lowering of Pantograph Type AM12
(iii)	RDSO/ELRS/SMI/192	Periodic Maintenance/Checks For Pantograph AM12 Type And Of Similar Design
(iv)	RDSO/ELRS/SMI/198	Lubrication Schedule for Improving Reliability of Pantograph AM-12 Type and of Similar Design
(v)	RDSO/ELRS/201	Grease Pan for Pantograph Type AM12 or Similar Design
(vi)	RDSO/2007/EL/TC/0094	Components to be Changed During AOH / IOH & POH of Similar Design Pantograph Type AM12, IR 01 and Pan 01.

18 CCTV CAMERA:

- Clean serviceable covers using a cleaning solution suitable for acrylic materials.
- Check the hinged covers of the unit always tightly closed.
- Check the functioning and display. Replace if defective.
- Maintenance of CCTV Camera shall be done as per recommended relevant OEM' s Maintenance Manual.

19 OHE SENSING DEVICE:

Following routine checks are recommended by M/s Samadhan Systems:

i) Sensor Mount with Guard & Cover: No Routine maintenance required. If it is found broken or bent due to any accident, replace it.

ii) Sealed Sensor: No Routine maintenance required. If ever water seeps through, check the O-ring.

iii) Connecting Cable-I: No Routine maintenance required except occasionally checking whether they are broken at any place.

iv) Connecting Cable-II: No Routine maintenance required except occasionally checking whether they are broken at any place.

v) Control cum Power supply unit: No Routine maintenance required.

vi) Display Unit: No Routine maintenance required.

vii) Power Connection Cable: No Routine maintenance required except occasionally checking whether they are broken at any place.

Note: Maintenance of OHE Sensing Device shall be done as per recommended relevant OEM' s Maintenance Manual.

20 CAB HEATERS:

Both the Driver' s Cabs are provided with electrical Heater to keep environment warm during winter season.

- Check the fuse links of correct rating.
- Clean the tightness of all connection.
- Cheek the tightness of fixing nuts & bolts of the unit.
- Check the functioning of temperature setting and different mode of heating, blower .
- Check the coil for heater and replace if defective.
- Maintenance of Cabin Heater shall be done as per recommended relevant OEM' s Maintenance Manual.

21 FLASHER LIGHT:

One Flasher Light each of LED type as per RDSO' s Spec. No. ELRS/SPEC/LFL/0017 (Re.1) Sept., 2004 is provided at either end of Tower Wagons. Maintenance of Flasher light shall be done as per recommended relevant OEM' s Maintenance Manual.

22 TWIN BEAM HEAD LIGHT:

24V, DC operated Twin Beam Head Lights are provided at both ends of Tower Wagon as per RDSO' s Specification No. ELRS/SPEC/PR/0024(Rev-1), Oct. 2004. Maintenance of Head light shall be done as per recommended relevant OEM' s Maintenance Manual.

- Inspect the headlight lens for cracks or chips or damage.
- Replace as necessary. Check the reflector for signs of oxidation, peeling or other damage. Replace sealed beam unit if necessary.
- Check the security of the headlight retaining ring.
- Tighten the knurled knob if necessary. The sealed beam headlights should also be replaced if the lenses are cracked, damaged or chipped.

23 MARKER LIGHT:

Marker Light of LED type (Red Aspect) as per RDSO' s Spec No. ELRS/SPEC/PR/0022 (Rev-1) Oct., 2004 are provided on either end of the Tower Wagon. Maintenance of Marker Light shall be done as per recommended relevant OEMs Maintenance Manual.

- Inspect the lenses for cracks or chips or damage. Replace as necessary. Refer to Marker Light Lens in Section Removal.
- Check the security of the retaining ring.
- If necessary, loosen the setscrew, then tighten the knurled knob. Tighten the setscrew to secure the knurled knob against vibration.

24 HORN:

Two Horns operated with compressed air are provided at the roof with different tones on both sides of Tower Wagon. Maintenance of Horn shall be done as per recommended relevant OEM' s Maintenance Manual.

- Inspect the condition of the horn gasket. Replace if worn, cracked or otherwise damaged.

25 SEARCH LIGHT:

Search Lights of 250 Watts, 24V DC, Metal Halide lamps, one on each end is provided with Tower Wagon for inspection of OHE.

Maintenance of Search light shall be done as per recommended relevant OEM' s Maintenance Manual.

- Inspect the condition of the Search Lights cover. Replace if damaged or defective.
- Check the condition of the rubber gasket, replace if necessary.
- Clean serviceable covers using a cleaning solution suitable for acrylic materials.
- Inspect the condition of the Search Lights gasket. Replace if worn, cracked or otherwise dam□aged.
- Clean the Search Lights lens using a cleaning solution suitable for use on acrylic materials.
- Replace cover if cracked, chipped or otherwise damaged.

26 MOBILE CHARGING:

Four Mobile charging points one in each staff cabins and both the driver' s cabs are provided with Tower Wagon as per RDSO approved source, Maintenance of Mobile charging shall be done as per recommended relevant OEM' s Maintenance Manual.

- Inspect the condition and electrical continuity/output Voltage/LED indication of the Mobile charging points. Replace if damaged or defective.
- Check the condition of the rubber gasket, replace if necessary.
- Clean serviceable covers using a cleaning solution suitable for acrylic materials.

PART-V

27. List of " Must Change Items during POH" for 8-Wheeler Tower Wagon

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
1	Traction Motor and Gear case/Transmission		
i)	Gear case	To be replaced on condition basis	To be replaced
ii)	Gear case oil and oil seal	To be replaced	To be replaced
iii)	Gear case bearing along with associate components	To be replaced on condition basis	To be replaced on condition basis
iv)	Suspension bearing (taper roller /plain sleeve) along with lubricating pad assembly	Remetalling/ Replacement on condition basis *(lubricating pad assembly- replacement during every POH)*	Remetalling/ Replacement on condition basis *(lubricating pad assembly- replacement during every POH)*
v)	Taper Roller bearing Unit	To be replaced on condition basis	To be replaced
vi)	Gearbox oil seal / ' O' rings	To be replaced	To be replaced
vii)	All gear case fasteners and TM fixing bolts.	To be replaced on condition basis	To be replaced
viii)	Drain plug washer and oil filling plug washer	To be replaced	To be replaced
ix)	Replacement of Felt and Cardium compound	To be replaced	To be replaced
x)	Gauge glass oil seal	To be replaced	To be replaced
xi)	TM support arm, Gear case support arm & Axle guide rod	To be replaced on condition basis	To be replaced on condition basis
xii)	Traction Motor bellow	To be replaced	To be replaced
xiii)	TM Filter element	To be replaced	To be replaced
xiv)	Set of bearing cartridge wiper with cover	To be replaced on condition basis	To be replaced on condition basis
xv)	Traction Motor pinion	To be replaced	To be replaced
xvi)	TM suspension tube bolt	To be replaced on condition basis	To be replaced
xvii)	PE end bearing	To be replaced	To be replaced
xviii)	CE end bearing	To be replaced	To be replaced
xix)	TM end shield	To be replaced on condition basis	To be replaced on condition basis
xx)	Flex plates	To be replaced on condition basis	To be replaced on condition basis

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
xxi)	Pressure cleaning, Greasing and Oil	To be replaced	To be replaced
xxii)	Brush holder assembly of TM	To be replaced on condition basis	To be replaced on condition basis
xxiii)	All carbon brushes liners, gaskets, inspection cover gasket, needle roller bearings of TM	To be replaced	To be replaced
xxiv)	Teflon ring of armature/PTFE/armature Teflon band	To be replaced	To be replaced
xxv)	Insulating rod	To be replaced on condition basis	To be replaced
xxvi)	Pinion and gear wheel	To be replaced on condition basis	To be replaced on condition basis
xxvii)	TM cables	To be replaced on condition basis	To be replaced on condition basis
2	**Wheel items**		
i)	Axle box bearing, MSU & its bearings, (DE & NDE side) MSU bolts, Axle lubricating assembly, axle shield, Axle box complete	To be replaced on condition basis	To be replaced on condition basis
ii)	Axle box ' O' ring and cover bolts	To be replaced	To be replaced
iii)	UT of wheel & Axle	To be done	To be done
iv)	Wheel turning	To be done	To be done
v)	Diameter, wheel to wheel distance, root wear, flange wear, sharp flange, hallow tyre.	All measurements to be taken & decision to be taken based on condition	All measurements to be taken & decision to be taken based on condition
3	**Pantograph**		
i)	Bow assembly with plunger	To be replaced on condition basis	To be replaced
ii)	Other items as per TC-94	To be replaced	To be replaced
iii)	Joint perfect (rubber for panto)	To be replaced	To be replaced
iv)	Overhauling kit of panto (rubber items)	To be replaced	To be replaced
v)	Overhauling kit for panto valve	To be replaced	To be replaced
vi)	Long & short shunt	To be replaced	To be replaced
vii)	Torque mounting assembly	To be replaced	To be replaced

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
viii)	Bearing for yoke assembly	To be replaced	To be replaced
ix)	Plunger box assembly	To be replaced	To be replaced
x)	Metalized Carbon strip/panto strip	To be replaced	To be replaced
xi)	Servomotor piston packing ring	To be replaced	To be replaced
xii)	Servomotor Throttle switch	To be replaced on condition basis	To be replaced on condition basis
xiii)	Bearing for pedestal, push rod, lower & middle articulation	To be replaced on condition basis	To be replaced on condition basis
xiv)	Foot insulator	To be replaced on condition basis	To be replaced on condition basis
xv)	Latching spring for panto valve	To be replaced on condition basis	To be replaced on condition basis
xvi)	Top mounting sub-assembly part A&B	To be replaced on condition basis	To be replaced on condition basis
xvii)	Bearing for yoke assembly	To be replaced on condition basis	To be replaced on condition basis
xviii)	Plunger box assembly for panto	To be replaced on condition basis	To be replaced on condition basis
xix)	Marking on pantograph (for stagger measurement)	To be replaced	To be replaced
4	**Rectifier and all Damping circuit**		
i)	Capacitors and resistors of RC network of Power Rectifier (as per OEMs manuals)	To be replaced on condition basis (to be measured by meter)	To be replaced
ii)	Other Damping/snubber Capacitors of control circuit/Relays other than in Power Rectifier (as per OEMs manuals)	To be replaced on condition basis (to be checked by multimeter)	To be replaced
iii)	Diodes, fuses & bus-bars	To be replaced on condition basis	To be replaced on condition basis
iv)	CT, PT	To be replaced on condition basis	To be replaced on condition basis
v)	Rectifier blowers	To be replaced on condition basis	To be replaced on condition basis
5	**Traction Alternator**		
i)	Bearing assembly, greasing	To be replaced	To be replaced
ii)	Fan, flex plate, fixing bolts	To be replaced on condition basis	To be replaced on condition basis

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
6	Roof		
i)	Twin beam Headlight Reflector with holder, gaskets & bulbs	To be replaced	To be replaced
ii)	Search Light Reflector with holder, gaskets & bulbs along with its swiveling motor	To be replaced on condition basis	To be replaced
iii)	Industrial Sockets (4 Nos.) and its switches/MCBs provided on Roof	To be replaced	To be replaced
iv)	Two pneumatic points for connecting pneumatic driven tools (its cock)	To be replaced	To be replaced
v)	OHE Voltage Sensing Device (as per OEMs manual)	To be replaced on condition basis	To be replaced
vi)	CCTV Camera system (as per OEMs manual)	To be replaced on condition basis	To be replaced
vii)	Fog light (if applicable)	To be replaced	To be replaced
viii)	Roof Mounted Radiator, hoses, Fan motors (as per OEMs manual)	To be replaced on condition basis	To be replaced on condition basis
ix)	Radiator AVM pads, Water pump belts, rubber sleeves, dresser coupler	To be replaced	To be replaced
7	Driving Cab		
i)	BL Box complete with switches	To be replaced on condition basis and Limit switches to be replaced in every POH	To be replaced on condition basis and Limit switches to be replaced in every POH
ii)	A9 valve, SA-9 valves, D-1 Emergency valves	To be replaced on condition basis. (Rubber kit & spring kit to be replaced).	To be replaced
iii)	Cab fans	To be replaced on condition basis. (Fan bearing to be replaced).	To be replaced
iv)	Cab Heaters (as per OEMs manual)	To be replaced on condition basis	To be replaced
v)	Cab window assembly complete	To be replaced on condition basis	To be replaced
vi)	All gauges, meters, indication panel & light fittings	To be replaced on condition basis	To be replaced
vii)	Master Controller (Cam switches) & rollers	To be replaced on condition basis. Fixed contact finger, moving contact, spring, must be replaced in each POH. Cam switch, contact screw, stem valve	To be replaced on condition basis. Fixed contact finger, moving contact, spring, must be replaced in each POH. Cam switch, contact screw, stem valve

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
		must be replaced on condition basis in POH	must be replaced on condition basis in POH
viii)	Throttle switch (for DHTC)	To be replaced	To be replaced
ix)	Throttle switch (for DETC)	To be replaced (pneumatic pressure valve of Master controller to be replaced)	To be replaced (pneumatic pressure valve of Master controller to be replaced)
x)	Driver Control Switch (DCS)	To be replaced on condition basis	To be replaced on condition basis
xi)	DC-DC Converter (if applicable)	To be replaced on condition basis	To be replaced
xii)	Flasher light unit & Lamp box.	To be replaced	To be replaced
xiii)	Marker Light, Tail Light	To be replaced	To be replaced
xiv)	All Push buttons	To be replaced on condition basis	To be replaced
xv)	All Control Relay and Earth Fault Relay	To be replaced on condition basis	To be replaced
xvi)	Time delay relay timer	To be replaced on condition basis	To be replaced
xvii)	All MCBs	To be replaced on condition basis	To be replaced
xviii)	All voltmeters, Ammeters and Shunt (including TM Ammeter and Load Ammeter)	To be replaced on condition basis	To be replaced
xix)	All Switches on Control Cubicle and Driver Desk	To be replaced on condition basis	To be replaced
xx)	Indication panel/Indication Lamps	To be replaced on condition basis	To be replaced
xxi)	VCD (as per OEMs manual)	Foot switch and push button to be replaced.	To be replaced
xxii)	**Speedometer** (following items are to be replaced as mentioned below. Other items which are not mentioned here shall be replaced as recommended in OEMs manual)		
a)	Indicator unit & recorder unit and Pulse Generator (PG)	Overhauling to be done and to be replaced on condition basis	To be replaced
b)	Oil seal gasket of PG	To be replaced	To be replaced
c)	Sensor of PG	To be replaced on condition basis	To be replaced
d)	Junction Box and interconnecting cables	To be replaced on condition basis	To be replaced
e)	Speedometer Unit	To be replaced on condition basis	To be replaced
xxiii)	LCC governor card of engine	To be replaced on condition basis	To be replaced on condition basis

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
		(Replace, if not proper functioning)	(Replace, if not proper functioning)
8	On-Board, Brake system and Other Items		
i)	Pressure switches and air flow relays-micro switch and diaphragm and Auxiliary Switches & Governor	To be replaced on condition basis	To be replaced on condition basis
ii)	All NR valves,	To be replaced on condition basis	To be replaced on condition basis
iii)	TM Filter and air intake Filter of engine and DG Set	To be replaced	To be replaced
iv)	TM cable cleats	To be replaced	To be replaced
v)	All switches including rotary switches/selector switch, toggle switch & fuses	To be replaced on condition basis	To be replaced
vi)	All gauges and meters	To be replaced on condition basis	To be replaced
vii)	Tri-plate panel, all valves rubber components, all valves base gasket, O-ring between plates, valves and pressure switches (Overhauling kit as per OEMs instruction)	To be replaced on condition basis (As per OEM instructions). Blowing of the connection ports with dry compressed air & cleaning with kerosene to be done.	To be replaced on condition basis (As per OEM instructions). Blowing of the connection ports with dry compressed air & cleaning with kerosene to be done.
viii)	Auto Drain Valve	To be overhauled. Rubber kit to be replaced.	To be overhauled. Rubber kit to be replaced.
ix)	Unloader valve (integrated with engine, in case of 8W-DHTC)	To be overhauled. Rubber kit to be replaced.	To be overhauled. Rubber kit to be replaced.
x)	Safety Valve	To be replaced on condition basis	To be replaced on condition basis
xi)	Emergency Valve	To be replaced on condition basis	To be replaced on condition basis
xii)	Solenoid Valve	To be replaced on condition basis	To be replaced on condition basis
xiii)	NRV & check valve	To be replaced on condition basis	To be replaced on condition basis
xiv)	Magnetic valves-Rubber kits	To be replaced	To be replaced
xv)	Various ball type isolating cocks, check valve, pressure cut out switch etc. Duplex valve, angle cock, drain cock	To be replaced on condition basis	To be replaced on condition basis
xvi)	Direction Cylinder (in case of DHTC, mounted on Hydraulic transmission)	To be replaced on condition basis	To be replaced on condition basis
xvii)	MR & other auxiliary reservoir	Painting to be done	Painting to be done
xviii)	Air treatment (filter, regulator cum regulator in DHTC)	To be replaced on condition basis	To be replaced on condition basis

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
xix)	Nylon filter elements	To be replaced	To be replaced
xx)	All filter elements of pneumatic circuit	To be replaced	To be replaced
xxi)	Rubber braided hose	To be replaced	To be replaced
xxii)	Main Reservoirs and Aux reservoir units	To be replaced on condition basis	To be replaced on condition basis
xxiii)	Main Reservoirs and Aux reservoir units-Fasteners	To be replaced	To be replaced
xxiv)	Governor	To be replaced on condition basis	To be replaced on condition basis
xxv)	All pneumatic gauges (including MR, BC, BP, FP, PB etc.)	To be replaced on condition basis (in IOH and POH)	To be replaced on condition basis
xxvi)	BC (Brake Cylinder)	Overhauling to be done	Overhauling to be done
	BC (Brake Cylinder) parts: Piston, piston packing ring, brass bush, dust excluder, Jubilee clamp (2" & 4) and spring, pawl, Cir clip, to be replaced	To be replaced	To be replaced
xxvii)	Gasket for centrifugal dirt collector	To be replaced	To be replaced
xxviii)	Parking Brake manual switch	To be replaced	To be replaced
xxix)	Parking Brake Cylinder	Overhauling to be done. (piston ring and spring kit to be replaced)	Overhauling to be done. (piston ring and spring kit to be replaced)
xxx)	Plunger rod, Tie rod, Shims, brake linkages, thread brake unit, Parking brake units, Hangers, Gear pins, brake levers	To be replaced on condition basis	To be replaced on condition basis
xxxi)	Sealing washers for air vent screw	To be replaced	To be replaced
	All brake rigging bushes	To be replaced	To be replaced
xxxii)	Throttle valve	To be replaced on condition basis	To be replaced on condition basis
xxxiii)	Magnet valve	Overhauling to be done	Overhauling to be done
xxxiv)	Magnet valve parts: Rubber kit	To be replaced	To be replaced
xxxv)	Deadman valve	Overhauling to be done	Overhauling to be done
xxxvi)	Deadman valve - Overhauling to be done	To be replaced	To be replaced
xxxvii)	DV (Distributor valve), C3W valve	Overhauling to be done and Item kit to be replaced	Overhauling to be done and Item kit to be replaced
xxxviii)	C2W – Relay valve	Overhauling to be done and rubber kit & spring kit to be replaced	Overhauling to be done and rubber kit & spring kit to be replaced
xxxix)	Reducing valves, bi-directional valves	Overhauling to be done and rubber kit &	Overhauling to be done and rubber kit &

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
		spring kit to be replaced. Valves may be replaced on condition basis.	spring kit to be replaced Valves may be replaced on condition basis.
xxxx)	Auxiliary contactors for EP contactors with power contact tips, all insulators and hardware' s including square head bolt.	To be replaced Tip and finger must be replaced	To be replaced
xxxxi)	Electro-pneumatic contactor (in MSGC)	To be replaced on condition basis and gasket to be changed Power contractor pair, Gasket, gyco washer, stem, stem valve to be replaced	To be replaced on condition basis and gasket to be changed Power contractor pair, Gasket, gyco washer, stem, stem valve to be replaced
xxxxii)	**Reverser** a) Fork & all Dowel Pins b) Servomotor Piston Bucket, Gasket Piston Bucket & Felt Ring c) Finger & Drum Contacts with brass ball. d) Aux Switches e) Notching Lever Complete	To be replaced on condition basis. Gasket, gyco washer, finger contactor, stem, stem valve to be replaced.	To be replaced on condition basis. Gasket, gyco washer, finger contactor, stem, stem valve to be replaced.
	f) Valve spring for magnetic valve, reverser	To be replaced	To be replaced
	g) Piston pack ring for motor contactor & overload relay	To be replaced	To be replaced
	h) Cap for magnetic valve for motor contactors and overload relay	To be replaced on condition basis.	To be replaced on condition basis.
	i) Finger assembly complete for Auxiliary motor contactor	To be replaced	To be replaced
	j) Valve stem for reverser and contactor	To be replaced	To be replaced
	k) Contact screw for notching relay	To be replaced	To be replaced
	l) Bottom valve (poppet valve) for reverser and contactor	To be replaced	To be replaced
xxxxiii)	Contactor and its solenoid coil of excitation control	To be replaced on condition basis.	To be replaced
9	**Air dryer**		
i)	Overhauling kit of air dryer. (As per OEM' s manual, make wise)	Overhauling and replacement of item Kit as per OEM	Overhauling and replacement of item Kit as per OEM
ii)	Body connector male & female	To be replaced on condition basis	To be replaced

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
10	**Under frame**		
i)	Battery 24V Lead Acid (LMLA) and 110V VRLA	To be replaced on condition basis (if not replaced during last IOH/or 4.5-years), codal life of battery 4.5 yrs, check with the lug date and replace if life is over	To be replaced on condition basis (if not replaced during last IOH/or 4.5-years) codal life of battery 4.5 yrs, check with the lug date and replace if life is over
ii)	All fasteners of battery boxes and its sling/rope	To be replaced	To be replaced
iii)	Replacement of Vertical/horizontal dampers	To be replaced	To be replaced
iv)	Battery Box and Unit	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
v)	Battery charger, auxiliary alternator, Diesel generators	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
vi)	**Sanding equipment**		
a)	Sand in all sand boxes	To be replaced	To be replaced
b)	Sander hosepipe and seal/rubber in the sand box lids	To be replaced	To be replaced
vii)	Sole bar, body pillars, trough floor, lifting & AVM pads	To be replaced on condition basis	To be replaced on condition basis
viii)	Head stock draw gear, buffer gear and running gear	To be replaced on condition basis	To be replaced on condition basis
11	**Bogie and Bogie Frame**		
i)	Axle box spring	To be replaced on condition basis	To be replaced on condition basis
ii)	Guide bush for axle guide	To be replaced	To be replaced
iii)	Nylon rubbing plate	To be replaced	To be replaced
iv)	Hanger for Bolster suspension and Hanger block	To be replaced on condition basis	To be replaced on condition basis
v)	Bogie DPT	To be replaced	To be replaced
vi)	Tramelling	To be replaced	To be replaced
vii)	Dust guard	To be replaced	To be replaced
viii)	Shock absorber	To be replaced	To be replaced
ix)	Suspension bearing	To be replaced	To be replaced
x)	Silent block for anchor link	To be replaced	To be replaced

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
xi)	Silent block for Centre pivot	To be replaced	To be replaced
xii)	All split pins	To be replaced	To be replaced
xiii)	All bulb cotters	To be replaced	To be replaced
xiv)	BMBC nuts	To be replaced	To be replaced
xv)	Wire rope nuts	To be replaced	To be replaced
xvi)	Cir clips	To be replaced	To be replaced
xvii)	Centre Pivot Bolts nuts	To be replaced	To be replaced
xviii)	Safety slings	To be replaced on condition basis	To be replaced on condition basis
xix)	Spring seat & equalizer of trimount bogie	To be replaced	To be replaced
xx)	Lower rubber washer	To be replaced	To be replaced
xxi)	Replacement of equalizer & compensating beam, pin, bushes, modified centre block, side bearer, D-shackle (high adhesion bogie), tie rod for equalizer, snubbers, split cotters	To be replaced on condition basis	To be replaced on condition basis
xxii)	Complete brake rigging along with pins, pads, bushes & fasteners	To be replaced	To be replaced
xxiii)	All rubber components and fasteners on the bogie	To be replaced	To be replaced
xxiv)	Wearing plate, all, oil seal felts, pins, bushes, high tensile fasteners of bogie & axle box etc.	To be replaced	To be replaced
xxv)	Foot step assembly	To be replaced	To be replaced
xxvi)	The hoses between – a) the bogie frame connection and the brake cylinders and b) the TW under frame and bogie	To be replaced	To be replaced
xxvii)	Replacement of Brake hanger	To be replaced on condition basis	To be replaced on condition basis
xxviii)	Brake beam hanger inner	To be replaced on condition basis	To be replaced on condition basis
xxix)	Brake beam	To be replaced	To be replaced
xxx)	Replacement of safety sling of brake hanger	To be replaced on condition basis	To be replaced on condition basis
xxxi)	Outer & inner straps, Conical thrust pad, Hanger pin, Bush, Brake head spring, brake hanger, happy pad	To be replaced on condition basis	To be replaced on condition basis

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
12	**Bogie and Running Gear:**		
a.	**Primary Suspension (Coil Spring)**		
i)	All Primary Suspension springs	To be replaced on condition basis	To be replaced on condition basis
ii)	Dampers	To be replaced on condition basis	To be replaced on condition basis
iii)	The lateral bump stops	To be replaced on condition basis	To be replaced on condition basis
iv)	Insulating bases of primary suspension	To be replaced	To be replaced
b.	**Secondary Suspension (coil spring)**		
i)	All Secondary Suspension springs	To be replaced on condition basis	To be replaced
ii)	Dampers	To be replaced on condition basis	To be replaced
iii)	The lateral bump stops	To be replaced	To be replaced
iv)	Insulating bases of secondary suspension	To be replaced	To be replaced
c.	**Secondary Suspension (Air Spring Suspension)**		
i)	All rubber components of suspension arrangement	To be replaced	To be replaced
ii)	All Limiting valves, sensors and proximity switches	To be replaced	To be replaced
iii)	Pressure switches/sensor for Air spring failure indication	To be replaced	To be replaced
iv)	Air Spring Suspension (as per OEM manual)	To be replaced on condition basis	To be replaced on condition basis
13	**General**		
i)	All perishable items like rubber gaskets/rubber components, rubber washer, rubber grommets, felts, rubber pipes, hoses, rubberized cork sheets, oil seals etc.	To be replaced	To be replaced
ii)	Brake block, cotters, mounting fasteners, carbon brushes, silica gel, grease nipple.	To be replaced	To be replaced
iii)	All oil and greases	To be replaced	To be replaced
iv)	Replacement of filters, Dust collector, stainer, filter, gasket	To be replaced	To be replaced
v)	All type of washers, spring washers etc.	To be replaced	To be replaced

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
vi)	Various ball type isolating cocks, check valve, pressure cut out switch etc.	To be replaced on condition basis	To be replaced
vii)	A9 & SA9 pipe line	To be replaced on condition basis	To be replaced on condition basis
viii)	Under water Spray testing for roof leakage after POH	To be done	To be done
ix)	Mirror provided in Toilet/bathroom	To be replaced	To be replaced
x)	Water Tap in Toilet/bathroom/kitchen	To be replaced on condition basis	To be replaced on condition basis
xi)	Water pump, Turbo charger, Fuel pump of engine (as per OEMs manual)	To be replaced on condition basis (as per OEMs manual)	To be replaced on condition basis (as per OEMs manual)
xii)	All rubber items of DHTC Transmission	To be replaced	To be replaced
xiii)	Hydraulic switch absorber and rubber hoses (breaded or non-breaded)	To be replaced	To be replaced
xiv)	Lavatory overhead tank	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
xv)	Toilet/Lavatory	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
xvi)	Fuel tank	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
xvii)	Fuel line and Hydraulic hoses	To be replaced	To be replaced
14	**Electrical items**		
i)	Fans and its components	To be replaced on condition basis	To be replaced
ii)	Fans bearing	To be replaced	To be replaced
iii)	Light fittings	To be replaced (preferably LED type)	To be replaced
iv)	Light Switches & Fan Switches	To be replaced on condition basis	To be replaced on condition basis
v)	Cables/ Wiring (including Control Cables and Power Cables) (as per OEMs manual)	To be replaced on condition basis (Control circuit wiring to be replaced Power circuit wiring Light and fan wiring on condition basis)	To be replaced on condition basis (Control circuit wiring to be replaced Power circuit wiring Light and fan wiring on condition basis)
vi)	Junction box, terminal box	To be replaced on condition basis	To be replaced on condition basis
vii)	WRA Motor	To be replaced	To be replaced

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
viii)	Engine control wiring	To be replaced	To be replaced
ix)	Engine mounted self-starter	To be replaced on condition basis	To be replaced on condition basis
x)	24V Engine mounted charging Alternator	To be replaced on condition basis	To be replaced on condition basis
xi)	Auxiliary Alternator & RRU (as per OEM)	To be replaced on condition basis	To be replaced on condition basis
xii)	Knife Switch for 24V and Rotary Switch for 110V and fuses.	To be replaced on condition basis	To be replaced
xiii)	Mobile charging points/socket	To be replaced on condition basis	To be replaced on condition basis
xiv)	OHE sensing Device (as per OEM recommendation)	To be replaced on condition basis	To be replaced (if not replaced during first POH)
xv)	24V Alternator	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
xvi)	24V, Self-starter motor	To be replaced on condition basis as per codal life.	To be replaced on condition basis as per codal life.
15	**Tower Wagon Body:** PU painting of Tower Wagon	To be done	To be done
16	**Exterior:** Seals involved in fitment of side body and roof filters	To be replaced	To be replaced
17	**Draft gear & couplers**		
i)	Complete CBC assembly including Draft gear	To be replaced on condition basis	To be replaced
ii)	Transition coupling	To be replaced on condition basis	To be replaced
iii)	Knuckle, clevis, clevis pin and yoke pin	To be replaced on condition basis	To be replaced
iv)	Striker block wear plate.	To be replaced	To be replaced
v)	Polymide bush for coupler	To be replaced	To be replaced
vi)	Sliding plate for coupler	To be replaced on condition basis	To be replaced on condition basis
18	**Buffers**		
i)	Buffers along with fasteners/fixing bolts	To be replaced on condition basis	To be replaced
ii)	All rubber rings.	To be replaced	To be replaced
19	**Cattle guard**		
i)	Cattle guard along with its hardware	To be replaced on condition basis	To be replaced
20	**Doors and steps**		
i)	Door seals	To be replaced	To be replaced

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
ii)	Door locks	To be replaced	To be replaced
iii)	Hinges of all doors	To be replaced	To be replaced
iv)	Doors	To be replaced on condition basis	To be replaced on condition basis
21	**Washer and Wipers**		
i)	Wiper assembly & wiper motor, wiper arm, pneumatic end, wiper blade and idler shaft assembly.	Overhauling & replacement on condition basis. Arm blade assembly to be replaced.	Overhauling & replacement on condition basis. Arm blade assembly to be replaced.
22	**Wind screen and windows**		
i)	Front lookout glass.	To be replaced	To be replaced
ii)	Seals of cab windows, side windows, Wind screen shield, and rubber flap on the cab side window drainage channel outlet.	To be replaced	To be replaced
iii)	All rubber components	To be replaced	To be replaced
23	**Horn**	To be replaced	To be replaced
i)	Horn gasket and other rubber parts of Horn.	To be replaced	To be replaced
ii)	Diaphragm for horns with horn valve	To be replaced	To be replaced
24	**Interior - Driver Seat & berth seats**		
i)	The seat cover and cushion & resin of driver seat and berth seats	To be replaced	To be replaced
ii)	Driver seat and Asstt. Driver seat	To be replaced	To be replaced
25	**Hydraulic Transmission**		
i)	Oil and filters	To be replaced	To be replaced
ii)	Transmission Oil Cooler	To be replaced on condition basis	To be replaced
iii)	Associated mountings	To be replaced	To be replaced
iv)	Manual selector valve	To be replaced	To be replaced
v)	Torque arm assembly	To be replaced on condition basis	To be replaced
vi)	Fasteners, springs, bushes, spherical joints, Cir clips and split pins	To be replaced	To be replaced
vii)	Pressure hoses	To be replaced	To be replaced
viii)	Return Hoses	To be replaced	To be replaced
ix)	O' ring and gaskets	To be replaced	To be replaced
26	**Cardan Shaft & Axle drive unit**		
i)	Nut and bolt	To be replaced	To be replaced

S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
ii)	Powered axle gear box unit	To be replaced	To be replaced
iii)	Axle drive Oil	To be replaced on condition basis (Replacement based on oil viscosity & colour)	To be replaced
iv)	Oil strainer in axle drive unit	To be replaced	To be replaced

Note:

1. As the above list of Must change items is not exhaustive, sheds/workshops may consider left out items if any for their replacement based on their local conditions.
2. Before allowing old items into service, healthiness and intactness should be ensured by conducting necessary tests/checks and should be mentioned in the booklet issued by the POH shops to sheds.
3. Further, POH items shall be replaced in POH as mentioned above. Other items which are not mentioned (for AOH/IOH also) shall be replaced as recommended in OEMs manual.

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Annexure-01

Correction slip no. 3 for Para 20317(2) of ACTM Volume-2 Part-I dated 17.08.2023

आज़ादी का अमृत महोत्सव

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAILWAY BOARD

No. 2006/Elect(G)/170/2/Pt-II E-3422660 New Delhi, Dated: 17.08.2023

The General Manager
All Indian Railways including Metro Railway/Kolkata, CORE/Prayagraj, ICF/Chennai, CLW/Chittaranjan, RCF/Kapurthala, MCF/Raebareli, DLW/Varanasi, RWF/Bangalore

The Chief Administrative Officers,
DMW/Patiala, RWP/Bela

Director General,
RDSO/ Lucknow and NAIR, Vadodara.

Chief Commissioner of Railway Safety, Lucknow
CRS/ Northern Circle/ Central Circle/ Eastern Circle/ Southern Circle/ South Central Circle/ South Eastern Circle/ Western Circle.

Commissioner of Metro Railway Safety/Delhi

Director General/Director,
IRIEEN, Nasik and Indian Railway Centre for Advance Maintenance Technology, Gwalior

Chairman & Managing Director,
RVNL, DFCCIL, MRVC, IRCON, RITES, PGCIL, New Delhi.

Sub: Advance Correction Slip No. 3 to Railway Manual of AC traction (ACTM) Vol. II Part I, Para 20317 (2) with regard to Periodicity of TXR inspection for Tower wagon.

Please find enclosed herewith the Advance Correction slip No. 3 (Modification/Revision) of Railways Manual of AC Traction (ACTM) Vol. II Part I, Para 20317 (2) with regard to Periodicity of TXR inspection for Tower wagons for your information and necessary action.

This issues with the approval of Board (M/T&RS)

17.08.23

(Nisha Manohar Patil)
Director Elect. Engg. (PS)
Phone: 011-47845419
Email- rbelectricaleem@gmail.com

Copy to : PPS to M/TRS, PPS to M/Infra, PPS to MST, PPS to AM/RE, PPS to AM/Traction, PPS to AM/CE, PPS to AM/Signal, PED/Safety, PED/Vig, PEDEE(RS), PED/GS, ED(GS)/Elect, PEDEE(Dev.), EDEE/G, EDCE(G), DEE(RS), DEE(G), Director (GS)/Electrical, Director(Safety), PCEE/All Zonal Railways & PUs, CAO/CORE/ALD, PED/TI/RDSO, RB(Library).

File No: 2006/Elect(G)/170/2/Pt-II

ACTM Correction slip no. 03 dated 17.08.2023

SN	ACTM Para No.	Existing Details	Recommendation of Committee Modified Para
1.	20317	2. A monthly mechanical inspection of the bogies and running gear of each OHE Inspection car(Tower wagon) shall be done by a nominated supervisor of electrical department(Electric Loco Shed or diesel Loco shed or Electrical supervisor who has been trained to check all issues related to safe to run examination)/TXR of the Mechanical Department, headquartered close to the OHE depot where the car is normally stabled. For each car on a Zonal Railway, the nominated supervisor of electrical department (Electric Loco Shed or diesel Loco shed or Electrical supervisor who has been trained to check all issues related to safe to run examination) /TXR responsible for monthly mechanical inspection will be nominated by PCEE/PCME respectively clearly laying down his duties.	2. A periodic (45 days/4500km, whichever is earlier) inspection of the bogies and running gear of each OHE Inspection Car (Tower Wagon) shall be done by a nominated supervisor of nearest Electric Loco shed or Diesel Loco Shed or EMU/MEMU Car Shed or Diesel/Electric Loco Trip Shed who has been trained to check all issues related to safe to run examination/C&W depot supervisor of the Mechanical Department, headquartered close to the OHE depot where the OHE Inspection Car is normally stabled. For each OHE Inspection Car (Tower Wagon) on a Zonal Railway, the Supervisor of nearest Electric Loco shed or Diesel Loco Shed or EMU/MEMU Car Shed or Diesel/Electric Loco Trip Shed who has been trained to check all issues related to safe to run examination/C&W depot supervisor responsible for Periodic mechanical inspection will be nominated by PCEE/PCME respectively clearly laying down his duties and a joint circular to this effect to be issued by PCME & PCEE ".
		The SSE/JE(TRD) in charge of the car will advise the nominated supervisor of electrical department(Electric Loco Shed or diesel Loco shed or Electrical supervisor who has been trained to check all issues related to safe to run examination)/TXR concerned the date on which it is required to be inspected and running repairs carried out. Such advise shall be given at least 48 h. in advance. SSE/JE(OHE) should ensure that this monthly advise is issued regularly and the car is offered for inspection and attended to every month. The nominated supervisor of electrical department(Electric Loco Shed or diesel Loco shed or Electrical supervisor who has been trained to	"The SSE (OHE) in - charge of the OHE Inspection Car will advise the nominated Supervisor of nearest Electric Loco shed or Diesel Loco Shed or EMU/MEMU Car Shed or Diesel/Electric Loco Trip Shed who has been trained to check all issues related to safe to run examination/C&W depot supervisor of the Mechanical Department concerned, the date on which Tower Wagon (OHE Inspection Car) is required to be inspected and running repairs carried out. Such advice shall be given at least 48 hrs. in advance. SSE (OHE) in - charge should ensure that this periodic inspection (45 days/4500km, whichever is earlier) advice is issued regularly and the OHE Inspection Car is offered for inspection and attended. The nominated

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

Annexure-2

List of proposed diesel shed nominated by Zonal Railways for carrying out IOH/POH of Tower Wagon

S.N.	Railways	Nominated Diesel loco shed for POH	Reference letter No.
1.	Central Railway	EMU POH workshop, Sanpada, Mumbai (CR), Electric Loco Workshop, BSL (CR), Diesel Loco shed, Pune(CR), Kurduwadi Wagon Workshop(CR), Motigag Workshop, NGP (SECR)	L.574.TRD.Veh.Maint, dated 17.10.2023
2.	Eastern Railway	Andal Diesel Shed	EL/92/25/POH(8W& 4W), dated 23.04.2021
3.	East Central Railway	Samstipur Diesel shed	ECR/ELD/500/05, dated 23.12.2020
4.	East Coast Railway	For 4W- Kharagpur workshop of SER For 8W-Katachrapara workshop of ER.	No. EcoR/EL/TRD/443/48, dated 28.12.2020
5.	Northern Railway	EMU Car Shed/Ghaziabad, Diesel Loco Shed, Alambagh/Lucknow, EMU car shed KJGY, Saharanpur, Diesel Loco shed, Ludhiana.	230-Elect/TRD/103, dated 14.06.2024
6.	North Central Railway	Diesel Loco Shed, Jhansi	EL/ TRD/NCR/TW POLICY, dated 29.12.2020

7.	North Eastern Railway	Loco Shed, Gonda	No. L/55/TRD/ Tower Wagon /, dated: 28.05.2021
8.	North Frontier Railway	There is no location for the POH of Tower Wagon in NFR.	No. EL/92/PHO/TW, dated 23.05.2021
9.	North Western Railway	Diesel Loco Shed/Bhagat ki Kothi/ Jodhpur Division	No. NWR-HQ/Elect(TR}/65/2020, dated 03.12.2020
10.	Southern Railway	MAS-Div:-Avadi EMU Workshop, Loco Workshop/Perambur PGT Div:- Diesel Shed/ERS SA Div:- Workshop/GOC MDU Div:- WorkShop/GOC	E.252/IV/15/1,dated 23.12.2020
11.	South Central Railway	Diesel Loco Shed/Kazipet	1.No. SCR-HQ0Mech(DSL)/32/2019, dated 02.12.2020 2.No.SCR-HQ0Mech(DSL)/32/2019, dated 30.12.2020
12.	South Eastern Railway	Kharagpur Diesel Loco Shed(DLKP)/KGP	No. CEE/D/114, dated 22.12.2020,
13.	South East Central Railway	For 8W-Diesel Loco shed Motibag (NGP). For 4W- Motibag (NGP), Workshop	SECR/ELECT/TRD/208/3303, dated 28.12.20
14.	South Western Railway	Krishnarajapuram Diesel Loco Shed and Diesel Loco Shed/UBL	SWR/EL/Tower Wagon, dated 15.01.2021

15.	Western Railway	Sabarmati Diesel Shed in Ahmadabad Division	EL 94/15/1/8, dated 01.01.2021
16.	West Central Railway	Diesel Loco Shed Itarsi of NCR, Bhopal division.	WCR/L03/2218/, dated 13.01.2020

Note: The above IOH/POH maintenance activities can be done at any other nominated Workshop/Shed/POH Center by Zonal Railways.

Annexure -3

List of nominated depot/Shed by Zonal Railways for AOH

Railway	Division	Depot	Nominated diesel/Electric loco shed
1.Central Railway			
	Pune division	TGN	Diesel/Electrical Loco shed, Ghorpuri, Pune
		CCH	
		PUNE	
		LONI	
		JJR	
		STR	
		MRJ	
		GRMT	
	Solapur division	YL	Diesel/Electrical Loco shed, Daund
		ANG	
		BWD	
		BAP	
		DD	
		KLBG	
		PRWD	
		PVR	
		KWV	
		SUR	
		DUD	
	Nagpur	DOH	Electric Loco Shed/Ajni
		GDYA	
		AMLA	
		PUX	
		PAR	
		WOC	
		KATL	
		AQ	
		BTBR	
		WR	
		DMN	

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		HGT	
		WRR	
		WUN	
		BPQ	
	Bhusawal	IGP	Electric Loco shed/BSL & Electric Loco Workshop/BSL
		NK	
		NR	
		MMR	
		NGN	
		CSN	
		PC	Electric Loco shed/BSL & Electric Loco Workshop/BSL
		JL	
		BSL	
		MKU	
		SEG	
		AK	
		MZR	
		BD	
		BAU	
		NPNR	
		KNW	
	Mumbai	CSMT	DSL Loco shed, Kurla & Electrical Loco shed Kalyan
		CLA	
		VVH	
		TNA	
		PNVL	Diesel shed KYN & Electric Loco Shed KYN
		DI	
		PEN	
		NEU	
		KYN	
		TLA	
		RD	
		KSRA	
		IGP	

		BUD	
		KJT	

Railways	Division	Depots	Nominated Diesel/Electric Loco Shed (nearest to OHE Depot)
2.ER	SDAH	Nakeldanga	Narkeldanga Trip shed, Beliaghata Diesel shed and Narkeldanga EMU Carshed
	SDAH	Barrackpore	
	SDAH	Halisahar	
	SDAH	Ranaghat	
	SDAH	Debogram	
	SDAH	Cossimbazar	
	SDAH	SDAH (South)	
	SDAH	Sonarpur	NKG Trip shed, BGA Diesel shed, SPR EMU Carshed.
	SDAH	Baruipur	
	SDAH	Lakshmikantapur	
	SDAH	Barasat	NKG Trip shed, BGA D/S, BT EMU C/S
	SDAH	Bashirhat	
	HOWRAH DIVISION		
	HWH	Lilluah	Electric Loco Shed/HWH
	HWH	Sheoraphulli	
	HWH	Bandel	
	HWH	Barddhaman	
	HWH	Dankuni	
	HWH	Belmuri	
	HWH	Nabdwipdham	
	HWH	Katwa	Diesel shed/ Barddhaman
	HWH	Azimganj	
	HWH	Arambag	
	HWH	Prantik	
	HWH	Rampurhat	
	HWH	Pakur	
	ASANSOL DIVISION		
	ASN	Panagarh	
	ASN	Andal	

	ASN	Pandabeshwar	Andal Diesel Shed, Andal Trip shed, Asansol MEMU Carshed
	ASN	Suri	
	ASN	Baraboni	
	ASN	Asansol	Asansol Electric loco shed, Andal Diesel shed, Asansol MEMU Carshed
	ASN	Barakar	
	ASN	Jamtara	
	ASN	Madhupur	
	ASN	Jasidih	
	ASN	Dumka	
	ASN	Deoghar	
	MALDA DIVISION		
	MLDT	Malda town	Malda Diesel Shed
	MLDT	Jangipur Road	
	MLDT	Barharwa	Sahibganj DEMU Shed
	MLDT	Sahibganj	
	MLDT	Sabour	JamalpurDisel Shed
	MLDT	Jamalpur	
	MLDT	Barahat	

Railways	Division	Depot			
3. ECR	DNR /Division	MKA	RU-2902	8-W/DETC/ ICF	SPJ
		ARA	ER-781	4-W MK-III	DDU
		JAJ	ER-868	4-W MK IV	SPJ
		RGD	PTL-006	4-Whealer /DHTW	SPJ
		HIL	ER-847	4-W MK-III	SPJ
		DLN	ER-864	4-W MK-III	DDU
		BKP	ER-866	4-W MK-III	SPJ
		TIA	ER-3485	8-W/Hydraulic/BEML	DDU
		BXR	ECR-190081	8-Whealer/ DETC/DMW Patiala	DDU
		DNR	ECR-190127	8-Whealer/ DETC/DMW Patiala	DDU
		JHD	ECR210006	8-Whealer/ DETC/DMW Patiala	DDU

		BXR	ECR-210081	8-W/ DETC/ICF	DDU
		JAJ	ECR-210058	8-Whealer/ DETC/DMW Patiala	SPJ
	SSE /Division	SEE	ECR-0011	8-W Hydraulic/BEML	SPJ
		KGG	PTL-0066	4- Whealer/DHTW	SPJ
		RD	PTL-0065	4- Whealer/DHTW	SPJ
		SPJ	ER-785	4- W MK -IV	SPJ
		NNA	ER-776	4- W MK -III	SPJ
		NNA	60	8- WDHTC(Two Engine)BEMK	SPJ
		BJU	ECR-190074	8- WDHTC(Two Engine)BEMK	SPJ
	SPJ/Division	SGL	EC-182305	8- W ICF/Chennai	SPJ
		NKE	EC-190039	8- W ICF/Chennai	SPJ
		SHC	EC-190050	8- Whealer/DETC/ICF/ Chennai	SPJ
		DBG	ECR-190133	DMW Patiala	SPJ
		KVC	ECR-200010	DMW Patiala	SPJ
		SMI	ECR-200059	DMW Patiala	SPJ
		SPJ	ECR-210001	DMW Patiala	SPJ
		SPJ	ECR-210062	DMW Patiala	SPJ
	DDU / Division	GAYA	ECRU-4907	8-W/DETC	DDU

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		KTQ	ER-855	4- W MK-II	DDU
		KMS	PTL-0016	4-W MK-IV	DDU
		RFJ	PTL-0052	4-Whealer/DHTW	DDU
		SEB	ER-845	4-W MK-II	DDU
		DDU	ER-837	4-W MK-II	DDU
		XBKJ	PTL-0082	4-Whealer/ DHTW	DDU
		KTQ	ER-846	4-W MK-II	DDU
		DDU	ER-902	8-W/DETC	DDU
		JPL	ER-869	4-W MK-III	DDU
		JPL	ER-003	4-WMark III	DDU
		DOS	ECR-190021	8-Whealer/ DETC/DMW Patiala	DDU
		JPL	ECR-210085	8-Whealer/ DETC/DMW Patiala	DDU
		RFJ	ECR-210089	8-Whealer/ DETC/DMW Patiala	DDU
		KTQ	ECR-210078	8-Whealer/ DETC/ICF	DDU
		DDU	ECR220024	8-Whealer/ DETC/DMW Patiala	DDU
	DHN /Division	HZD	PTL-2011060053	4-Whealer /DHTW	PTRU
		PRP	ER-866	4- W MK-II	PTRU
		GMIA	ER-844	4-W MK-III	PTRU
		BRHI	ER-868	4-W MK-III	PTRU
		KLRE	PTL-0083	4-Whealer/ DHTW IV	PTRU
		DHN	RU-00901	8-Whealer/ DETC/ICF	PTRU
		GJD	RU-00904	8-Whealer/ DETC/ICF	PTRU
		BRKA	RU-3906	8-Whealer/	PTRU

				DETC/ICF	
		CRP	PTL-2010080021	4-Whealer/DHTW	PTRU
		GMIA	ER-863	4-W MK-II	PTRU
		LTHR	PTL-0086	4-WDHTW	PTRU
		BRKA	ECR-190060	8-Whealer/ DETC/DWM/Patiala	PTRU
		DTO	ECR-190105	8-Whealer/ DETC/DMW Patiala	PTRU
		GMO	ECR-190089	8-Whealer/ DETC/DMW Patiala	PTRU
		CPU	ECR-200007	8-Whealer/ DETC/DMW Patiala	PTRU
		GMO	EC-200027	8-Whealer/ DETC/DMW Patiala	PTRU
		RNQ	EC-210015	8-Whealer/ DETC/DMW Patiala	PTRU
		SGRL	EC-210011	8-Whealer/ DETC/DMW Patiala	PTRU
		KLRE	EC-210025	8-Whealer/ DETC/DMW Patiala	PTRU
		DHN	EC-210037	8-Whealer/ DETC/DMW Patiala	PTRU

Railways	Division	Depot	Nearest Diesel /Electric shed
5 ECoR	Khurda Road	Ichhapuram (IPM)	MEMU Shed /KUR
	Khurda Road	Chatrapur (CAP)	MEMU Shed /KUR
	Khurda Road	Balugaon (BALU)	MEMU Shed /KUR
	Khurda Road	Khurda Road (KUR)	MEMU Shed /KUR
	Khurda Road	Bhubaneswar (BBS)	MEMU Shed /KUR
	Khurda Road	Cuttack (CTC)	MEMU Shed /KUR
	Khurda Road	Jajpurkeonjhar Road	MEMU Shed /KUR

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		(JJKR)	
	Khurda Road	Bhadrak (BHC)	MEMU Shed /KUR
	Khurda Road	Sakhigopal (SIL)	MEMU Shed /KUR
	Khurda Road	Rahama (RHMA)	MEMU Shed /KUR
	Khurda Road	Paradeep (PRDP)	MEMU Shed /KUR
	Khurda Road	Kendrapara (KENP)	MEMU Shed /KUR
	Khurda Road	Rajathgarh (RJGR)	MEMU Shed /KUR
	Khurda Road	Talcher (TLHR)	MEMU Shed /KUR
	Khurda Road	Angul (ANGL)	MEMU Shed /KUR
	Khurda Road	Tomka (TMKA)	MEMU Shed /KUR
	Khurda Road	Kendujhargarh (KDJR)	MEMU Shed /KUR
	Khurda Road	Nayagarh Town (NGYT)	MEMU Shed /KUR
	Khurda Road	Kamakhyanahgar (KKNR)	MEMU Shed /KUR
ECoR	Waltair	Visakhapatnam (VSKP)	DLS/ELS/WAT
	Waltair	Simhachalam North (SCMN)	DLS/ELS/WAT
	Waltair	Vizianagaram (VZM)	DLS/ELS/WAT
	Waltair	Srikakulam Road (CHE)	DLS/ELS/WAT
	Waltair	Srikakulam Road (NWP)	DLS/ELS/WAT
	Waltair	Bobbili (VBL)	DLS/ELS/WAT
	Waltair	Rayagada (RGDA)	DLS/ELS/WAT
	Waltair	Bhalumaska (BLMK)	DLS/ELS/WAT
	Waltair	Laxmipur (LKMR)	DLS/ELS/WAT
	Waltair	S.Kota (SUP)	DLS/ELS/WAT
	Waltair	Araku (ARK)	DLS/ELS/WAT
	Waltair	Koraput (KRPU)	DLS/ELS/WAT
	Waltair	Jeypore (JYP)	DLS/ELS/WAT
	Waltair	Dilimili (DMK)	DLS/ELS/WAT
	Waltair	Dantewara (DWZ)	DLS/ELS/WAT
	Waltair	Gunupur (GNPR)	DLS/ELS/WAT
	Sambalpur	Boinda (BONA)	ELS /ANGL
	Sambalpur	Rairakhol (RAIR)	ELS /ANGL
	Sambalpur	Sambalpur City (SBPY)	ELS /ANGL
	Sambalpur	Rengali (RGL)	ELS /ANGL

ECoR	Sambalpur	Bargarh Road (BRGA)	ELS /ANGL
	Sambalpur	Balangir Junction (BLGR)	ELS /ANGL
	Sambalpur	Titlagarh Junction (TIG)	ELS /ANGL
	Sambalpur	Rupra Road (RPRD)	ELS /ANGL
	Sambalpur	Muniguda (MNGD)	ELS /ANGL
	Sambalpur	Kantabanji (KBJ)	ELS /ANGL
	Sambalpur	Khariar Road (KRAR)	ELS /ANGL
	Sambalpur	Mahasamund (MSMD)	ELS /ANGL
	Sambalpur	Bhawanipatna (BWIP)	ELS /ANGL

ZONE	Division	Depot	Proposed Diesel /Electric Loco shed for Nomination
6. NR	DLI	New Delhi	EMU Car shed, Ghaziabad
	DLI	Ghaziabad	
	DLI	Kurukshetra	
	DLI	Panipat	
	DLI	Narela	
	DLI	Meerut Cantt.	
	DLI	Modi Nagar	
	DLI	Jarauda Nara	
	DLI	Shamli	
	DLI	Patel Nagar	Diesel Shed, Shakur Basti
	DLI	Patel Nagar	
	DLI	Bahadurgarh	
	DLI	Rohtak	
	DLI	Jind	
	DLI	Jakhal	
	DLI	Mansa	
	DLI	Garhi Harsaru	
	DLI	Tughlakabad	Elect. Loco Shed, Tughlakabad
	DLI	Faridabad	
	FZR	Ludhiana	Diesel Loco shed Ludhiana
	FZR	Moga	
	FZR	Firozpur	

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	FZR	Kotkapura	
	FZR	Fazilka	
	FZR	Lohian Khas	DMU Shed Jallandhar
	FZR	Amritsar	
	FZR	Jallandhar Cantt.	
	FZR	Tarn Taran	
	FZR	Dasua	
	FZR	Gurdaspur	
	FZR	Pathankot	
	FZR	Samba	
	FZR	Martyr Captain Tushar Mahajan	
	FZR	Nawashahr	
	FZR	Budgam	DMU Shed Budgam
	FZR	Banihal	
NR	FZR	Katra	
	UMB	SRE	EMU Car Shed, Saharanpur
	UMB	UMB	
	UMB	PTA	
	UMB	CDG	
	UMB	SIR	Diesel Loco shed Ludhiana
	UMB	RPAR	
	UMB	MRND	
	UMB	DUI	
	UMB	BTI	
	UMB	UKN	
	UMB	AADR	
	UMB	ABS	
NR	LKO	ON	Diesel loco shed / Alambagh, LKO
	LKO	AMB	
	LKO	HGH	
	LKO	SLN	
	LKO	ZBD	
	LKO	BSB	

	LKO	BOY	
	LKO	PFM	
	LKO	UCR	
	LKO	SHG	
	LKO	PBH	
	LKO	GNG	
	LKO	RBL	
	LKO	LLJ	
	LKO	JNH	
	LKO	DRG	
	LKO	BBK	
NR	MB	SANDILA	Alambagh diesel loco shed
	MB	HARDOI	
	MB	ROZA	
	MB	BAREILLY	
	MB	SITAPUR	
	MB	BALAMAU	
	MB	MALLAWAN	
	MB	RAMPUR	EMU Car shed Ghaziabad
	MB	MORADABAD	
	MB	CHAUNDAUSI	
	MB	RAJGHAT	
	MB	AMAROHA	
	MB	HAPURA	
	MB	CHANDPUR	
	MB	NAJIBABAD	EMU Car shed Saharanpur
	MB	ROORKEE	
	MB	JWALAPUR	
	MB	HARAWALA	

Railways	Division	Depot	Nominated diesel/Electric Loco Shed
7. NCR	PRYJ	All TRD Depots	Diesel Loco Shed, Jhansi for AOH/LOH/POH
	JHS		

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	AGC		

Railways	Division	Depot	Nominated Electric Loco shed for AOH
8. NER	LJN	ASH	Electric Loco Shed/GD
		BUW	
		GD	
		BRK	
		MUR	
		BLP	
		BVN	
		STP	
		PD	Electric Loco Shed/GD
		BST	
		GKP	
		ANDN	
		SOT	
	IZN	BPR	Electric Loco Shed/GD
		LKU	
		KHMA	
		BSUR	
		PP	
		RUPC	
		KSV	
		BEM	
		KSJ	
		MEU	
		KJN	Electric Loco Shed/GD
		FBD	
		BRT	
		CPR	Electric Loco Shed/GD
		SV	

		GCT	
		MBS	
		BSBS	
		DHE	
		PEP	
		HDK	
		RPV	
		MAU	
		AMH	
		ARJ	
		BTT	Electric Loco Shed/GD
		CPJ	

Railway	Division	TW Nos.	TW Depot	Proposed Nominated Diesel Loco Shed
9 NFR	KIR	190078 (DMW)	New Jalpaiguri (NJP)	SGUJ/Diesel Shed
		200032 (DMW)		
		210063 (DMW)	Bagdogra (BORA)	
		190072 (DMW)	Alubari Road (AUB)	MLDT/Diesel Shed
		190065 (DMW)	Dalkhola (DLK)	
		200019 (DMW)	Katihar (KIR)	
		190122 (DMW)		
		190021 (ICF)	Samsi (SM)	
		210061 (DMW)	Buniyadpur (BNDP)	

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		210083 (DMW)	Raiganj (RGJ)	
		210038 (DMW)	ARRARIYA	
	APDJ	210016 (DMW)	Gosaigaonhat (GOGH)	SGUJ/Diesel Shed
		210056 (DMW)	New Alipurduar (NOQ)	
		210009 (DMW)	Dhupguri (DQG)	MLDT/Diesel Shed
		210109 (DMW)	Alipuduar Jn.(APDJ)	SGUJ/Diesel Shed
		210091 (DMW)	New Mal Junction (NMZ)	MLDT/Diesel Shed
		210096 (DMW)	Golakganj (GKJ)	SGUJ/Diesel Shed
		210105 (M-192) (DMW)	New Coochbehar (NCB)	
	RNY	210029 (DMW)	Rangiya (RNY)	SGUJ /Diesel Shed
		210019 (DMW)	BarpetaRaoad (BPRD)	
		210027 (DMW)	New Bongaigaon (NBQ)	
		210033 (DMW)	Goalpara (GLPT)	
		210035 (DMW)	Chaygaon (CGON)	
		1-130 (220011)	Udalguri (UGL)	
		220003 (ICF)	Rangapara North (RPAN)	
		220037 (DMW) (M-226)		
		230015 (M-	ViswanathChariali (VNE)	

		226)		
		Not Allotted Till date	Harmuti (HMY)	
	LMG	210031 (DMW) (M-144)	Kamakhya (KYQ)	NGC/Diesel Shed
		210047 (DMW) (M-156)	Chaparmukh (CPK)	
		210087 (DMW) (M-180)	Lumding (LMG)	
		Not Allotted Till date	Mupa (MUPA)	
		230019 (DMW) (M-254)	New Haflong (NHLG)	
		1-119 210082 (ICF)	Badarpur(BPB)	
		Not Allotted Till date	Lalabazar (LLBR)	
		I-122	Arunachal (ARCL)	
		I-127 (220008)	Karimganj (KXJ)	
		Not Allotted Till date	Dharmanagar (DMR)	
		Not Allotted Till date	Ambassa (ABSA)	
		D-55 (DETC-256)	Agartala (AGTL)	
		Not Allotted Till date	Udaipur (UDPU)	
		220025 (M-214)	Rangapahar (RXR)	
		J-9(Jamalpur)	SenchoaJn(SCE)	

		210113 (M-200)	Furcating (FKG)	NGC/Diesel Shed
	TSK	210115 (DMW)	Simaluguri (SLGR)	
		210118 (M-205)	Naharkatia (NHK)	
		210122 (M-209)	Dibrugarh (DBRG)	
		Not Allotted Till date	Dhemaji (DMC)	
		Not Allotted Till date	Telam (TQM)	
		Not Allotted Till date	BaruaBamungaon (BBGN)	
		Not Allotted Till date	Makun Jn. (MJN)	

Railways	Division	Depot	Nominated diesel/Electric Loco Shed	Remarks
10 SR	MAS & SA	All Depots	DS/TNP	
SR	TVC & PGT	All Depots	DS/ERS	
SR	TPJ & MDU	All Depots	DS/GOC	

Railways	Division	Depot	Tower Car No.	Nominated diesel/Electric Loco Shed
		KI	4112	
		BKL	4922	
		MTMP	4134	
		BDCR	42303	
		DKJ	42203	

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11 SCR	SC	Construction	4073	DLS/KZJ
		NKD	4113	
		Construction	4954	
		Construction	4891	
		KZJ	4218	
		JMKT	42201	
		KRMR	4125	
		RDM	4203	
		BPA	4124	
		SKZR	4133	
		MAGH	42301	
		ALER	4137	
		MLY	4201	
		SNF	4126	
		VKB	42302	
		BIDR	4216	
		TDU	4121	
		BKL	42305	
		SEM	4071	
	HYB	KCG	4193	
		GWD	4001	
		TMX	4219	
	BZA	GDR	4951	DLS/BZA
		NLR	4136	
		KVZ	4206	
		OGL	4041	
		For RVNL Works	4132	
		BPP	4191	
		KCC	42204	
		BZA	4204	
		BVRM	4194	
		GDV	4127	
		EE	4215	
		TDD	4212	

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		RJY	4051	
	BZA	SLO	4214	
		AKP	4213	
		TUI	4182	
	GNT	GNT	4172	
		NLPD	4217	
		VKN	42202	
		MRK	4173	
		GID	4962	

Railways	Division	Depot	Nominated diesel/Electric Loco Shed
12 SER	ADA	ADA	ELS/BKSC
		ANR	ELS/BKSC
		BJE	ELS/BKSC
		BKSC	ELS/BKSC
		BQA	ELS/BKSC
		BWCN	ELS/BKSC
		CDGR	ELS/BKSC
		CNI	ELS/BKSC
		DMA	ELS/BKSC
		MHQ	ELS/BKSC
		PRR	ELS/BKSC
	CKP	BNDM	DLS/BNDM
		BMB	DLS/BNDM
		BSPX	ELS/TATA
		BUF	DLS/BNDM
		CBSA	ELS/TATA
		CKP	ELS/TATA
		DPS	ELS/TATA
		GP	DLS/BNDM
		MOU	DLS/BNDM
		ROU	DLS/BNDM

		SNY	ELS/TATA
		TATA	ELS/TATA
		OND	ELS/TATA
	KGP	BLS	ELKP/KGP
		DNT	ELKP/KGP
		DSPN	ELKP/KGP
		DVM	ELKP/KGP
		GII	ELKP/KGP
		HLZ	ELKP/KGP
		KGP	ELKP/KGP
		MCA	ELKP/KGP
		PKU	ELKP/KGP
		SRC	ELKP/KGP
		ULB	ELKP/KGP
		VZR	ELKP/KGP
	RNC	BANO	DLS/BNDM
		GBX	DLS/BNDM
		GRE	ELS/BKSC
		HTE	ELS/BKSC
		LAD	ELS/BKSC
		MURI	ELS/BKSC

Railways		For minor schedule		
13 SECR	Minor schedule i.e.Monthly, Quarterly, Six Monthly and AOH for tower wagon maintenance to be carried out at nearest Diesel/Electric loco shed from the Tower Car holding depot. Accordingly, depot wise nomination of nearest Diesel/Electric loco shed	DIV	4W/8W	Nominated DLS/ELS
		BSP	4W & 8W	MIB/DLS,MIB/WS,ELS/BSP
		R	4W & 8W	DLS/R, ELS/BIA
		NGP	4W & 8W	ELS/BIA,DEMU/G,MIB/WS, MIB/DLS

	for carrying out minor schedules to be provided in the below format.	

Railway	Division	TRD Depot	Loco/Deisel/Memu shed
14 WCR	JBP	BGTA	DLS/ET
		PPI	DLS/ET
		NU	DLS/ET
		KEQ	DLS/ELS, NKJ
		SHR	DLS/ELS, NKJ
		KTE	DLS/ELS, NKJ
		STA	DLS/ELS, NKJ
		JTW	DLS/ELS, NKJ
		REWA	DLS/ELS, NKJ
		KHBJ	DLS/ELS, NKJ
		BEHR	DLS/ELS, NKJ
		MWJ	DLS/ELS, NKJ
		SGAM	DLS/ELS, NKJ
		BRGW	DLS/ELS, NKJ
		KMZ	DLS/ELS, NKJ
		SYA	DLS/ELS, NKJ
		DMO	DLS/ELS, NKJ
		SGO	MEMU Shed/BINA
		KYE	MEMU Shed/BINA
		GAR	Gadarwada depot
		VMA	ELS/TKD
		SGZ	ELS/TKD
		RMA	ELS/TKD
		KOTA	ELS/TKD

	KOTA	BUDI	ELS/TKD
		MLGH	ELS/TKD
		SGAC	ELS/TKD
		BAZ	ELS/TKD
		CAG	ELS/TKD
		LKE	ELS/TKD
		SWM	ELS/TKD
		GGC	ELS/TKD
		HAN	ELS/TKD
		BXN	ELS/TKD
		BTE	ELS/TKD
		JAPN	ELS/TKD
	BPL	KNW	DLS/ET
		KKN	DLS/ET
		HD	DLS/ET
		BPF	DLS/ET
		ET	DLS/ET
		ODG	DLS/ET
		NSZ	DLS/ET
		BHS	MEMU Shed/BINA
		BAQ	MEMU Shed/BINA
		BINA	MEMU Shed/BINA
		MNV	MEMU Shed/BINA
		ASKN	MEMU Shed/BINA
		GUNA	MEMU Shed/BINA
		BRRG	MEMU Shed/BINA
		SVPI	MEMU Shed/BINA

Railways	Division	Depot	Nominated diesel/Electric Loco Shed	Remarks
15	Ratnagiri (RN)	MANGAON, Chiplun, Ratnagiri. Kankavali	Ratnagiri	Complete Tower car maintenance is being
	Karwar (KAWR)	Karmail, Karwar,	Verna	

Konkan Railway		Udupi		done by Mechanical Dept at the nominated Shed as per laid down schedule.

16 NWR	Division	Depot	Nominated diesel/Electric Loco Shed	Remarks
	Ajmer	All depots	Diesel shed ABR/Ajmer Workshop	
	Jaipur	All depots	Diesel shed ABR/Ajmer Workshop	
	Bikaner	All depots	Diesel shed BGKT	
	Jodhpur	All depots	Diesel shed BGKT	

17 SWR	Division	Depot	Nominated diesel/Electric Loco Shed	Remarks
	UBL	RDG/BAY	UBL	
		TNGL	UBL	
		HPT	UBL	
		GDG	UBL	
		UBL	UBL	
		LWR	UBL	
		GDI	UBL	
		IDR	UBL	
		BJP	UBL	
		DUR	UBL	
		UBL	UBL	
		AYB	UBL	

		BDM	UBL	
		YLG	UBL	
		SBC	UBL	
	UBL	HUP	BNC	
	SBC	KNP	BNC	
		DBU	BNC	
		DBU	BNC	
		BID	BNC	
		SSPN	BNC	
		SBC	BNC	
		SBC	BNC	
		BWT	BNC	
		WFD	BNC	
		DPJ	BNC	
		HSRA	BNC	
		MYA	BNC	
		SOLR	BNC	
		SBC	BNC	
		SZV	BNC	
		BWT	BNC	
		TK	BNC	
		MYS	BNC	
		SMET	BNC	
		CAT	BNC	
		HHT	BNC	
		DAD	BNC	
		KRVL	BNC	
	SBC	JRU	BNC	
	MYS	MYS	BNC	
		ASK	BNC	
		MYS	BNC	

RVNL		NVU	UBL	
		VSG	UBL	
		NVU	UBL	
		SVM	UBL	
		SVM	UBL	
		MMEC/JSW	UBL	
		UBL	UBL	
		GDG-HG	UBL	
CORE		DAD	UBL	
		DAD-HVR	UBL	
		SMET	UBL	
		NTR	BNC	
		YNK	BNC	
		UBLS	BNC	
		UBLS	UBL	
		KJM	UBL	
		WFD	BNC	

Note: The above AOH maintenance activities can be done at any other nominated Depot/Workshop/Shed/POH Center by Zonal Railways.

Annexure-04

Spare items for M/s Cummins India Limited make Engine

MODEL N-743-L

Sr. No.	Part No.	Description	Qty.	Category
1	KIT3238521	B CHECK KIT N743/855	1	Mandatory
2		Valvoline Cummins Oil Ltrs 15-W-40 CH4	50 Lts.	Mandatory
3	4055643	KIT,AIR CLEANER	1	Mandatory
4	125019	GASKET BREATHER COVER	1	Mandatory
5	3167218	INHIBITOR,CORROSION	1	Mandatory
6	KITBM50745	GASKET CYLINDER HEAD	1	Mandatory
7	3046418	ROD,PUSH	12	Optional
8	3046431	ROD,PUSH	6	Optional
9	BM30073	CONNECTION,FUEL INLET	6	Optional
10	BM30075	CONNECTION,FUEL DRAIN	6	Optional
11	146483	SCREEN,FILTER	1	Mandatory
12	154088	SEAL,RECTANGULAR RING	1	Mandatory
13	AX1013359	RADIWASH_3LTR	3	Mandatory
14	9097	GASKET WATER PUMP	1	Mandatory
15	168306	SCREW,SLOTTED SET	18	Optional
16	S 212	NUT,REGULAR HEXAGON	18	Optional
17	178570	BELT,V	1	Mandatory
18	178597	BELT,V	2	Mandatory
19	178567	BELT,V	1	Mandatory
20	135675	THERMOSTAT	1	Mandatory
21	186780	SEAL,THERMOSTAT	1	Mandatory

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

22	3931904	SEALANT LIQUID GASKET	2	Mandatory
23	123716	ELEMENT,BREATHER	1	Mandatory
24	3166497	PUMP,WATER	1	Optional
		PT Pump		
25	KIT3880567	PT PUMP REPAIR KIT(PTG AUTO)	1	Optional
26	AR41043	WEIGHT,CARRIER	1	Optional
27	BM73133	HOUSING,GOVERNOR	1	Optional
28	3034243	PUMP,GEAR FUEL	1	Optional
		Injectors		
29	KIT3880779	KIT,INJECTOR REPAIR - N743	6	Optional
30	167157	BALL,CHECK	6	Optional
31	3045006	PLUG,INJECTOR ORIFICE	6	Optional
		Cylinder Head		
32	KIT3880581	CYLINDER HEAD REPAIR KIT	3	Optional
		ACC DRIVE		
33	3880497	SHAFT,ACCESSORY DRIVE	1	Optional
34	3026556	BEARING,THRUST	1	Optional
35	3026557	BEARING,THRUST	1	Optional
36	3004316	SEAL,OIL	1	Optional
37	181236	SEAL,KEYWAY	1	Optional
38	190397	SLEEVE,WEAR	1	Optional
39	3069101	GASKET,ACC DRIVE SUPPORT	1	Optional
40	116391	BUSHING	1	Optional
		Air Compressor		
41	5277629	KIT,UNLOADER VALVE	1	Optional
42	165430	PISTON AIR COMPRESSOR	1	Optional
43	3245718	RING SET PISTON (SERVICE)	1	Optional

Note: - Above spare items are as per submission of M/s Cummins and may vary. M/s Cummins may be contacted for updated spare list.

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

MODEL NT-855-R BC

Sr.No.	Part No.	Description	Qty.	Category
1	KIT3238528	B CHECK KIT NT/NTA	1	Mandatory
2		Valvoline Cummins Oil Ltrs 15-W-40 CH4	60 Lts.	Mandatory
3	KIT3238156	KIT AIR CLEANER ELEMENTS	1	Mandatory
4	254608	GASKET,BREATHER	1	Mandatory
5	4024946	UPPER ENGINE GASKET SET	1	Mandatory
6	3067459	GASKET,ROCKER LEVER COVER	3	Mandatory
7	3167218	INHIBITOR,CORROSION	1	Mandatory
8	3046420	ROD,PUSH	12	Optional
9	3046430	ROD,PUSH	6	Optional
10	AX1013359	RADIW ASH_3LTR	4	Mandatory
11	168306	SCREW ,SLOTTED SET	18	Optional
12	S 212	NUT,REGULAR HEXAGON	18	Optional
13	217638	BELT,V RIBBED	1	Mandatory
14	504867	BELT,V	1	Mandatory
15	135675	THERMOSTAT	1	Mandatory
16	186780	SEAL,THERMOSTAT	1	Mandatory
17	208128	GASKET,THERMOSTAT HOUSING	1	Mandatory
18	209961	HOSE,FLEXIBLE	1	Mandatory
19	3931904	SEALANT LIQUID GASKET	2	Mandatory
20	3065060	HOSE,FLEXIBLE	1	Mandatory
21	3081053	HOSE,PLAIN	1	Mandatory
		PT Pump		
22	AR41043	W EIGHT,CARRIER	1	Optional
23	BM73133	HOUSING,GOVERNOR	1	Optional
24	212602	GEAR,TACHOMETER	1	Optional

		DRIVE		
25	212613	HUB,JAW COUPLING	1	Optional
26	212601	SHAFT,FUEL PUMP DRIVE	1	Optional
27	S 16052	BEARING,BALL	1	Optional
28	3058555	BARREL,GOVERNOR	1	Optional
29	3803615	KIT,SEAL	1	Optional
30	212668	KEY,SQUARE	1	Optional
31	3015665	SHAFT,TACHOMETER DRIVE	1	Optional
32	KITBM68356	GASKET GOVERNOR SET	1	Optional
33	3046200	SPIDER,JAW COUPLING	1	Optional
34	163944	BUSHING	1	Optional
35	3034243	PUMP,GEAR FUEL	1	Optional
36	3234051	SCREEN	1	Optional
37	147901	W ASHER,SEALING	2	Optional
38	AR40132	PLUNGER,GOVERNOR	1	Optional
		Injectors		
39	KIT3238442	KIT BARREL PLU AND CUP	6	Optional
40	167157	BALL,CHECK	6	Optional
41	3045006	PLUG,INJECTOR ORIFICE	6	Optional
42	193736	SEAL,O RING	18	Optional
43	3054999	SCREEN,FILTER	6	Optional
44	3804700	KIT,STC TAPPET REPAIR	6	Optional
		Cylinder Head		
45	KIT4986817	KIT CYL HEAD NTBC REPAIR	3	Optional
		ACC DRIVE		
46	3880497	SHAFT,ACCESSORY DRIVE	1	Optional
47	3026556	BEARING,THRUST	1	Optional
48	3004316	SEAL,OIL	1	Optional
49	3026557	BEARING,THRUST	1	Optional
50	181236	SEAL,KEYW AY	1	Optional

51	190397	SLEEVE,W EAR	1	Optional
52	3069101	GASKET,ACC DRIVE SUPPORT	1	Optional
53	116391	BUSHING	1	Optional
		Air Compressor		
54	3880524	KIT REPAIR 2CYL AIR COMPR	1	Optional
55	165430	PISTON AIR COMPRESSOR	2	Optional
56	3245718	RING SET PISTON (SERVICE)	2	Optional
		Water Pump		
57	3050394	SHAFT,W ATER PUMP	1	Optional
58	3063246	BEARING,BALL	2	Optional
59		RING,RETAINING	1	Optional
60	3602788	IMPELLER,W ATER PUMP	1	Optional
61	196844	SPACER,BEARING	1	Optional
62	3002385	GASKET,W ATER PUMP	1	Optional
63	3609826	SEAL,W ATER PUMP	1	Optional
		Turbo Charger		
64	3545661	KIT,TURBO REPAIR 4LG	1	Optional
65	3521440	COLLAR,THRUST	1	Optional
66	3759619	SLINGER,OIL	1	Optional
67	3500717	HOUSING,TUR BEARING	1	Optional
68	3759618	PLATE,OIL SEAL	1	Optional
69	3521731	SHAFT & W HEEL	1	Optional

Note: Above spare items are as per submission of M/s Cummins and may vary. M/s Cummins may be contacted for updated spare list.

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

MODEL -NT-855-R

Sr.No.	Part No.	Description	Qty.	Category
1	KIT3238528	B CHECK KIT NT/NTA	1	Mandatory
2		Valvoline Cummins Oil Ltrs 15-W-40 CH4	60 Lts.	Mandatory
3	KIT3238156	KIT AIR CLEANER ELEMENTS	1	Mandatory
4	254608	GASKET,BREATHER	1	Mandatory
5	4024946	UPPER ENGINE GASKET SET	1	Mandatory
6	3067459	GASKET,ROCKER LEVER COVER	3	Mandatory
7	3167218	INHIBITOR,CORROSION	1	Mandatory
8	3046420	ROD,PUSH	12	Optional
9	3046430	ROD,PUSH	6	Optional
10	AX1013359	RADIW ASH_3LTR	4	Mandatory
11	168306	SCREW ,SLOTTED SET	18	Optional
12	3004316	SEAL OIL	1	Optional
13	181236	SEAL KEY W AY	1	Optional
14	3008947	SEAL KEY W AY	1	Optional
15	190397	SLEEVE W EAR	1	Optional
16	3069101	GASKET ACC.DRIVE	1	Optional
17	S 212	NUT,REGULAR HEXAGON	18	Optional
18	217638	BELT,V RIBBED	1	Mandatory
19	504867	BELT,V	1	Mandatory
20	135675	THERMOSTAT	1	Mandatory
21	186780	SEAL,THERMOSTAT	1	Mandatory
22	208128	GASKET,THERMOSTAT HOUSING	1	Mandatory
23	209961	HOSE,FLEXIBLE	1	Mandatory
24	3931904	SEALANT LIQUID GASKET	2	Mandatory
25	3065060	HOSE,FLEXIBLE	1	Mandatory
26	3081053	HOSE,PLAIN	1	Mandatory
		PT Pump		
27	AR41043	W EIGHT,CARRIER	1	Optional
28	BM73133	HOUSING,GOVERNOR	1	Optional
29	212602	GEAR,TACHOMETER DRIVE	1	Optional
30	212613	HUB,JAW COUPLING	1	Optional
31	212601	SHAFT,FUEL PUMP DRIVE	1	Optional
32	S 16052	BEARING,BALL	1	Optional

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

33	3058555	BARREL,GOVERNOR	1	Optional
34	3803615	KIT,SEAL	1	Optional
35	212668	KEY,SQUARE	1	Optional
36	3015665	SHAFT,TACHOMETER DRIVE	1	Optional
37	KITBM68356	GASKET GOVERNOR SET	1	Optional
38	3046200	SPIDER,JAW COUPLING	1	Optional
39	163944	BUSHING	1	Optional
40	3034243	PUMP,GEAR FUEL	1	Optional
41	3234051	SCREEN	1	Optional
42	147901	W ASHER,SEALING	2	Optional
43	AR40132	PLUNGER,GOVERNOR	1	Optional
		Injectors		
44	KIT3880782	KIT BARREL PLU AND CUP	6	Optional
45	167157	BALL,CHECK	6	Optional
46	3045006	PLUG,INJECTOR ORIFICE	6	Optional
47	193736	SEAL,O RING	18	Optional
48	3054999	SCREEN,FILTER	6	Optional
		Cylinder Head		
49	KIT3880582	CYLINDER HEAD REPAIR KIT	3	Optional
		ACC DRIVE		
50	3880497	SHAFT,ACCESSORY DRIVE	1	Optional
51	3026556	BEARING,THRUST	1	Optional
52	3026557	BEARING,THRUST	1	Optional
53	116391	BUSHING	1	Optional
		Air Compressor		
48	3880524	KIT REPAIR 2CYL AIR COMPR	1	Optional
49	165430	PISTON AIR COMPRESSOR	2	Optional
50	3245718	RING SET PISTON (SERVICE)	2	Optional
		Water Pump		
51	208134	IMPELLER,W ATER PUMP	1	Optional

52	3000889	SHAFT,W ATER PUMP	1	Optional
53	S 16073	BEARING,BALL	2	Optional
54	112302	RING,RETAINING	1	Optional
55	196844	SPACER,BEARING	1	Optional
56	3038997	OIL SEAL	1	Optional
57	3038998	SEAL,OIL	1	Optional
58	3609826	SEAL,W ATER PUMP	1	Optional
59	3002385	GASKET,W ATER PUMP	1	Optional
		Turbo Charger		
60	3545661	KIT,TURBO REPAIR 4LG	1	Optional
61	3751240	RING,THRUST	2	Optional
62	3759618	PLATE,OIL SEAL	1	Optional
63	3759619	SLINGER,OIL	1	Optional
64	3500717	HOUSING,TUR BEARING	1	Optional
65	3500433	SHAFT & W HEEL	1	Optional

Note: Above spare items are as per submission of M/s Cummins and may vary. M/s Cummins may be contacted for updated spare list.

MODEL KTA-19-R

Sr.No.	Part No.	Description	Qty.	Category
1	KIT3238514	B CHECK KIT N743/855	1	Mandatory
2		Valvoline Cummins Oil Ltrs 15-W-40 CH4	75 Lts.	Mandatory
3	KIT3238358	KIT AIR CLEANER ELEMENT	2	Mandatory
4	254608	GASKET,BREATHER	1	Mandatory
5	KIT4072233	GASKET SET	1	Mandatory
6	3167218	INHIBITOR,CORROSION	1	Mandatory
7	3017961	ROD,PUSH	12	Optional
8	3057139	ROD,PUSH	6	Optional
9	AX1013359	RADIW ASH_3LTR	4	Mandatory

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

10	168306	SCREW ,SLOTTED SET	18	Optional
11	S 212	NUT,REGULAR HEXAGON	18	Optional
12	178598	BELT,V	1	Mandatory
13	178567	BELT,V	1	Mandatory
14	3931904	SEALANT LIQUID GASKET	2	Mandatory
15	135675	THERMOSTAT	2	Mandatory
16	186780	SEAL,THERMOSTAT	2	Mandatory
17	207058	GASKET,THERMOSTAT HOUSING	1	Mandatory
18	3016142	HOSE,PLAIN	1	Optional
19	3803852	KIT,KV POSE SEAL	1	Optional
		PT Pump		
20	AR41043	W EIGHT,CARRIER	1	Optional
21	BM73133	HOUSING,GOVERNOR	1	Optional
22	3034243	PUMP,GEAR FUEL	1	Optional
23	KIT3880567	PT PUMP REPAIR KIT(PTG AU	1	Optional
		Injectors		
24	KIT3880785	KIT INJECTOR REPAIR-KTA	6	Optional
25	167157	BALL,CHECK	6	Optional
26	3045006	PLUG,INJECTOR ORIFICE	6	Optional
27	193736	SEAL,O RING	6	Optional
28	3054999	SCREEN,FILTER	6	Optional
29	3010510	SEAL,O RING	6	Optional
30	205216	SEAL,O RING	6	Optional
31	207244	SEAL,INJECTOR	6	Optional
		Cylinder Head		
32	KIT3238299	KIT CYL HEAD REPAIR K6	6	Optional
		ACC DRIVE		
33	3880497	SHAFT,ACCESSORY DRIVE	1	Optional
34	3026556	BEARING,THRUST	1	Optional
35	3026557	BEARING,THRUST	1	Optional

36	116391	BUSHING	1	Optional
37	3069101	GASKET,ACC DRIVE SUPPORT	1	Optional
		Air Compressor		
38	3880524	KIT REPAIR 2CYL AIR COMPR	1	Optional
39	165430	PISTON AIR COMPRESSOR	2	Optional
40	3245718	RING SET PISTON (SERVICE)	2	Optional
		Water Pump		
41	206948	SEAL,OIL	1	Optional
42	3609826	SEAL,W ATER PUMP	1	Optional
43	3042827	SHAFT,W ATER PUMP	1	Optional
44	70183	RING,RETAINING	1	Optional
45	205258	RING,RETAINING	1	Optional
46	145623	SEAL,O RING	1	Optional
47		BEARING,BALL	1	Optional
48		BEARING,BALL	1	Optional
49	205243	IMPELLER,W ATER PUMP	1	Optional
50		COCK DRAIN	1	Optional
51	2884938	GASKET,W ATER PUMP SUPPORT	2	Optional
52	205258	RING,RETAINING	1	Optional
53	205288	GASKET,W TR TRF CONNECTION	1	Optional
54	205289	GASKET,W TR TRF CONNECTION	1	Optional
		Turbo Charger		
55	3545647	KIT,TURBO REPAIR HC5A	1	Optional
56	3523980	SLINGER,OIL	1	Optional
57	3523429	HOUSING,TUR BEARING	1	Optional
58	3521033	SHAFT & W HEEL	1	Optional
59	3591522	COLLAR THRUST	1	Optional

Note: Above spare items are as per submission of M/s Cummins and may vary. M/s Cummins may be contacted for updated spare list.

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

MODEL N-855-R

Sr.No.	Part No.	Description	Qty.	Category
1	KIT3238521	B CHECK KIT N743/855	1	Mandatory
2		Valvoline Cummins Oil Ltrs 15-W-40 CH4	60 Lts.	Mandatory
3	4055644	KIR,AIR CLEANER	1	Mandatory
4	254608	GASKET,BREATHER	1	Mandatory
5	4024946	UPPER ENGINE GASKET SET	1	Mandatory
6	3067459	GASKET,ROCKER LEVER COVER	3	Mandatory
7	3167218	INHIBITOR,CORROSION	1	Mandatory
8	3046418	ROD,PUSH	12	Optional
9	3046431	ROD,PUSH	6	Optional
10	AX1013359	RADIW ASH_3LTR	4	Mandatory
11	181236	SEAL KEY W AY	1	Optional
12	3931904	SEALANT LIQUID GASKET	2	Optional
13	3008947	SEAL KEY W AY	1	Optional
14	190397	SLEEVE W EAR	1	Optional
15	3069101	GASKET ACC. DRIVE	1	Optional
16	168306	SCREW ,SLOTTED SET	18	Optional
17	3004316	SEAL OIL	1	Optional
18	S 212	NUT,REGULAR HEXAGON	18	Optional
19	3058383	BELT,V	2	Mandatory
20	4085738	BELT,V	1	Mandatory
21	135675	THERMOSTAT	1	Mandatory
22	186780	SEAL,THERMOSTAT	1	Mandatory
23	3931904	SEALANT LIQUID GASKET	2	Mandatory
24	208128	GASKET,THERMOSTAT HOUSING	1	Mandatory
		PT Pump		

	PREPARED BY	CHECKED BY	ISSUED BY
SIGNATURE	23.08.24		
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25	AR41043	W EIGHT,CARRIER	1	Optional
26	BM73133	HOUSING,GOVERNOR	1	Optional
27	212602	GEAR,TACHOMETER DRIVE	1	Optional
28	212613	HUB,JAW COUPLING	1	Optional
29	212601	SHAFT,FUEL PUMP DRIVE	1	Optional
30	S 16052	BEARING,BALL	1	Optional
31	3058555	BARREL,GOVERNOR	1	Optional
32	3803615	KIT,SEAL	1	Optional
33	212668	KEY,SQUARE	1	Optional
34	3015665	SHAFT,TACHOMETER DRIVE	1	Optional
35	KITBM68356	GASKET GOVERNOR SET	1	Optional
36	3046200	SPIDER,JAW COUPLING	1	Optional
37	163944	BUSHING	1	Optional
38	3034243	PUMP,GEAR FUEL	1	Optional
39	3234051	SCREEN	1	Optional
40	147901	W ASHER,SEALING	2	Optional
41	AR40132	PLUNGER,GOVERNOR	1	Optional
		Injectors		
42	KIT3880782	KIT INJECTOR REPAIR-NT855	6	Optional
43	167157	BALL,CHECK	6	Optional
44	3045006	PLUG,INJECTOR ORIFICE	6	Optional
45	193736	SEAL,O RING	18	Optional
46	3054999	SCREEN,FILTER	6	Optional
		Cylinder Head		
47	3880582	CYLINDER HEAD REPAIR KIT	3	Optional
		ACC DRIVE		
48	3880497	SHAFT,ACCESSORY DRIVE	1	Optional
49	3026556	BEARING,THRUST	1	Optional
50	3026557	BEARING,THRUST	1	Optional
51	116391	BUSHING	1	Optional

		Air Compressor		
52	3880524	KIT REPAIR 2CYL AIR COMPR	1	Optional
53	165430	PISTON AIR COMPRESSOR	2	Optional
54	3245718	RING SET PISTON (SERVICE)	2	Optional
		Water Pump		
55	208134	IMPELLER,W ATER PUMP	1	Optional
56	3000889	SHAFT,W ATER PUMP	1	Optional
57		BEARING,BALL	2	Optional
58	112302	RING,RETAINING	1	Optional
59	196844	SPACER,BEARING	1	Optional
60	3038997	OIL SEAL	1	Optional
61	3038998	SEAL,OIL	1	Optional
62	3609826	SEAL,W ATER PUMP	1	Optional

Note: Above spare items are as per submission of M/s Cummins and may vary. M/s Cummins may be contacted for updated spare list.

MODEL VTA-1710-L

Sr.No.	Part No.	Description	Qty.	Category
1	KIT3238519	B CHECK KIT VT1710	1	Mandatory
2		Valvoline Cummins Oil Ltrs 15-W-40 CH4	110 Lts.	Mandatory
3	KIT3238358	KIT AIR CLEANER ELEMENT	2	Mandatory
4	254608	GASKET,BREATHER	2	Mandatory
5	KIT3240239	GASKET SET	1	Mandatory
6	3167218	INHIBITOR,CORROSION	2	Mandatory
7	3046419	ROD,PUSH	10	Optional
8	3046432	ROD,PUSH	4	Optional
9	AX1013359	RADIW ASH_3LTR	3	Mandatory
10	168306	SCREW ,SLOTTED SET	36	Optional
11	S 212	NUT,REGULAR HEXAGON	36	Optional
12	3040377	BELT,V	2	Mandatory
13	178655	BELT,V	1	Mandatory
14	135675	THERMOSTAT	2	Mandatory
15	186780	SEAL,THERMOSTAT	2	Mandatory
16	3020187	SEAL OIL	1	Mandatory
17	3033215	GASKET,THERMOSTAT HOUSING	2	Mandatory
18	3931904	SEALANT LIQUID GASKET	2	Mandatory
19	3081053	HOSE,PLAIN	2	Mandatory
		PT Pump		
20	KIT3880567	PT PUMP REPAIR KIT(PTG AU	1	Optional
21	AR41043	W EIGHT,CARRIER	1	Optional
22	BM73133	HOUSING,GOVERNOR	1	Optional
23	3034222	PUMP,GEAR FUEL	1	Optional
		Injectors		
24	KIT3238363	KIT,BARREL PLU CUP BIG	12	Optional
25	167157	BALL,CHECK	12	Optional

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26	3045006	PLUG,INJECTOR ORIFICE	12	Optional
27	193736	SEAL,O RING	36	Optional
28	3054999	SCREEN,FILTER	12	Optional
		Cylinder Head		
29	127554	COLLET,VALVE	96	Optional
30	145701	VALVE,EXHAUST	24	Optional
31	170296	GUIDE,VALVE SPRING	48	Optional
32	172034	GUIDE,VALVE SPRING	48	Optional
33	211999	SPRING,VALVE	48	Optional
34	135957	VALVE,INTAKE	24	Optional
35	127930	INSERT,VALVE	24	Optional
36	3872815	INSERT,VALVE	24	Optional
37	3006456	GUIDE,VALVE STEM	48	Optional
38	3007759	SEAL,O RING	12	Optional
39	3406702	SLEEVE,INJECTOR	12	Optional
40		KIT CYL HEAD REPAIR K6	6	Optional
		ACC DRIVE		
41	3880497	SHAFT,ACCESSORY DRIVE	1	Optional
42	3026556	BEARING,THRUST	1	Optional
43	3026557	BEARING,THRUST	1	Optional
44	116391	BUSHING	1	Optional
45	200808	GASKET,ACC DRIVE SUPPORT	1	Optional
		Water Pump		
46	209806	SHAFT,W ATER PUMP	1	Optional
47	3003350	SPACER,SEAL	1	Optional
48	3003353	SEAL,OIL	2	Optional
49	3003354	BEARING,ROLLER	1	Optional
50	3011230	GASKET,W ATER PUMP	1	Optional
51	3609826	SEAL,W ATER PUMP	1	Optional
52	4072619	IMPELLER,W ATER PUMP	1	Optional
		Turbo Charger		
53	3545661	KIT,TURBO REPAIR 4LG	2	Optional
54	3751240	RING,THRUST	4	Optional
55	3759618	PLATE,OIL SEAL	2	Optional

56	3759619	SLINGER,OIL	2	Optional
57	3500717	HOUSING,TUR BEARING	1	Optional
58	3500433	SHAFT & W HEEL	1	Optional

Note: Above spare items are as per submission of M/s Cummins and may vary. M/s Cummins may be contacted for updated spare list.

Annexure-5

M/s CUMMINS GUIDELINE FOR ENGINE STORAGE AND PREVENTION

QuickServe Online

000-005 Engine Storage - Long Term

General Information

⚠ WARNING ⚠

Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

⚠ CAUTION ⚠

After 24 months in storage, the engine cooling system must be drained and flushed with a suitable solvent or a hot, lightweight mineral oil. Repeat flushing procedure a second time before being put back into service.

This procedure describes the proper method for the long-term (more than 6 months) storage of an engine that is currently in running condition. This procedure applies to this engine either remaining in chassis - or being removed out of chassis upon completion of the steps below.

Prepare the Engine for Long Term Storage

⚠ CAUTION ⚠

Do not use fuel system preservative oil on Natural Gas or Propane Engines.

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- Operate the engine at high idle until the coolant temperature is 70°C [158°F].
- Turn the engine off.
- Drain the oil.
- Install the drain plugs.
- Fill the engine oil pan sump to the high mark using Tectyl™ 910 or equivalent engine preservative oil. This will provide long term engine rust protection. The oil **must** meet military specification MIL-PRF-21260, Type P-10, Grade 2, SAE 30.

Internal Preservation of the Fuel System with Mechanically and Electronically Actuated Injectors.

⚠ CAUTION ⚠

Do not use diesel fuel containing bio components for internal preservation of fuel system for engine storage. Fuel properties degradation may cause damages and lead to premature failure of fuel system components.

- Disconnect the fuel lines to the engine fuel filter and the injector return line.
- Use Diesel Pump and Injector calibration fluid that meets ISO 4113 standard, SAE J967d standard and Bosch VS 15665-OL standard.

NOTE: Using calibration fluid allows storage for up to 12 months. After 12 months the engine fuel system must be drained and flushed again with fresh calibration fluid. Repeat after each 12-month period.

Alternatively you can use the diesel fuel with 0 percent bio components content for Internal Preservation of the Fuel System.

NOTE: Using diesel fuel with 0 percent bio components content allows storage for up to 6 months. After 6 months, the engine fuel system must be drained and be flushed again with fresh diesel fuel with 0 percent bio components content. Repeat after each 6-month period.

- Start the engine.
- After the engine is operating smoothly, transfer the fuel supply line to the container of calibration fluid or the container of diesel fuel with 0 percent bio components content.
- Let the engine run for approximately 25 minutes at low idle in order to ensure that the engine preservative oil (Tectyl™ 910 E or equivalent) is distributed around the engine and its internal components and that the calibration fluid or the diesel fuel with 0 percent bio components content flows out of the injector return line.
- Turn the engine OFF.
- Connect the fuel lines to the fuel filter and the injector return line.
- Drain all the preservative oil from the engine oil pan sump, the air compressor (if applicable), and drain all the oil filters and all the fuel filters.
- Install the drain plugs.

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⚠ CAUTION ⚠

Before starting another Internal Preservation of the Fuel System procedure again (after passing a storage period) it is required to fill the engine oil pan sump to the high mark using Tectyl™ 910 or equivalent engine preservative oil.

- If the engine is being stored as a loose engine, drain the engine coolant and cover all cooling system openings with plastic and tape.
- If the engine is **not** being removed from chassis and the engine has an extended life coolant with rust inhibitor, then coolant does **not** need to be drained.
- If the engine will remain in storage for over 24 months, the engine cooling system **must** be drained and flushed with a suitable solvent or a hot, lightweight mineral oil. Repeat after each 24-month period.
- Remove the intake and exhaust manifolds.
- Spray preservative oil into the intake and exhaust ports in the cylinder heads and in the exhaust manifolds **only**. Do **not** use preservative oil on the intake manifold or any fuel system components as this may permanently damage sensors or valves.
- Spray preservative oil in the inlet port on the air compressor (if applicable).
- Remove the rocker lever covers.
- Spray the rocker levers, the valve stems, the springs, the valve guides, the crossheads, and the push rods with preservative oil.
- Install the rocker lever covers, intake and exhaust manifolds.
- Brush or spray the preservative oil on all the exposed metal surfaces that are **not** painted. Preservative oil should **not** be applied to any plastic, rubber, or similar surfaces. Make sure to coat the flywheel, flywheel housing and all other unpainted machined surfaces with this preservative oil. Use a rust preservative oil compound that meets military specification MIL-C-16173C, type P-2, Grade 1 or 2.
- For components containing exposed bearings that are **not** easily accessible e.g. Fan Hubs, remove the component to aid access. Brush or spray preservative oil on all surfaces that are **not** painted and refit the component. Use a rust preservative oil compound that meets military specification, MIL-C-16173C, type P-2, Grade 1 or 2.
- Cover all the openings (engine and components) with heavy paper and tape to prevent dirt and moisture from entering the engine. Cover the entire engine with plastic.
- Put a warning tag on the engine. The tag **must** indicate:
  - Do **not** operate the engine.
  - Do **not** bar the crankshaft.
  - The engine has been treated with preservatives.
  - The coolant has been removed.
  - The date of treatment.
  - The date of the 6 week inspection if required.

⚠ CAUTION ⚠

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The engine must be stored in an area that is dry and has uniform temperature.

- Remove any external drive belts to prevent localized stretching and deformation.
- If the engine can be stored inside a designated storage facility isolated from the external environment, ignore the following step.
- Excluding the crankshaft, ensure that all external dynamic engine components are rotated every 6 weeks. Ensure parts are free from corrosion, debris and water ingress. Record and date this on the engine tag created.

Remove the Engine from Long Term Storage

To remove the engine from long term storage, follow the following steps:

⚠ CAUTION ⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

- Flush the engine preservative oil out of the engine by removing the plug from the main engine oil rifle and pumping a hot, lightweight mineral oil through it. Make sure that the engine crankshaft is barred at least three to four revolutions during this flushing procedure.
- Drain all the mineral oil that was used to flush the engine clean of the engine preservative oil.
- Install the drain plugs.
- Install new oil, fuel and coolant filters.
- Fill the engine to the high mark with engine oil.
  - If the engine has been in storage for less than 24 months and if the cooling system was drained, fill the cooling system with coolant. See the Coolant Recommendations and Specifications procedure in Section V of the corresponding owners and/or operation and maintenance manual for antifreeze, water, and Supplemental Coolant Additive (SCA) specifications.
  - If the engine has been in storage for 24 months, every 24 months the engine cooling system **must** be drained and flushed with a suitable solvent or a hot, lightweight mineral oil. Fill the cooling system with coolant. See the Coolant Recommendations and Specifications procedure in Section V of the corresponding owners and/or operation and maintenance manual for antifreeze, water, and SCA specifications.
  - If the engine has been in storage for less than 24 months and the engine has an extended life coolant with a rust inhibitor, drain the cooling system. Fill the cooling system with coolant. See the Coolant Recommendations and Specifications procedure in Section V of the corresponding owners and/or operation and maintenance manual for antifreeze, water, and SCA specifications.

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- Adjust the engine brake (if applicable) and valve clearances. See the Overhead Set procedure in the corresponding base Troubleshooting and Repair Manual or Service Manual for the engine being serviced.
- Tighten the intake and exhaust manifold mounting capscrews.
- Prime the lubricating system.
- Reinstall any external drive belts that were removed.
- Replace all spark plugs. See the Spark Plugs procedure in the corresponding base Troubleshooting and Repair Manual or Service Manual for engine being serviced(if applicable).
- Make sure all fuel lines are securely tightened and all fuel shutoff valves are open prior to attempting to start the engine.
- Start the engine.
  - Note that if might take multiple cranking attempts to start the engine. Do **not** crank the engine more than 30 seconds at a time as this might cause the starter to overheat and fail.
  - Note that the engine might run rough until the fuel system is completely primed or until all residual fuel system preservative oil is completely flushed out of the fuel system (if the fuel has been treated with fuel system preservative oil).
- Install the exhaust aftertreatment components (if applicable).
- Force an active regeneration (if applicable).

Last Modified: 20-Mar-2015

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Annexure-06

Maintenance manual submitted by OEM of Engine to be followed for different make and model of Engine.

MAINTENANCE STEPS

1 KEEP DIRT OUT OF THE ENGINE

2 MAINTAIN A LUBRICATING FILM ON ALL BEARING SURFACES

3 REGULATE THE ENGINE'S FUEL

4 CONTROL OPERATING TEMPERATURES

5 GUARD AGAINST CORROSION

Cummins

MAINTENANCE

IMPORTANT INSTRUCTIONS AND RECOMMENDATIONS

1. This Maintenance Schedule is applicable for NTA-855-R.
2. Recommended Engine Oil Valvoline API 15W40 CH4 or higher grade of CH4.
3. Recommended Hydraulic Oil Anti-Wear VG 46 (or equivalent).
4. Recommended Coolant Premix Fleetguard Compleat EG 50:50.
5. Do not intermix different brands or grades of oil or coolant.
6. Refer the Operation and Maintenance Manual supplied with the engine for detail instructions.
7. The maintenance schedule in Hours / Months should be considered whichever comes early.
8. The maintenance schedule after 6000 Hours / 24 Months check should be repeated as per regular cycle.

Contact nearest Cummins Authorised Service Office for any clarification.

MAINTENANCE STEPS

6 LET THE ENGINE BREATHE

7 PREVENT OVERSPEEDING

8 KNOW YOUR ENGINE'S CONDITION

9 CORRECT TROUBLES WHILE THEY ARE SIMPLE

10 SCHEDULE AND CONTROL YOUR MAINTENANCE

"A" Check Daily Interval	"B" Check Every 300 Hours / 6 Months whichever is earlier	"C" Check Every 1500 Hours / 12 Months whichever is earlier	"D" Check Every 6000 Hours / 24 Months whichever is earlier
• FUEL-WATER SEPARATOR - DRAIN	• REPEAT "A" CHECK INTERVAL	• REPEAT "A" & "B" CHECK INTERVAL	• REPEAT "A" "B" & "C" CHECK INTERVAL
• LUBRICATING OIL LEVEL - CHECK	• FUEL FILTER - CHANGE	• INJECTOR AND VALVES[1] - ADJUST	• FUEL PUMP AND INJECTOR CALIBRATION - CHECK, IF REQUIRED CALIBRATE
• COOLANT LEVEL - CHECK	• SEDIMENTS FROM FUEL TANK - DRAIN	• AIR CLEANER ELEMENT - CHANGE	• COOLING SYSTEM - FLUSH AND FILL UP WITH FRESH PREMIX FLEETGUARD COMPLEAT EG 50:50
• AIR INTAKE RESTRICTION - VISUAL CHECK	• LUBRICATING OIL FILTER - CHANGE	• RADIATOR / OIL COOLER - CLEAN EXTERNALLY	• VIBRATION DAMPER, VISCOUS - CHECK
• WATER PUMP AND ALTERNATOR DRIVE BELTS - CHECK	• LUBRICATING OIL BYPASS - CHANGE	• WATER PUMP IDLER - CHECK	• AIR COMPRESSOR - CHECK - AIR OUTLET PIPING - CLEAN
• LEVEL OF OIL IN HYDRAULIC TANK-CHECK	• LUBRICATING OIL - CHANGE	• AIR CLEANER EVACUATOR VALVE - CHECK & CHANGE, IF REQUIRED	• AIR RETENSION TIME - RECORD
• RADIATOR CORE LEAKAGE OR CHOKE-CHECK	• LUBE OIL PRESSURE - RECORD	• ALTERNATOR CHARGING VOLTAGE - CHECK	• WATER PUMP AND ALTERNATOR DRIVE BELTS - REPLACE
• AIR TANKS AND RESERVOIRS - DRAIN	• ENGINE MOUNTS - CHECK	• HYDRAULIC FILTERS - REPLACE	• TURBOCHARGER - INSPECT
• COOLANT, FUEL, OIL AND AIR LEAKAGES - CHECK	• WATER PUMP - CHECK	• HYDRAULIC OIL - REPLACE	• TURBOCHARGER RADIAL BEARING CLEARING - INSPECT
	• COOLANT CONCENTRATION - CHECK		• TURBOCHARGER AXIAL CLEARANCE - INSPECT
	• BELTS - CHECK AND ADJUST, IF REQUIRED		
	• COOLANT PIPES CONDITION- CHECK, IF REQUIRED REPLACE		
	• CRANKCASE BREATHER - CLEAN		
	• CRANKCASE BREATHER ELEMENT- CHECK, IF REQUIRED CHANGE		

1. After an initial adjustment at 1500 hours, it is recommended that the valves and injectors not be adjusted again prior to injector calibration at the 6000 hours or 24 months interval
2. Parker Hydraulic System - Initially, replace Return Filter Element at first 50 hours and at 500 hours, replace both Return Filter and Boost Unit filter and at 1000 hours, change both the filters again.
3. Please ensure Porta Trolley method while replacing Hydraulic oil for Parker Hydraulic system.

Cummins India Limited

Bulletin No: 4398992

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Annexure-07

List of Tools plant facilities to be with Maintenances Depot/shed.

It is as per Annexure-B of Railway Board letter no. 2006/Elect(G) /170/2 /Part II dated 26.06.2023

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAILWAY BOARD

No.2006/Elect(G)/170/2/Pt-II — New Delhi, Dated: 26.06.2023

General Managers,
All Zonal Railways

Sub: POH of Tower Wagons.

Ref: RDSO's letter no TI0 LKO (OHE)/91/2020-O/o PED/TI/RDSO dated 16.05.23.

RDSO has submitted a report of the committee nominated to deliberate upon the maintenance issues of Tower Wagons vide their letter under reference above for acceptance/approval of recommendations. The Committee comprised of EDRE/Railway Board, EDTI/RDSO, CEDE/NR and CEDE/NWR. Committee report is based on the recommendations of Item no. 438 of **63rd ESC meeting** held at BLW, Varanasi on 20th&21st September, 2019.

2. In this connection, Board (MTRS) has approved the following recommendations of the committee:

i. In addition to existing nominated Workshops and EMU Car shed for POH of Tower Wagon, nomination of Diesel loco sheds for POH of Tower Wagons have been done by Zonal Railways (as per Annexure - A).

ii. All M&P, T&P, spare parts and other infrastructure required for POH of Tower Wagons (as per Annexure - B) should be ensured.

iii. Wheel Pressing Machine and Wheel Turning Machine, if not available in nominated diesel shed, can be outsourced to dedicated Loco POH workshops of that shed as per existing practice being followed. Sufficient wheel sets may be kept as a spare item in Loco Sheds.

3. Zonal Railways are advised to take necessary action accordingly.

DA: As above.

26.6.23

(Nisha Manohar Patil)
Director Elect. Engg. (PS)
Phone: 011-47845419
Email- rbelectricaleem@gmail.com

Copy to: PCEE/PCME of all Zonal Railways for kind information and necessary action please.

Room No. 102-A, Rail Bhawan, Raisina Road, New Delhi- 110001

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Annexure-A

Nominated Railway wise location for IOH/POH of Tower Wagons in addition to existing workshops is tabulated below:

SN	Railways	Railway wise location, where POH is being done as per existing practice	Nominated Railway wise location for IOH/POH of Tower Wagon in addition to existing workshops
1	Central Railway	i) Parel Diesel Loco workshop (CR). (ii) Electric Loco Workshop, BSL (CR) (iii) Motibagh Workshop (SECR) (iv) Dahod Workshop(WR)	Parel Diesel Loco Workshop
2	Eastern Railway	Kanchrapara workshop (8W) & Jamalpur Workshop (4W)	Andal Diesel Shed
3	East Central Railway	Jamalpur workshop & Kanchrapara workshop	Samstipur Diesel shed
4	East Coast Railway	Kharagpur C & W Workshop (4W + 8W) of SER	Kharagpur Diesel Loco Shed (DLKP)/KGP
5	Northern Railway	EMU Car Shed, Ghaziabad	-Diesel Loco Shed, Alambagh/Lucknow - EMU Carshed, KJGY (Khanalampura Marshalling yard, Saharanpur) - Carriage & Wagon Workshop, Jagadhari
6	North Central Railway	EMU Car Shed Maripat, GZB (8 Wh. & 4 Wh. Mark- III & IV) Jhansi Workshop (4 Wh. Mark-II)	Diesel Loco Shed, Jhansi (8 Wh. & 4 Wh. Mark- III & IV)
7	North Eastern Railway	Izzat Nagar Loco Workshop, EMU Car Shed, Ghaziabad	Loco Shed, Gonda
8	North Frontier Railway	Kachrapara workshop(ER) Jamalpur Workshop (ER)	Siliguri Diesel Shed
9	North Western Railway	-	Abu Road Shed /Ajmer Division
10	Southern Railway	Avadi EMU Workshop Loco Workshop/Perambur	MAS Div:-Avadi EMU Workshop, Loco Workshop/Perambur PGT Div:- Diesel Shed/ERS SA Div:- Workshop/GOC MDU Div:- WorkShop/GOC
11	South Central Railway	Carriage workshop Lallaguda, Secunderabad	Diesel Loco Shed/Kazipet

Annexure-B

I. Machines & Plant to be available for undertaking POH of Tower Wagons

SN	Details of Machine & Plants	Rating
1	Test bench for Overload relay	1000 Amp DC
2	Test bench for Pressure Switch	Variable pressure upto 10kg/cm^2
3	Test bench for MCB testing	Output supply 100 Amp DC
4	Test bench for testing of Head light,Flasher light, Marker light & DC-DCconvertor.	Variable DC of 0-150 volt
5	EOT crane	40T (Main hoist) / 5T (Aux.hoist)
6	Stands for berthing of superstructure	4 nos. per Tower wagon
7	Lifting tackle	40 T (2 nos.)
8	Hydraulic trolley (motorized) capacity	5T
9	Rectifier & variation set for TM run test	Suitable for 2 TMs of l67KW
10	Stand for TM run test	Suitable for motorized wheel set
11	Hydraulic Bearing puller for Axle box	5 HP l400rpm. 600kg/cm^2&250 kg/cm^2
12	Induction heater for bearing mounting	8 KVA
13	Induction heater for TM bearing racerwith armature	40 KVA
14	Dynamic Balancing machine	3T weight capacity & suitablefor TMtypes (2141 A, C 1005,4303BY, 4601BZ or similar)
15	Hydraulic Pinion Extractor	400 MPa
16	Armature lathe machine	Suitable for TM (2141A,C1005,4303BY. 4601 AZ or similar) armature
17	Wheel lathe for profile turning	Suitable for Wheel dia 700 mm to1100mm.
18	Welding plant	MIG & MMAW type
19	Coil Spring load deflection testing machine	5T
20	Electromagnetic crack detector for coil spring	--
21	Press machine suitable for assembly ofBogie Bolster	20T
22	Air spring testing bench for air leakage.	10 Kg/cm^2 Max
23	Constant current/constant voltage IGBTbased battery charger & discharger	0-220 Amp output current &40-155 V
24	Test bench for testing of Valves (A9,SA9, C2W,Duplex Check valve, Non return Valve,SafetyValve, N-1 reducing valve, Horn, Hornswitch, wiper assembly, Feed valve,Throttlevalve, Guard valve, Angle cock & Pilotvalve etc.	5-12kg/ cm^2
25	Wheel press machine	--
26	Wheel turning machine	--
27	No load Test bench for Traction Motor	--
28	Pneumatic test bench for testing of brake system	--
29	Battery Charge/discharge machine	--
30	Test bench for pantograph	--

II. Tool & Plant to be available for undertaking POH of Tower Wagons

SN	Details of Tool & Plant	Rating
1	Infrared temperature gun	Non-contact type
2	Megger	1000V
3	HV Tester	3KW
4	Set of Spanners (Box, Open, Ring)	--
5	Torque Wrench	20kgf
6	Micrometer inside	125-150mm, 150-175mm,275-300mm
7	Micrometer Outside	125-150mm, 150-175mm,275-300mm
8	Main compressor & reservoir for pipeline blowing.	1000lpm
9	Electric motor & pump for diesel tankcleaning.	1 HP motor with pump &flexible hose
10	Parking cylinder opening fixture.	--
11	Lifting Chains	5T, 10T, 20T
12	Lifting Wire Rope	5T, 10T, 20T
13	DPT Kit	--
14	Platform trolley	3/5 Ton
15	Pinion puller for traction motor	--
16	Distilled water plant for treatment of battery	--
17	Welding machine,	--
18	Hydraulic jack	10 Ton

III. Required Spare partsto be available for undertaking POH of Tower Wagons

SN	Details of Spare Parts	Rating
1	Front lookout glass set	1 Tower wagon set
2	Observation dome.	1 Tower wagon set
3	Dashpot & axle suspension bearingOil	SS-68,VG1000
4	Batteries	6V,120AH (LML or VRLA) & 290AH (LMLA)
5	DC fans	110V 400mm,300mm & 225 mmSweep
6	LED light	9W,110VDC
7	Pantograph	AM-12
8	Main Compressor	ELGI,1000 lpm
9	Rectifier Blower	110VDC
10	A9, SA9, C2W, Duplex Check valve,Non return Valve, Safety Valve, N-1reducing valve, Horn,Horn switch, wiper assembly, Feedvalve, Throttle valve, Guard valve,Angle cock & Pilot valve etc.	--
11	Double row self-aligning sphericalroller bearing	22328/C3
12	Wheel disc, Axle, Axle box housing,Collar, Axle box front cover, finishmachined rear cover, lowerrubber washer, Collar for axle box,securing cup, retaining ring, feltring, rubber snubber, sealingring, wheel tag, locking plate,leather washer, rubber packingring, split pins & spring washer etc.	--
13	K-type non-asbestos brake blocks	16 nos. per Tower Wagon.

14	Axle box helical spring	16 nos. per Tower Wagon.
15	Bolster helical spring Inner & Outer	8 nos. inner & 8 nos. outer.
16	Screw coupling, Draw geararrangement, Cattle guard	1 no. each
17	Twin beam head light, Marker light,flasher light	1 no. each.
18	MCBs	2Amp, 3 Amp, 5 Amp, 6 Amp,10Amp, 16 Amp, 20 Amp, 35Amp DC.
19	Overload relay	650Amp
20	Pressure Switch	SMC type
21	Control Relay	110VDC
22	Ammeter Shunt	1000 Amp,75 m volt
23	Voltmeter	0-50VDC & 0-150 VDC
24	TM Current meter	0-1000Amp.
25	Stator, Armature, Carbon brush,brush holder, pinion, PE & CEbearings & set of end shield	For TM type (2141A, C1005. 4303BY,4601AZ or similar)
26	Spare parts of all brake system related item	--
27	Different types of relay, contactor for switch box	--
28	All Spare parts for POH of Rectifier,	--
29	All spare parts for POH of Pantograph	--
30	All spare parts for POH of Bogie(For DETC)	--
31	All spare parts for POH of other electrical itemsuch as head light, tail light, markerlight, search light, fog light, BL box,Master controller.	--
32	Different type of switches, cables, wooden wedge, brake pipes, wipers etc.	--

IV. Other Infrastructure to be available for undertaking POH of Tower Wagons

SN	Details of Other infrastructure.	Rating
1	High bay shed with Cranefacility & Pit facility	Length 30 mtrs (approx.)
2	Paint machines, Washing Lines	--
3	Trial Lines for run test of TW	--
4	Check sheets &Proforma	--
5	02 nos. crane along-with liftingtackle	40/5 Ton
6	Trussle for berthing of Tower Car	--

Annexure-08

OEM manual (M/s Wabtec) for Brake Overhauling:

/// 11. Recommended maintenance schedule for air brake equipment

This device requires the following maintenance operations:

Note: The following table specifies general schedule for the components,
However, it is advisable to refer the individual manuals for the exact schedule if provided.

Legend for the Maintenance Table

E	Visually examine for loose fastenings, leaks or other damages
C	Clean
X	Renew material/Item Replacement
T	Operate and / or Check Performance
T*	Operate and / or check performance as part of the brake equipment system
O	Overhaul
H	Hydrostatic Test

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RECOMMENDED MAINTENANCE SCHEDULE FOR AIR BRAKE EQUIPMENTS (Only for FTIL scope of supply)

Ref	Part No	Description	1 Month	6 Months	1 Year	2 Years	3 Years	5 Years	8 Years	10 Years	Remarks
A04	FT0050204-000	AUXILIARY RESERVOIR 200 LTS			E/C					H	
A05	522001000	J-1 SAFETY VALVE ASSY-1"NPT			T*		O				
A03, A08	702001100	CHECK VLV 1½" BSPT OGA-02-0021			T*			X			
A12	703001200	CUT OFF COCK W/O VENT 1/4"BSPT			T*			X			
A13	518001400	D-1 AUTO DRAIN VLV. W/TC			T*		O				
A09, D04	703010200	1/2" DRAIN COCK			T*			X			
A10	703006300	CUT OFF COCK W/VENT 1" BSPT			T*			X			
A11, V02	709005000	J-1 FILTER WITH DRAIN COCK			T*/C			X			
B02	502001000	A9 AUTO BR VLV ASSY			T*		O				
B03	503001000	SA9 IND BR VALVE			T*		O				
B12	705023400	RESERVOIR 09 LITRES			E/C					H	
S01	714003000	SANDING CONTROL VALVE			T		O				
B17	608001100	BRAKE HOSE COUPLING		E/C				X			
B04	537001100	EMERGENGY BRAKE VALVE			T*		O				
B07	FT0050183-100	4"DUPLEX PRESSURE GAUGE(MR-BP)									
B06	704013400	PRESSURE GAUGE 4"(BC) W/LED			T			X			
C01	706007000	8"X3-3/4" JSL BRCYL W/SA'A'-40		E/C				O			
C02	799500280	SPRING BRAKE CHAMBER – PARKING BRAKE		E/C				O			
C03	546101000	PARKING BRAKE ASSEMBLY		E/C				O			
C04	546102000	QUICK RELEASE MECHANISM		E/C				O			
C05	708008500	HOSE ASSY 1/2"x 700I SAE100R1 AT		E/C				X			
D01, V01	703003200	CUT OFF COCK W/O VENT 1/2"BSPT			T*			X			
D02	609006100	2 WAY CDC W/SINT BRON FILTER - PBS					O				
D03	702004200	CHECK VLV W/CHOKE DIA 3			T*			X			
D04	FT0050205-000	AIR RESERVOIR 150 LTS (SS)			E/C					H	
D05	038001000	HORIZONTAL LEVELING VALVE TY-5						X			
D05	038102500	INSTALLATION LEVER ASSEMBLY						X			
D05	FT0051153-A00	DUPLEX CHECK VALVE						X			

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D06	708009800	HOSE ASSY 3/8"x 500I SAE100R1 AT		E/C				X			
B05, P04, S04	703002200	3/8 " CUT OUT COCK			T*			X			
	FT0050227-000	RESERVOIR 20 LTS (SS)			E/C					H	
	702010600	DRAIN VALVE			T*			X			
S02	031001000	SANDING NOZZLE			T		O				
V03	523002700	N-1 REDUCING VALVE 1/2"BSPT THD						X			
P02	AB441-T16	HAND OPERATED HORN VALVE- PB TYPE			T						
A16	703002300	CUT OFF COCK W/VENT			T*			X			
A17, V07	709004100	3/8"BSP AIR STRAINER-TYPE Y			T*/C			X			
B18	708010800	DUMMY COUPLING TYPE"F"WITH CHA		E/C				X			
A06	029003100	AIR DRYER MEM., W/MUF., MNTG BKT			T*		O				
A07	029001000	FINAL FILTER (975-075)			T*		O				
B16	607001500	1-1/4"CUTOFF ANGLECOCK BP W/V			T*			X			
A15, S03	516013000	MAG VLV - 3WAY NC-110V SR-3038			T*		X				
P01	714001200	PNEUPHONIC HORN - DUAL TONE			T						
A14, B09, P03, V06	707002500	PRESSURE SWITCH RT 116 (PB/SS)			T						
B11	703003100	COC W/VENT 1/2"BSP OGA-02-22			T*			X			
B08	704013600	PRESSURE GAUGE 4"(PB) W/LED			T			X			
B14	780003000	SOLENOID VALVE 3325B (110V-DC)		E/C			X				
B13	523002600	N-1 REDUCING VALVE			T*		O				
B10, V04	702005000	½" CHECK VALVE (SOFT SEATED)			T*			X			
V05	FT0050193-007	PRESSURE GAUGE 4"(FP) W/LED			T			X			
P05	702003400	24-A DOUBLE CHECK VALVE			T*		O				

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Annexure-09

OEM manual (M/s CGL) for Propulsion system items Overhauling:

CHAPTER X

RECOMMENDED SPARES & TOOLS

LIST OF RECOMMENDED CONSUMABLE MAINTENANCE SPARES FOR DIESEL ELECTRIC TOWER CAR - US

1.	Carbon Brushes for Traction Motor	-	8 Sets
2.	Phase fuse for Rectifier Regulator	-	2 Nos.
3.	Field Fuse for Rectifier Regulator	-	2 Nos
4.	HRC fuse for Controlgear	-	1 Set
5.	Trip Fuse for power rectifier	-	6 Nos.
6.	Carbon Brushes for Blower Motor	-	2 Sets

* * * * * * * *

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RECOMMENDED LIST OF SPARES FOR 2 YEARS FOR 2 SETS OF DIESEL ELECTRIC TOWER CAR - US

1) TRACTION ALTERNATOR

1.1	Ball Bearing	:	1set
1.2	Diodes	:	2sets

2) TRACTION MOTOR

2.1	Armature	:	1No
2.2	Stator Assembly	:	1No
2.3	Carbon Brushes	:	8 Motor sets
2.4	Brush Holders	:	2 Motor sets
2.5	Armature Bearings (CE & PE)	:	2 Nos.each
2.6	Axle Bearings (CE & PE)	:	2 Motor sets
2.7	Lubricators (2Nos/set)	:	2 Motor sets
2.8	Gear Case felt seals	:	2 Motor sets
2.9	Gear Case	:	1set
2.10	Bellows	:	2 Nos.

3 AUXILIARY ALTERNATOR

3.1	Set of Bearings	:	2 Sets.
3.2	Rotor - Fan - Driving end side	:	1 No.
3.3	Alternator pulley - 4 groove 224mm PCD	:	1No.

4)	RECTIFIER REGULATOR		
4.1)	Regulator rack	:	1No.
4.2	Excitation Transformer	:	2Nos.
4.3	Current Transformer	:	2Nos.
4.4	Voltage Detector DT 1	:	1No.
4.5	Voltage Detector DT 2	:	1No.
4.6	Field Rectifier Diodes D5, D6, D7 fixed on the Aluminium plates	:	1set (2 Pcs/set)
4.7	Magnetic Amplifier	:	1No.
4.8	Capacitor assembly C1, C2 & C3	:	2sets
4.9	Rheostat Rh1 & Rh2 - 1 no each	:	2sets
4.10	Rectifier Board Assembly	:	1No.
4.11	Control Rectifier Assembly	:	1No.
4.12	Phase fuse	:	2Nos.
4.13	Field Fuse	:	2Nos.
4.14	DMC Terminals (7 Nos/set)	:	1set
4.15	Resistance RB I	:	1No.
4.16	Power Diode	:	1No.
4.17	Gasket for Rect. & Reg. Assembly	:	2Nos.
5.	CONTROL GEAR		
5.1	HRC Fuses	:	1 set
5.2	Resistors 36ohms, 300W	:	1 set
5.3	Earth Fault Relay	:	1 No.
5.4	General Purpose Relay	:	5 Nos.
5.5	Toggle Switches	:	5 Nos.
5.6	Reverse Current Diode	:	2 Nos.
5.7	Arc Chutes for Contactor	:	2 Nos.
5.8	Cam Switches (Master Controller)	:	5 Nos.
5.9	Bearing for Master Controller	:	2 Nos.
5.10	MCB	:	5 Nos.

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LIST OF SPECIAL TOOLS

	EQUIPMENT	QTY
1.	TRACTION ALTERNATOR	
1.1	Lifting Shackle	1 No
2	TRACTION MOTOR	
2.1	Lifting Shackle	1 No
2.2	Extractor for PE Bearing inner race	1 No
2.3	Extractor for CE bearing	1 No
2.4	CE protecting sleeve and lifting cap	1 No
2.5	Retaining plate for PE Bearing	1 No
2.6	Lifting Cap P.E.	1 No
2.7	Protecting Sleeve PE Bearings	1 No
3.	Auxiliary Alternator	No Special Tools required.
4.	Control Gear	No Special Tools required

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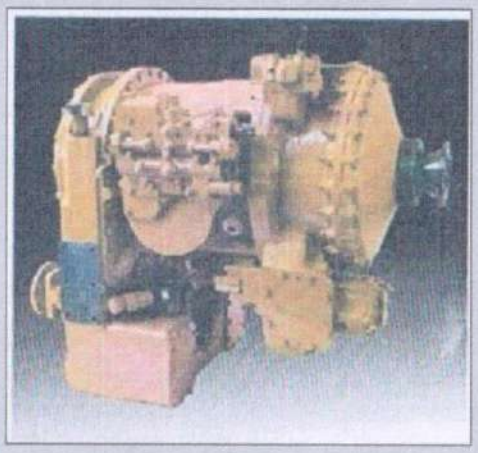
Annexure-10 A

OEM manual (M/s AVTEC Hindustan Transmissions) for DHTC with CRT 5000 series and OEM instructions for Transmission Oil for 5633 Series

OPERATORS MANUAL

Allison Transmissions CRT 5633 Series



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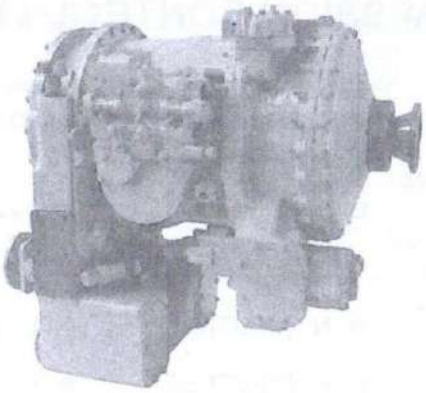


A LOOK AT THE CRT 5000 SERIES

These transmissions set the standard for reliability and high work output. ALLISON CRT's are reversing transmissions that provide: full-power crowd and bucket loading ability-continuous, sensitive feel of the load-hydraulic clutch cutoff-smooth handling of off-balance loads-positive positioning for load spotting-faster reversing.

Matched with engines in the 175 to 350 horsepower class these rugged and complete units contain all transmission components in one compact package. This package consists of a torque converter for powerful starting torque, a forward and reverse planetary gear set and two range planetary gear sets. Hydraulic actuated clutches provide smooth, fast, full-power shifting in each of the three forward and three reverse ranges and smooth transition between forward and reverse operation.

Optional features include: remote mount or direct engine mounted-parking brake-oil filter remote mount or on transmission-speedometer drive-choice of popular flanges-power takeoff-implement pump drive-clutch cutoff valve (air or hydraulic) - choice of 7 torque converter ratios.

TRANSMISSION CONTROL LEVERS

The following shift patterns show the sequence of the shift levers for the directional control and the range control for all models.

Directional Lever	Range Lever
• F (FORWARD)	• N (NEUTRAL)
• N (NEUTRAL)	• L (LOW)
• R (REVERSE)	• I (INTERMEDIATE)
	• H (HIGH)

OPERATING TIPS

Starting Engine

Place the selector lever in neutral position before starting the engine. If the transmission is equipped with a neutral start switch, the switch will prevent the engine from starting unless the selector lever is in neutral. If the starter will not operate in neutral, or will operate in any range other than neutral, call this to the attention of your maintenance personnel.

Pressures, Temperatures

When gages are provided for indicating transmission pressures and temperature, check them frequently to determine if readings are within normal range. Normal operating range is 180° to 200°F. The oil temperature should not exceed 250°F. Should the temperature reach this limit, the vehicle should be stopped, shifted to neutral, and the entine operated at 1200 to 1500 rpm. The temperature should fall to normal before operating the vehicle any further. If the high temperature persists, stop the engine and have the overheating condition investigated by your maintenance personnel.

2

- The rear disconnect is in the OFF position.
- The range selector lever is in NEUTRAL
- The directional lever is in NEUTRAL
- The clutch cutoff is in the ON position and the service brakes are applied.

Towing or Pushing

Before towing the vehicle, be sure to lift the drive wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing. Because of the design of the hydraulic system, the engine cannot be started by towing or pushing the vehicle.

Parking Brake

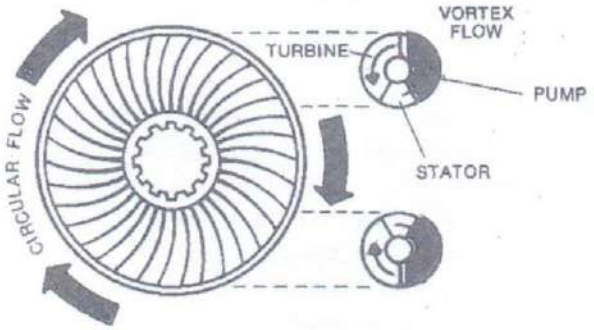
Since there is no "park" position in the shift pattern, the parking brake must be applied to hold the vehicle when it is unattended.

MAINTENANCE INSTRUCTIONS

OPERATION AND FUNCTION OF THE TORQUE CONVERTER

The torque converter, driven by the engine, is the input member of the transmission. It multiplies engine torque and provides a hydraulic cushion between the engine and the load. No disconnect clutch is needed.

The torque converter includes the pump, stator and turbine. The engine drives the pump, which throws oil against the turbine vanes. The turbine transmits torque to the transmission gearing. The stator redirects the oil to the pump in a direction which will assist pump rotation. This redirection of oil is the key to torque multiplication.



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CAUTION : The engine should never be operated for more than 30 seconds at full throttle with the transmission in gear and the vehicle not moving. Prolonged operation of this type will cause excessively high transmission oil temperature which will damage the transmission.

The transmission oil pressure gage indicates clutch application pressure. The needle will vary with transmission shifting and speeds but should return to normal at normal engine operating speeds. Shut the engine off if the pressure remains abnormal and have the condition investigated by your maintenance personnel.

Speed Limitations When Shifting

The transmission can be upshifted or down-shifted even at full throttle. There is no speed limitation on upshifting. However, a downshift must not be made if the vehicle speed exceeds maximum speed normally attainable in the next lower gear. Downshifting at excessive speed will overspeed the engine.

Changing Direction of Travel

When shifting from forward to reverse, or reverse to forward, the throttle should be closed and the vehicle braked to a slow (creeping) speed. Then the shift to the opposite direction may be made, and the throttle reopened when the vehicle begins to move in the opposite direction.

Sense-Feel Operation

Some transmissions are equipped with a "sense-feel" valve which provides a definite hydraulic retarding force against shifting the directional lever from neutral to forward or from neutral to reverse. The retarding force persists until full clutch engagement occurs, then is automatically cancelled. The operator has the sensation of "picking up" the load, and can more accurately gage the application of the clutch.

5

Inching Control

Some transmissions are equipped with an inching control feature. This is a valve which is controlled by the operator separately from the range selector and the directional selector.

This valve is manipulated by the operator to accurately control the application of main pressure to the forward or reverse clutch. Thus, the operator has a feel of the load pick up and precise "inching" of the load.

Clutch Cutoff Control

Some transmissions are equipped with a clutch cutoff, or "declutch" device. This control eliminates the need to shift to neutral when full engine power is needed to drive accessory equipment, such as a bucket. The device is activated when the operator fully applies the service brakes. After the brake pedal passes through the first portion of the stroke (some linkages have a detent), the clutches are completely released. When the brake pedal is released the clutches are re-applied. Some installations are equipped with an on-off switch which allows the operator to lock out the clutch cutoff when it is not wanted. For example, when "roading" the vehicle over long distances, or when inching the vehicle forward or backward in thigh quarters and the clutch cutoff, with each brake application, is not wanted.

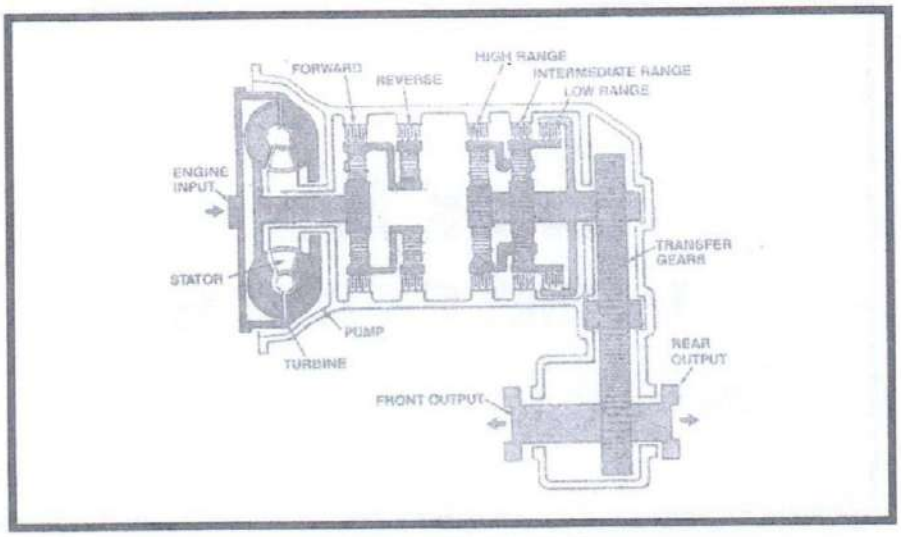
Power Takeoff Operation

All transmissions have provisions for a power takeoff (PTO) at the front of the transmission. It is engine driven and rotates whenever the engine is running.

In most applications, the power takeoff is continuous and is used to drive a hydraulic pump which supplies hydraulic pressure for the operation of various accessories.

In addition to the engine driven power take-off, mentioned above, the CRT 5600 series may also have a power takeoff driven by the transmission output. This allows the operator to operate the power takeoff in either low-, intermediate- or high-range as well as for-ward or reverse. A mechanical disconnect allows the operator to engage or disengage the power takeoff. The power takeoff will not operate when:

6



INSIDE THE CRT 5000 SERIES

Torque Converter

The torque converter includes the pump, stator and turbine. It functions as a torque multiplier, or as a fluid coupling, depending upon load and operating conditions.

Planetary Gearing

The planetary gear train consists of four constant mesh planetary gear sets. The front set is the forward set, followed by the reverse, the high-range and the intermediate-range set. These planetaries are combined with five clutches to provide three forward ranges and three reverse. The operator controls the application of the various clutches by moving the directional control lever and the range control lever. The transmission output is a transfer gear case (drop-box) which permits both a forward and a rear output. A parking brake mounted on the rear output is available as an option.

Hydraulic System

A single integral hydraulic system serves the converter and the range gearing. Oil for all hydraulic operations is supplied by the same integral sump and is returned to it.

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CARE AND MAINTENANCE

Periodic Inspections

A minimum of maintenance is necessary on your ALLISON POWER SHIFT transmission. However, careful attention should be given to all control linkages and to the oil level. For easier inspection, the transmission should be kept clean. Make periodic inspections for loose bolts, leaking oil lines or wet split lines

Importance of Proper Oil Level

Maintaining the proper oil level is very important. Transmission oil cools, lubricates, and transmits power. If the oil level is too low the converter and clutches will not get a proper oil supply, resulting in poor performance. If the oil level is too high the oil will become aerated, causing overheating.

Daily Pre-start Checks

Control Linkage

1

Check the transmission shift control linkage and the directional linkage to ensure that the linkages are free and that the selector levers are properly positioned. The shift levers should engage in all shift tower positions freely. Inspect the linkages for binding wear, cracks, breaks or defective cotter pins.

Cold Oil Level Check

2

The cold check (engine not running) is made to determine if there is sufficient oil to safely start the engine-especially if the vehicle has been idle. The oil level should be at or near the full-level check plug. Some transmissions have one plug, others have two plugs-an ADD and a FULL plug.

Hot Level Check

3

Oil level must be checked with the engine running at 1000 rpm, transmission in neutral and with the transmission at normal operating temperature (180° to 200°F). The upper check plug (if there are two plugs) indicates the full oil level while the lower plug is the add level. The oil must be maintained at the FULL level. If there is only one check plug, the oil level must be maintained at this level. Add oil if necessary to bring the level to the FULL mark.

NOTE: Observe the type of flow from the plug opening. If it is aerated or flows freely in a full stream, allow the oil to drain down to the full level before replacing the plug.

9

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Torque Converter

The oil should be changed every 1000 hours of operation or sooner, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odor. The filter screen in the sump should be removed and cleaned with mineral spirits at each oil change.

Planetary Gearing

The filter elements should be replaced at each oil change and at 200 hour intervals between oil changes. The filter shells should be cleaned. New gaskets and seal rings must be used when replacing filter elements. After installation, check the filter for oil leakage while the vehicle engine is running.

It is absolutely necessary that the oil put in the transmission be clean. Oil must be handled in clean containers, filter etc., to prevent foreign material from entering the system.

Hydraulic System

At temperatures above - 10°F, pour hydraulic transmission fluid type C-2 into filler opening. At temperature below - 10°F, an auxiliary pre-heat is required to raise the temperature in the sump. Use only C-2 fluids from approved manufacturers. See your dealer for this approved list.

For the CRT 3000 series, the refill capacity is 5½ US gallons for the straight-through models and 7 gallons for the drop-box models. For the CRT 5000 series, the refill capacity is 11¼ US gallons.

Make the Cold Oil Level Check and the Hot Level Check as described above.

The breather should be kept clean at all times. It should be checked and cleaned regularly and as frequently as necessary, depending upon the operating conditions. A badly corroded or plugged breather restricts proper breathing, causing oil leaks.

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(C) AERATED (foaming) OIL

	Cause		Remedy
1.	Incorrect type oil used	1.	Change oil; use proper type
2.	High oil level	2.	Restore proper oil level
3.	Low oil level	3.	Restore proper oil level
4.	Air entering suction side of oil pump	4.	Check oil pump bolts and gasket
5.	Air entering at clutch cutoff valve (air actuated)	5.	Check plug seal and sealring of valve

(D) VEHICLE WILL NOT TRAVEL

1.	Low clutch apply pressure	1.	Refer to (A)
2.	Selector linkage broken or disconnected	2.	Repair or connect linkage
3.	Internal mechanical failure	3.	Overhaul transmission

(E) VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED

1.	Selector linkage out of adjustment	1.	Adjust linkage
2.	Clutch failed (won't release)	2.	Overhaul transmission

(F) VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED

1.	Low clutch apply pressure	1.	Refer to (A)
2.	Low converter-out pressure	2.	Refer to (A)
3.	Engine malfunction	3.	Check engine; refer to engine service manual
4.	Aerated oil	4.	Refer to (C)

(G) CLUTCH CUTOFF VALVE INEFFECTIVE

1.	Valve or plug sticking	1.	Rebuild control valve body assembly
2.	Brake apply hydraulic pressure incorrect	2.	Check pressure at control valve (min-max limit-130-2000 psi)
3.	Brake apply air pressure not reaching air cylinder	3.	Check at air cylinder (35 lb force required to stroke valve)
4.	Plunger sticking in air cylinder	4.	Check operation of air cylinder
5.	Air entering at valve (air actuated)	5.	Check operation of air cylinder (seals)

PRESERVATION AND STORAGE

Preservative Method Selection

When transmissions are to be stored or remain inactive for extended periods of time, specific preservative methods are recommended to prevent rust and corrosion damage. The length of storage will usually determine the preservative method to be used. Various methods are described below.

(1) The following procedures will prepare a transmission for a month to 6 weeks storage, depending on the environment.

(2) Drain the oil. Remove the transmission oil filter element(s).

(3) Install the drain plugs and new filter element(s).

(4) Fill the unit to operating level with any commercial preservative oil which meets the US Military Specification MIL-L-21260, Grade 1.

(5) Operate the unit for at least 5 minutes at a minimum of 1000 rpm. Shift the transmission slowly through all selector positions to thoroughly distribute the oil, then shift to forward (high) range and stall the transmission output to raise the oil temperature to 225°F.

CAUTION: Do not allow temperature to exceed 225°F. If the unit does not have a temperature gage, do not stall for more than 30 seconds.

(6) As soon as the unit is cool enough to touch, seal oil openings and breathers with moisture-proof tape.

(7) Coat all exposed, unpainted surfaces with a good grade of preservative grease, such as a petrolatum that meets US Military Specification (MIL-C-11796), Class 2.

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Control Linkage Adjustment

Manual shift linkage must be adjusted so that the operator's control is positioned to exactly match the detent position of the selector valve on the transmission. Adjust the linkage so that it can be freely connected without moving either the valve or the operator's control. Then operate the range selector lever, the directional selector lever and the output disconnect (if applicable) through each position. Make minor adjustments, if necessary, to insure that each of the selector levers seats in each position of the operator's control. Then inspect the control linkage for binding wear or breaks.

Parking Brake Adjustment

The internal, expanding shoe-type of parking brake is mounted on the rear of the transmission housing at the output. Following is the procedure for adjusting the parking brake.

- Adjust the brake shoes for proper drum clearance by inserting a screwdriver or brake adjusting tool into a hole at the rear of the brake drum, and rotating the star wheel between the lower ends of the brake shoes. The star wheel should be rotated until 0.010-inch thick feeler gages are held snugly between the adjusting ends of the shoes and the brake drum. Use two thickness gages simultaneously-one on each shoe.
- Adjust the vehicle brake linkage by releasing the hand lever fully, and adjusting the connecting linkage so that it can be freely connected to the apply lever on the brake. All slack should be taken out of the brake, without actually moving the brake shoes, when the linkage adjustment is made.

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TROUBLESHOOTING

A transmission malfunction should be investigated immediately to prevent further damage to the transmission. Some evidences of malfunctioning are overheating, poor performance or unusual sounds.

The following charts lists the possible causes of, and remedies for, transmission troubles. As indicated in the chart, the engine and transmission must be considered as a single package when searching for trouble.

(A) LOW CLUTCH APPLY PRESSURE (transmission oil pressure gage)

	Cause		Remedy
1.	Low oil level	1.	Add oil to correct level
2.	Clogged oil strainer	2.	Clean strainer
3.	Clogged oil filter	3.	Replace filter element
4.	Inching control adjustment not fully retracted	4.	Check, adjust linkage
5.	Air leak at intake side of oil pump	5.	Check pump mounting bolts
6.	External oil leakage	6.	Tighten bolts or replace gaskets
7.	Brake hydraulic (or air) pressure applying clutch	7.	Check brake residual pressure (brakes released); release
8.	Internal failure	8.	Overhaul transmission, or repair subassembly

(B) OVERHEATING

1.	High oil level	1.	Restore proper oil level
2.	Clutch failed	2.	Rebuild transmission
3.	Vehicle overloaded	3.	Reduce load
4.	Low clutch apply pressure	4.	Refer to (A)
5.	Engine water overheated	5.	Correct engine overheating
6.	Cooler oil or water line kinked or clogged	6.	Clean or replace line

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(8) Repeat the above procedures ((5) through (7)) at monthly intervals for indefinite storage.

Storage, 1 Year -Without Oil

(1) Drain the oil.

(2) Seal all openings and breathers with moisture-proof tape.

(3) Coat all exposed, unpainted surfaces with a good grade of preservative grease.

(4) Atomize or spray 2 ounces of Motor-stor*, or equivalent, into the transmission through the oil pan drain plug.

(5) If additional storage time is required, (3) and (4), above, should be repeated at yearly intervals.

Storage, 1 Year -Without Oil

(1) Drain the oil. Remove the transmission oil filter element(s).

(2) Install the drain plugs and new filter element(s).

(3) Fill the transmission to operating level with a mixture of 30 parts type C-4-transmission fluid to 1 part Motorstor, or equivalent.

(4) Operate the unit for approximately 5 minutes at a minimum of 1000 rpm. Shift the transmission slowly through all selector positions to thoroughly distribute the oil, then stall the converter to raise the oil temperature to 225°F.

Caution: Do not allow temperature to exceed 225°F. If the unit does not have a temperature gage, do not stall for more than 30 seconds.

(5) As soon as the unit is cool enough to touch, seal all openings and breathers with moisture-proof tape.

* Motorstor is a preservative additive manufactured by the Daubert Chemical Company, Chicago, Illinois. Motorstor (under the designation of "Nuice Oil") is covered by US Military Specifications MILL-L-46002 (ORD) and MIL-I-23310 (WEP).

(6) Coat all exposed, unpainted surfaces with a good grade of preservative grease.

(7) If additional storage time is required, (3) through (6), above, should be repeated at yearly intervals, except it is not necessary6 to drain the transmission-just add the Motorstor, or equivalent.

Restoring Units to Service

(1) If Motorstor, or equivalent, was used in preparing the transmission for storage, use the following procedures to restore the unit to service.

(2) Remove the tape from openings and breather.

(3) Wash off all the external grease with solvent.

(4) Add hydraulic transmission fluid, type C-4 to proper level.

NOTE: It is not necessary to drain C-4 oil and Motorstor mixture from the transmission.

(5) If Motorstor, or equivalent, was not used in preparing the transmission for storage, use the following procedures to restore the unit to service.

(6) Remove the tape from openings and breathers.

(7) Wash off all the external grease with solvent.

(8) Drain the oil.

(9) Install a new oil filter element(s).

(10) Refill transmission with hydraulic transmission fluid, type C-4 to proper level.

	Approved Allison Transmission Fluids	Manufacturer
1.	Power Glide C4-310 or C4-330	Hindustan Petroleum Corporation.
2.	SERVO Transmission C-4 SAE 10 or C-4 SAE-30	Indian Oil Corporation
3.	Tide Water Transgear C-4 SAE-10 or C-4 SAE-30	Tide Water Oil Company (India) Limited.

ANNEXURE 10 B

OEM (M/s AVTEC Hindustan Transmissions) instructions for Transmission Oil for DHTC with CRT 5633 Series

SL NO	AVTEC LIMITED FEEDBACK - CRT 5633 TRANSMISSION ASSY			
	Transmission Oil			
	The Transmission oil used in the transmission is very critical as it			
1	Provides the working medium for the torque converter , controls , and clutch application			
2	Transfers heat from the transmission to the cooler			
3	Serves as a lubricant which carries rust inhibiting chemicals throught the transmission			
4	Carries contaminant to the filter			
	APPROVE TRANSMISSION OIL GRADE TO BE USED IN TRANSMISSION			
	C4 SAE 30 - Is the approved Transmission grade of oil to be used in the transmission in normal ambient operating condition			
	APPROVED SOURCE OF TRANSMISSION OIL			
	SL NO	**SUPPLIER**	**SUPPLIER BRAND NAME**	**GRADE**
	1	Indian Oil Corporation	SERVO transmission fluid	C4 SAE 30
	2	Bharat Petroleum Corporation	BHARAT hydraulic transmission fluid	C4 SAE 30
	3	Hindustan Petroleum Corporation	POWERGLIDE C-430	C4 SAE 30
	4	Tide water oil company (India) Ltd	VEEDOL TRANSGEAR	C4 SAE 30
	5	Chemoleum Private Limited	CHEMOLEUM transmission oil	C4 SAE 30
	6	Gulf India Limited	GULF HI FLUID	C4 SAE 30
	7	Castrol Limited	DEUSOL TFC 430	C4 SAE 30
	8	Total Raffinage Distribution	Total Transmission AC	C4 SAE 30
	9	ELF lubricants (India) Limited	TRANSELF C4-30	C4 SAE 30
	10	Sunstar Lubricants Limited	LIQUI Moly Trans Fluid	C4 SAE 30
	11	Balmer Lawrie - Fuchs Limited	TITAN FLEX C4	C4 SAE 30
	12	IBP Company Limited	IBP TF	C4 SAE 30
	13	Caltex Lubricants (India) Limited	TORQUE FLUID 430	C4 SAE 30
	14	Valvoline Cummins Limited	Valvolin Driver Train Transmission oil C4 SAE 30	C4 SAE 30
	15	Shell international Petroleum Company Ltd	Shell RIMULA X SAE 30	C4 SAE 30
	16	Pensol Industries Limited	Pensol Trans C4 SAE 30	C4 SAE 30
	17	Exxon Mobile Corporation	Mobile Delvac 1330	C4 SAE 30
	TRANSMISSION SUMP CAPACITY			
	1	The CRT 5633 Transmission oil sump capacity is 49.2 liters		
	2	OEM manuals to be refered for the transmission oil fill capacity as the sump capacity is not considering the external circuit requirement like cooler line and filter line		
	CHECKING OF TRANSMISSION Oil			
1	Transmission oil level to be checked every day before cranking the engine to understand if sufficient qty of oil is available in the transmission to crank the engine			
2	After checking the transmission oil is sufficiently available to crank the engine actual oil level to be checked in Transmission as advised in the Transmission service manual / OEM manual			

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3	checking of transmission oil level is through the uses of" Full" and or " add" plug provision in the rear of the transmission drop box in some cases the OEM provides a dip stick - refer to Transmission manual / OEM maintenance manual for proper oil level check		
4	Low Oil level - Operating the transmission with low oil level will affect the reliability of the transmission		
5	High Oil level - High oil level in transmission other than the recommended limit will lead to churning in the transmission and overheating and will also affect the transmission clutch plate life and churning operation will cause foaming in the transmission		
6	Maintaining proper oil level is vital for the transmission performance add or remove oil as required while checking the oil level as advised in transmission service manual when the transmission is in neutral brake applied and the engine is running , refer transmission service manual		
	OIL CHANGE PERIOD		
1	First oil and filter change after commissioning of the equipment and operating for 50 hours		
2	The second oil change should be changed every 1000 hours of operation or 6 months which ever is earlier or sooner depending upon operating condition		
3	Also oil must be changed when ever there are traces of dirt or evidence of high temperature indicated by discolouration or strong odour		
4	Also oil change must be made if traces of engine coolant / water is present in the transmission oil		
5	Advised to use single brand of oil as changing the oil brand during oil change can create abnormalities as the aditives added by the manufacturer is different		
6	Oil should be drained from the transmission when the transmission oil is warm after taking necessary preacutions on safety so that maximum oil can be drained from the system		
7	During oil change also remove the oil from the cooler line and filter line for better performance of the transmission		

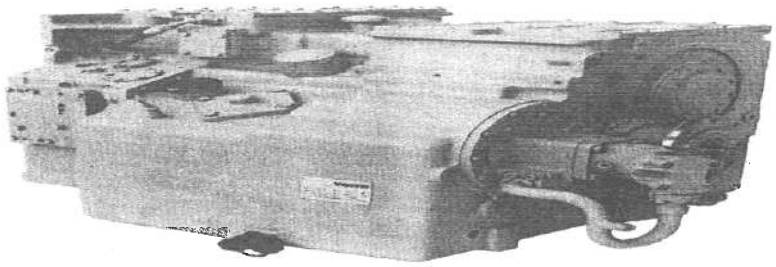
ANNEXURE 11

OPERATING INSTRUCTION FOR M/S VOITH (OEM) MAKE TURBO TRANMSISSION - T311 r OF DHTC

J.M. Voith GmbH D-7920 Heidenheim
Produktgruppe Antriebstechnik

VOITH

OPERATING INSTRUCTIONS
for
VOITH TURBO TRANSMISSION
T 311 r



March 1989
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Dear Customer,

With the T 311 r turbo transmission from **VOITH** you have chosen a field-proven, reliable, and practical hydraulic component for your rail vehicle.

VOITH transmission components are manufactured to high quality standards and are subjected to thorough tests.

Before dispatch, each **VOITH** transmission passes a comprehensive performance check and inspection.

If problems should occur or technical assistance be needed during commissioning or after a longer period of operation, please contact:

Address:	J. M. VOITH GMBH Antriebstechnik 7920 Heidenheim, Postfach 19 40 Kundendienst "Turbogetriebe"
Telephone:	07321/37-0 J. M. VOITH 07321/37-4567 direct line
Telegrams:	Voithwerk Heidenheim/Brenz
Telex:	714 799 80 VH D
Telefax:	(07321) 37 3104

Please always state the number of the transmission concerned!

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Overall view of the VOITH T 311 r turbo transmission

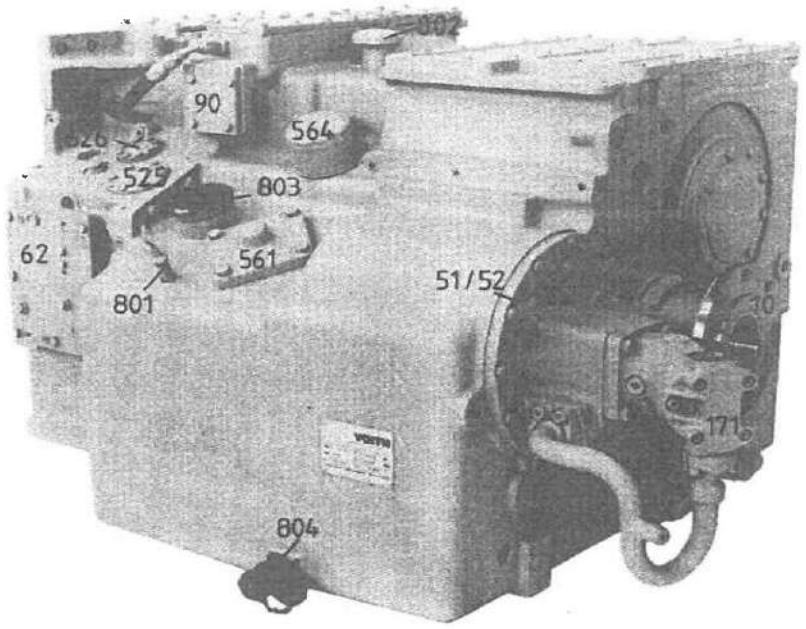

Fig. 1: Front view

10	Input
51	Filler pump
52	Primary control and lubricating pump
62	Governor
90	Rotary actuator
171	Hydrostatic pump
525	Non-return valve
526	Pressure relief valve - control pump
561	Disposable filter
801	Dipstick
802	Breather filter
803	Oil filler neck
804	Oil drain valve

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Overall view of the VOITH T 311 r turbo transmission

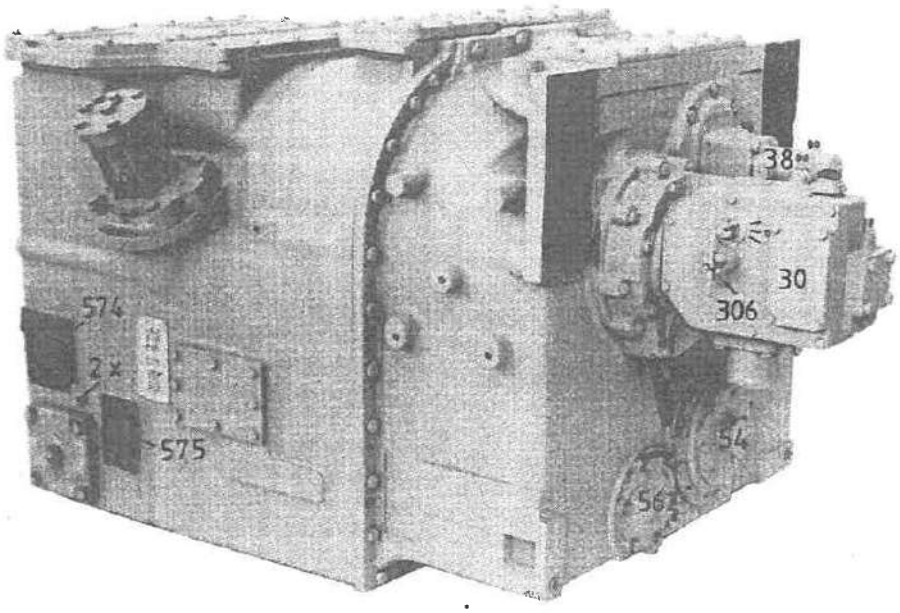

Fig. 2: Rear view

30	Reverse gear operating cylinder
38	Standstill detector valve
54	Secondary lubricating pump
60	Main control
306	Centre position locking pin
562	Pleated filter - secondary lubricating pump
574	Oil outlet to oil cooler
575	Oil inlet from oil cooler
2x	Test point filler pump pressure behind oil cooler

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1. Description

1.1 General

The VOITH T 311 r turbo transmission is a fully automatic hydrodynamic transmission for power transmission in railcars with diesel engine drive. Its principal components are a hydrodynamic torque converter and a hydrodynamic coupling which both transmit power through the inertia forces of an operating fluid (mineral oil).

The torque converter consists of a pump impeller, a turbine wheel, and a stationary reactor. The power-absorbing part, the pump impeller, transforms the mechanical energy delivered by the diesel engine into energy of flow. In the turbine wheel, mechanical energy is recovered by decelerating and deflecting the fluid mass. The torque developing in the turbine wheel depends on the degree of deflection of the fluid. It is greatest when the turbine is stationary and decreases with increasing turbine speed. The purpose of the third main component of a torque converter, the reactor, is to keep the approach direction towards the impeller constant independent of the discharge direction at the turbine wheel. Power absorption of the pump impeller is only slightly influenced by turbine speed. The reactor absorbs the torque difference between pump impeller and turbine wheel, thus permitting a torque multiplication.

The hydrodynamic coupling consists of a primary coupling wheel or a secondary coupling wheel. The torque absorbed and delivered between the primary and secondary coupling wheel is the same. The coupling has a higher hydraulic efficiency than the torque converter.

The speed of the turbine wheel in the torque converter or the secondary coupling wheel in the coupling adapts steplessly to the existing load conditions, thus determining the vehicle driving speed. The hydraulic circuits are engaged by filling them with operating fluid and disengaged by draining them. Filling is effected by the filler pump, a gear pump coupled to the transmission primary side.

The torque converter as speed I and the fluid coupling as speed II each have a specific speed range allocated to them. The control system automatically selects the speed offering optimum power transmission for a given driving speed and master controller position or engine speed. Starting is effected smoothly and without jolts. Equally smooth and jolt-free is the change-over from torque converter to coupling speed, which takes place without interruption in tractive effort. All gears are constantly engaged. Thanks to the hydraulic mode of operation of VOITH turbo transmissions, no mechanical shifting elements liable to wear are needed. This ensures maximum reliability and minimum maintenance.

1.2 Design (see control diagram 3.285-1447)

Transmission input is from the diesel engine onto input shaft 10 and via gears 101 and 102 to primary shaft 103 (hollow shaft). On the primary shaft are mounted pump impeller 111 of torque converter 11 and primary coupling wheel 151 of coupling 15.

The input gear ratio can be changed by gears 101 and 102. This is to match power absorption and input speed to different types of engine.

Turbine wheel 112 and secondary coupling wheel 152 are firmly connected with secondary shaft 23. The torque available at turbine wheel 112 when the torque converter is filled or secondary coupling wheel 152 when the coupling is filled is transmitted to output 20 via the secondary shaft and the gears in the reversing mechanism.

The direction of rotation of the output flange depends on the position of sliding shaft 313.

Direction of rotation A: output flange rotates in the same direction as input flange, power flow: 313/232/201/20.

Direction of rotation B: output flange rotates in the opposite direction to the input flange, power flow: 313/231/221/22/222/201/20.

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1.3 Control

Converter and coupling are controlled by pilot control piston 602 and main control piston 601. Main control piston 601 engages speeds I and II by filling the respective hydraulic circuits with oil. Speed-shifts from speed I to II or vice-versa are effected in such a way that there is no interruption of tractive effort due to a precisely adjusted speed of movement of the main control piston.

1.3.1 Transmission idling (see control diagram 3.285-1447)

When the engine is off, all circuits are drained and all oil lines are relieved. When the engine is idling, the filler and control pumps deliver the oil flow and pressure necessary for filling, control, and lubrication.

Gear 511 on input shaft 10 drives both the filler pump 51 and the control pump 52 via cylindrical gear 515. Filler pump 51 sucks oil from the transmssion sump via filter 561 and delivers it to main control valve 60 via line 514, oil cooler 57, filter 565, and line 576. When main control piston 601 is in idling position, the oil is not fed into one of the circuits.

Pressure relief valve 516 is connected with line 514. Excess oil is returned to filler pump 51 via line 512.

After oil cooler 57, filler pump oil is supplied to the control pump via filter 565 and line 521. Control pump 52 provides control oil for pressure relief valve 565 and governor 62 via lines 522/641. The control oil simultaneoulsy reaches lubrication points 58 through line 524, non-return valve 525, and line 582. Through throttle 563, part of the oil is passed to filter 564 and returns to the sump. The disposable filter effects a fine filtration of the oil.

1.3.2 Engagement/disengagement of the transmission (see control diagram 3.285-1448, speed I)

By bringing the master controller into transmission filling position, line 608 is filled with compressed air by the vehicle control. Pilot control piston 602 presses main control piston 601 downwards until piston 602 comes to its limit stop. The oil delivered by the filler pump flows to the converter via main control piston 601 and supply passage 115. At the same time, main control piston 601 closes drain passage 116. The transmission is engaged.

In the case of automatic speed-shifts from speed I to speed II (see 1.3.3), main control piston 601 is pressed into its end position by the control oil in line 642 (see control diagramm 3.285-1449). Filling passage 115 is closed and drain passage 116 opened so that the converter is drained. The oil in line 576 now flows via passage 154 to the hydraulic coupling.

The transmission is disengaged by setting the master controller to zero. Compressed air line 608 is relieved by the vehicle control. Pilot control piston 602 and main control piston 601 are shifted to their initial position by spring force, thus closing the corresponding filling passage. The coupling is drained through permanent drain ports 153 or the converter is drained through passage 116 open to the sump. The transmission is disengaged.

1.3.3 Governor (see control diagram 3.285-1449, speed II, and sectional drawing 3.285-1441)

Automatic speed-changing is enabled by governor 62 which always engages the speed stage offering optimum tractive effort of the vehicle for the prevailing rail speed and engine velocity.

Governor 62 is driven by output shaft 20 via gears 201 and 639 so that flyweights 621 exert an axial force onto control pin 622 depending on secondary speed or driving speed.

The centrifugal forces are balanced by the force of spring 653 acting on control pin 622 via lever 623. The initial stress of spring 653 is changed by the primary influence air pressure in line 655.

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Depending on which of the two forces acting on it is greater, control pin 622 is either moved into the position for speed II or into that for speed I. Speed-changing takes place at a predetermined ratio of driving speed to engine speed (see section 1.3.4).

The shifting point is determined by the pre-set counterforce of spring 653. When speed increases to a degree that the axial force of flyweights 621 acting on control pin 622 exceeds the force of spring 653, control pin 622 is shifted and opens the way for control oil to flow from line 641 into line 642 leading to main control valve 60 and pushes main control piston 601 downwards into speed II position. As a consequence, line 576 is connected with filling passage 154 and the coupling is filled. At the same time, filling passage 115 is closed and drain passage 160 is opened towards the sump so that the converter previously engaged can be drained.

With decreasing speed, speed-changing takes place in reverse sequence. Control pin 622 shuts off the control oil from line 641 to line 642.

A spring moves main control piston 601 into speed I position. The coupling is drained and the converter filled (see section 1.3.2).

Governor 62 is so adjusted that down-shifting takes place at a slightly lower driving speed than up-shifting. This is to prevent hunting between speed I and speed II when driving near the shifting point.

Governor 62 is also operative while driving with drained circuits. When the transmission is engaged while on the move, the governor 62 therefore always selects the correct speed.

1.3.4 Primary influence on the governor

The shifting point from converter to coupling is fixed in such a way that a large operating range is covered by the coupling whose hydraulic efficiency is higher than that of the torque converter. However, engine lugging must not reach unpermissible levels. Under partial load, i.e. at low engine speeds, the shifting point is at a lower driving speed. Speed shifts take place always at the same ratio of engine to driving speed.

For influencing the shifting points, the air dependent on engine torque acting on piston 654 in primary influence unit 65 is used.

At lower engine speeds, piston 654 does not pre-stress spring 653 in the governor so that flyweights 621 can effect the speed-change at a lower centrifugal force, i.e. at a lower driving speed (partial load shift).

1.4 Reversing mechanism

1.4.1 Reverse gear operating cylinder

The direction of output shaft rotation A or B selected by means of the vehicle control is indicated at reverse gear operating cylinder 30. The direction of rotation of output shaft 20 is determined by the position of sliding shaft 313 (see idling diagram 3.285-1447). Sliding shaft 312 is moved by piston 309 via self-aligning ball bearing 311 and selector rod 310. The piston is switched to direction A by control air in line 301 and to direction B by control air in line 302.

Reverse gear operating cylinder 30 is equipped with a spring-loaded selector mechanism 303/304. This mechanism always presses the reversing piston up to a stop (either "tooth-on-tooth position" or limit stop). No intermediate position is possible without mechanical locking. If control air pressure should fail during a shifting operation, the sliding shaft will reach either the new end position or return to the previous one.

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1.4.2 Control elements

The solenoid valves for operating the reversing mechanism and for transmission filling are installed in the vehicle and controlled from the driver's cab. If a "tooth-on-tooth position" occurs during reversing, rotary actuator 90 is automatically set under air pressure and sliding shaft 313 is turned until it engages.

1.4.3 Monitoring devices

The reversing mechanism can only be operated if the conditions mentioned in section 2.4 are fulfilled. These conditions are monitored by several devices whose design and installation differs according to the customer's requests.

1.4.3.1 Standstill detector valve (see control diagram 3.285-1440.1)

Standstill detector valve 381 prevents forward / reverse shifts while the vehicle is rolling. Compressed air can only pass the valve when the vehicle is stationary, a reversing command has been issued, and control air pressure is at least 5 bar. The air is supplied from the detector valve to rotary actuator 90, to the vehicle control, and from there to reverse gear operating cylinder 30.

If there is control air in line 381, sensor finger 385 in valve 38 is pressed onto intermediate shaft 22 (see control diagram 3.285-1440.1).

If intermediate shaft 22 is stationary, sensor finger 385 remains straight on it and lifts valve plate 384 up so that compressed air can enter lines 907 and 382. If the vehicle is rolling and the intermediate shaft rotating, the sensor finger is deflected and remains so, valve plate 384 is not lifted up. The compressed air does not reach the vehicle control or reverse gear operating cylinder 30, line 382 is not pressurized. The shifting operation has to be stopped and repeated after the vehicle has come to a standstill.

1.4.3.2 End position indicators

The two electrical limit switches 305 are installed in reverse gear operating cylinder 30 and are operated by double lever 312. They monitor the end position of sliding shaft 313. The position of the shaft is indicated in the driver's cab by signal lights. If the end position for the selected driving direction is not reached, switches 305 prevent acceleration of the engine and transmission filling.

1.4.3.3 Centre position locking

The centre position locking mechanism is mounted on reverse gear operating cylinder 30 (see fig. 7). The cylinder must only be locked in centre position for towing in the case of damage to hydraulic components. Note: The safety instructions in section 2.5, 1-3, must by all means be complied with. The engine must not or, if switches 305 are fitted, cannot be started as long as the cylinder is locked in centre position.

1.4.4 Rotary actuator

The purpose of pneumatic rotary actuator 90 is to turn sliding shaft 313 in the case of "tooth-on-tooth position" of the reversing mechanism until it engages with the corresponding coupling gear and reaches its end position.

The control of the rotary actuator is connected with the control circuit of the reversing mechanism.

When the reversing switch is operated, the solenoid valves in the vehicle apply air to lines 381/382/907 and 301 or 302.

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Throttle 908, non-return valve 911, and air tank 909 prevent the rotary actuator from being switched on when there is no "tooth-on-tooth position", i.e. there is no pressure in the entire pipe system of the rotary actuator able to move piston 902.

If there is a "tooth-on-tooth position", control air pressure is applied to the rotary actuator and causes it to work. Push rod 903 on piston 902 in actuating cylinder 901 is pushed between actuating disc 912 and contact roller 904 by the pressure applied to piston 902. Due to the precisely adjusted gap between actuating disc 912 and contact roller 904 and to the spring force acting on lever 905, the actuating disc, secondary shaft 23, and sliding shaft 313 are turned until shaft 313 engages.

When sliding shaft 313 has reached its end position, double lever 312 trips the corresponding limit switch 305 and the solenoid valves are de-energized. The compressed air system is relieved. Actuating cylinder 901 is relieved and piston 902 is reset to its initial position under spring force.

Lines 907 and 382 are relieved via breather hole 386 on standstill detector valve 38.

If, in the case of an unfavourable "tooth-on-tooth position", sliding shaft 313 should fail to engage, the reversing switch in the vehicle has to be set to its centre position. This causes the reversing control circuit to be relieved. After this, the reversing operation can be repeated.

1.5 Cooling

The temperature of the oil in the engaged circuit increases due to the power loss and must therefore be constantly cooled. From the hydraulic circuit, it flows to the sump through permanent drain ports 114 or 153 and through the labyrinths and is then pumped to oil cooler 57 by filler pump 51 via line 514. After cooling, the oil is fed back into the hydraulic circuit via line 576, main control 60, and line 115 or 154.

Under normal operating conditions, the temperature of the transmission oil should be between 70° C and 105° C.

A momentary peak temperature of above 130° C is possible under certain conditions.

Prolonged operation at such a high temperature should be avoided, however, since it progressively leads to a deterioration of oil quality.

The cooling unit must meet the technical requirements mentioned in our Order Confirmation in respect of oil flow rate and the amount of heat to be dissipated. The oil pressure losses in the oil cooler and connecting lines to the transmission must not exceed the specified values.

The stated oil temperatures are before the oil cooler.

1.5.1 Oil temperature monitoring

Transmission oil temperature has to be monitored and displayed in the driver's cab.

The oil cooling system has been designed such that, under normal operating conditions, oil temperature is kept within the permissible limits.

When a temperature of 130° C is reached, transmission and engine have to be set to idling by the loco control. Possible causes for an emergency shuntdown are: contaminated cooling unit, defective temperature sensor, or prolonged operation below the minimum permissible continuous speed.

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1.6 Lubrication

All anti-friction bearings and meshing gears of the transmission are lubricated with filtered and cooled power transmission oil. When the engine is started, the oil is sucked in by filler pump 51 via filter 561 and then delivered to primary control and lubricating pump 52 via filter 565 and line 521 after having passed through oil cooler 57. Pump 52 supplies the oil to lubrication system 58 via line 522, pressure-relief valve 526, line 524, non-return valve 525, and line 582.

While the vehicle is driving, secondary lubricating pump 54 supplies the lubrication points with additional lubricating oil via lines 544 and 582.

When the engine is stopped and the vehicle towed, only secondary lubricating pump 54 remains on. It sucks in oil via filter 562, line 542, and non-return valve 545, and delivers it to lubrication system 58 via lines 544/582. The secondary lubricating pump operates in both directions of rotation.

1.7 Hydrostatic pump (not included in the Voith scope of supply)

Hydrostatic pump 171 is connected with filler pump 51 and driven by a common driving gear 515. The pump converts the movement of rotation to an oil flow by means of pistons. The pump sucks cooled transmission oil from line 521 and supply line 172 and delivers it via pipes and tubes to the hydraulic motor driving the fan impeller of the cooling unit outside the transmission. From there the oil is returned to the oil circuit through return line 173 after cooler 57 and before entering transmission 575.

2. COMMISSIONING AND OPERATION

IMPORTANT: remove "Silica-GEL" bags from the transmission!

Turbo transmissions to be shipped by sea are provided with "Silica-GEL" bags. These desiccant bags must be removed before installing the turbo transmission in the rail vehicle by opening the covers marked .

2.1 Preparations before starting

1. Check oil level or fill new transmission with oil as described under 3.1.
2. Check that reversing mechanism is in end position.
3. Start engine while the master controller is in idling position.
4. If engine speed is to be increased to accelerate air charging, apply the transmission filling inhibitor.

2.2 Starting

Select the desired driving direction by means of the reversing switch (see section 2.4) and set the master controller to transmission filling. The converter will be filled and a higher power stage can be selected. Avoid wheel-slip. If wheel-slip occurs, do not sand but reduce power on the master controller.

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2.3 Mainline operation

The transmission governor automatically engages the correct gear for the prevailing driving speed and master controller position.

If the master controller is set to zero while on the move, the engaged circuit is drained and the engine decelerates to idling speed. This permits a complete freewheeling of the transmission. When reengaging the transmission, the correct circuit (converter or coupling) is filled immediately.

The max. speed stated must not be exceeded, neither under full load nor while the engine is idling, e.g. on descents. Otherwise, the secondary parts of the transmission may be damaged.

2.4 Changes in driving direction

Forward / reverse shifts must only be effected while:

1. The vehicle is stationary.

2. Master controller and transmission are set to idling.

3. The engine is running at idling speed.

4. Control air pressure for operating the reversing mechanism is at least 5 bar.

This is a binding instruction for the driver.

If these conditions are fulfilled, the desired driving direction can be engaged with the reversing switch. The initiated or concluded gear shift is indicated by signal lights in the vehicle. In the case of "tooth-on-tooth position" of the sliding shaft, rotary actuator 90 is operated automatically so that the sliding shaft can engage (see section 1.4.4).

2.5 Manual emergency operation of the transmission (only while the engine is off)

Important: Please note that in the case of manual operation of the transmission the driver is fully responsible for operational safety.

In case of malfunctions interfering with the normal service,

a) the main control valve 60 (speed I)
b) the reverse gear operating cylinder 30

can be operated by hand considering the following points:

1. Stop all engines and protect them from re-starting
2. Apply the vehicle or train brake
3. Operate main control valve 60 or reverse gear operating cylinder 30
4. Start engine without releasing the brake

Note: When releasing the brake the vehicle will start to move also while the engine idles and transmission filling inhibitor is applied.

For safety reasons, these instructions must be strictly observed.

a) Main control valve
In case of failure of the pneumatic actuation of main control valve 60, speed I can be engaged by means of adjusting screw 691. Screw out plug screws 692 and adjusting screw 691 on main control valve 60, insert adjusting screw 691 into the tapped hole as shown on fig. 4 and tighten up to the stop. This causes the converter to be filled already when starting the engine. Subsequent changes to speed II are effected in the normal way by governor 62.

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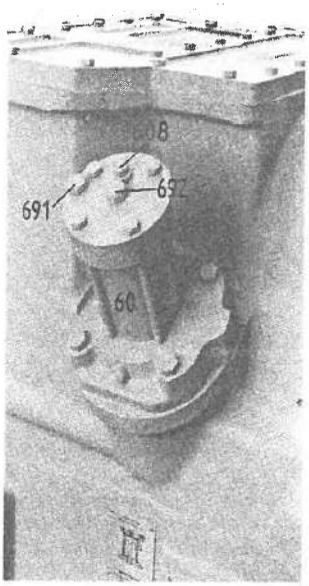
Important: Before changing the direction of driving, main contol valve 60 must be returned to idling. For this purpose, screw out adjusting screw 691 completely.

Fig. 3

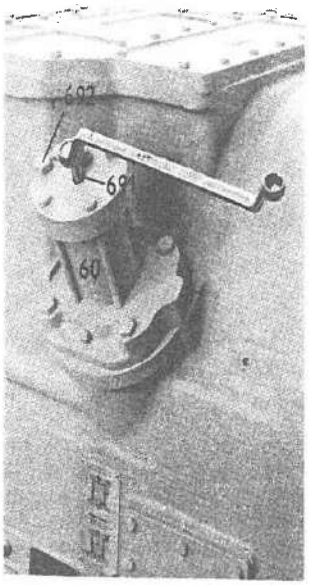


Main control valve, normal operation

60 Main control valve
608 Control air fitting to main control valve
691 Adjusting screw
692 Screw plug

Upon completion of the ride or repair of the defect, adjusting screw 691 and screw 692 have to be replaced on main control valve 60 as necessary for normal operation (see fig. 3).

Fig. 4



Manual emergency operation of main control valve 60

60 Main control valve
691 Adjusting screw
692 Screw plug

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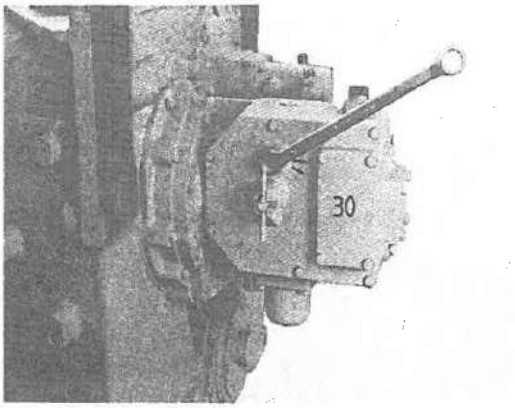

Fig. 5

Operating cylinder 30 in driving direction A.

Turn selector shaft by means of ring spanner SW 19. In the case of "tooth-on-tooth position" switch to and from several times.

b) Reverse gear operating cylinder
If the cylinder control should fail, the driving direction can be reversed manually on operating cylinder 30 (see figs. 5 and 6).

A prerequisite for this is that points 1-2 are fulfilled.

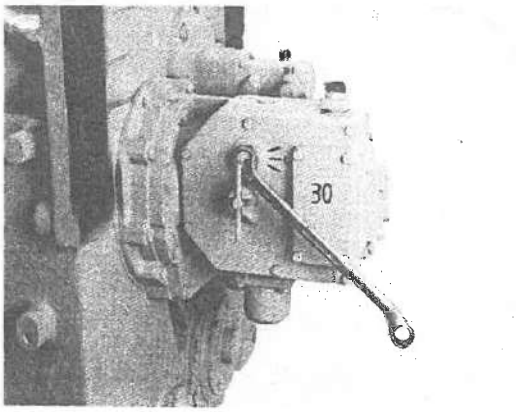

Fig. 6

Operating cylinder 30 in direction of rotation B.

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2.6 Towing

For towing the vehicle, the engine must be switched off and the operating cylinder 30 locked in centre position (see 2.5 and 1.4.3.3).

After that, the vehicle can be towed up to the permissible maximum speed.

If a damage in the mechanical transmission section blocking the axle is suspected, remove the cardan shaft between turbo transmission and axle drive (see 2.5 and 1.4.3.3).

Important: The engine must not be started while cylinder 30 still is in centre position.

Important: Centre position locking only after engine and vehicle have been stopped!

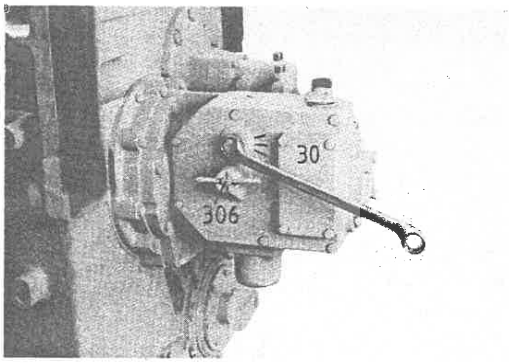

Fig. 7

Operating cylinder 30 locked in centre position.

Pull out locking pin 306, turn it through 90° and insert it into the other groove.

Apply spanner SW 19 to selector shaft and switch to centre position until locking pin 306 engages.

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3. MAINTENANCE

3.1 Filling of the transmission

Before starting the engine, the transmission must be filled with power transmission oil. Filling of the transmission is performed as follows:

1. Remove cover from oil filler neck 803 and pull out dipstick 801.
2. Fill in oil. Approximately 120 l are needed for the transmission, not taking into account the content of the oil cooler or heat ex- changer and piping.
3. Let the engine idle for a couple of minutes and then switch off.
4. Check oil level (fig. 8) and top up, if necessary, until the oil level is between the "min" and "max" bores of the dipstick.
5. If a great quantity of oil has had to be added, repeat (3) and (4).

Permissible oil brands
Use one of the oils included in the enclosed List of Recommended Oils (see appendix) for filling the transmission. Other brands claimed to be of "equivalent" quality, oil mixtures, or contaminated oil are not permissible. If such oil fillings are used, no guarantee can be assumed for the Voith transmission.

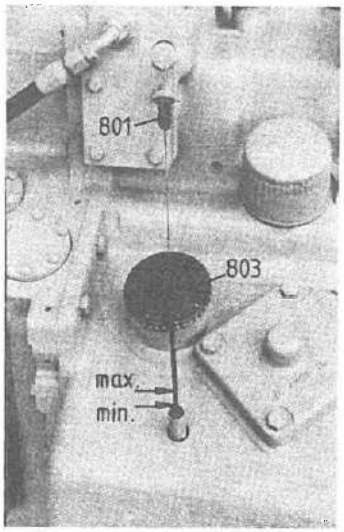

Fig. 8

801 Dipstick pulled out
803 Oil filler neck

The arrows point to the marks for the maximum and minimum permissible oil levels.

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3.2 Maintenance procedure

Survey

Maintenance intervals	Work to be performed
20,000 Kms or 2 years	Check and top op oil level
30,000 Kms or 3 years	Change oil, inspect all control parts, Replace Oil filters in Drawing numbers 561,562,565 and 564.
8,00,000 Kms or 12 years	Do major overhaul (change of bearings, Oil seals, O rings seal rings and rubber components) and damaged parts.

3.2.1 Maintenance after 20,000 Kms or 2 years

Check oil level and top up level (see 3.1)

3.2.2 Maintenance after 30,000 Kms or 3 years

a) Oil change
Under normal operating conditions, the oil filling lasts for a long distance of approx. 30,000 Kms. This period can be extended if the oil sample is still within the tolerance of the specification for new oil.

For changing the oil, drain it off from the valve 804 while it is at operating temperature and drain the oil cooler, too. If oil of a different approved brand is to be filled in , flush the transmission and cooling system with half the quantity of the new oil needed for a complete fill.

b) Replace filters 561,562,564and 565. For this purpose, drain off the oil first, then remove the filters, take off the caps ad remove filter elements (see fig. 10,11 and 12).

c) Check control parts such as Governor 62, standstill detector valve38, operating cylinder 30, main control valve 60 for proper operation, leakage and wear.

3.2.3 Major overhaul (see point 5)

A major overhaul of the transmission is recommended after approx. 8,00,000 Kms or after 12 years of operation, depending upon operating conditions and duty. During this overhaul, the transmission is stripped as far as necessary, Bearings, labyrinth rings, shaft seals etc. are changed and other damaged parts are replaced. A set of special tools are needed for dismantiling and assembly.

If a major overhaul is carried out in our works, the oil has to be drained after the test run. Drain off the oil and filter it after approx 50 operating hours. (see 3.2.2, section a) and remove and clean filters 561/562 and 565.

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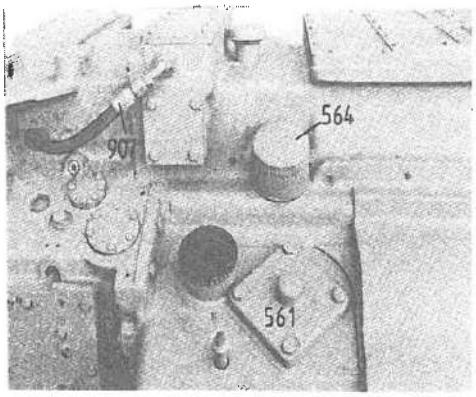

Fig. 9

561 Pleated filter
Intake side of
filler pump
564 Disposable filter
907 Compressed air line
to 90

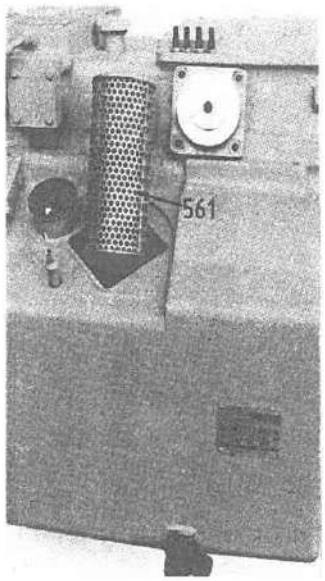

Fig. 10

561 Pleated filter
Intake side of filler pump removed

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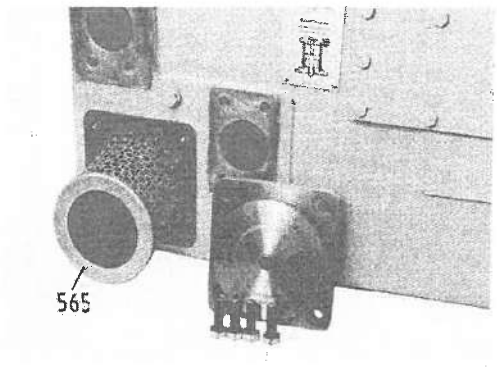

Fig. 11

565 Pleated filter element discharge side of filler pump behind oil cooler removed

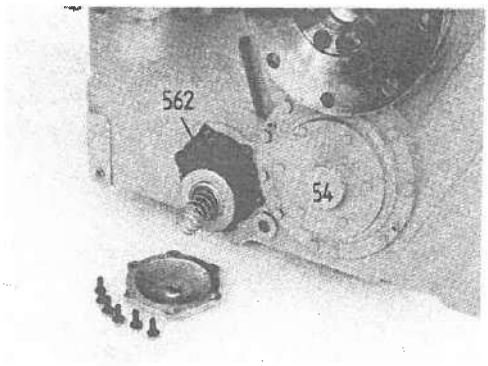

Fig. 12

54 Secondary lubricating pump
562 Pleated filter for 54 removed

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4. Malfunctions

4.1 Detection and rectification of faults, turbo transmission type T 311 r

In case of malfunctions, always check the oil first (see 1a - d).

Fault	Possible cause	Remedy
1. Vehicle fails to move off although the brake has been released and the power controller set to driving.	a) Not enough oil in the transmission.	a) Check oil level (see fig. 8) and top up with oil of the same brand, if necessary.
	b) Oil too cold (guaranteed tractive effort is only reached with oil warmer than 70° C).	b) Apply vehicle brakes, set master controller alternately to traction and idling until the normal oil temperature is reached. Set controller to idling several times to drain the converter and prevent overheating.
	c) Incorrect or deteriorated oil.	c) Change oil (see section 3.2.2, point a, and section 3.1).
	d) Oil contaminated with water (if cooled by heat exchanger).	d) Check heat exchanger for tightness and seal, if necessary. Change oil (see section 3.2.2, point a).
	e) Main control piston 601 remains in idling position.	e) Check control air pressure in line 608 (minimum pressure 5 bar).
	f) Main control piston 601 or pilot control piston 602 jammed.	f) Remove and free control piston 601 and piston 602 (fig.13).
	g) Grooved rings on piston 602 leaking.	g) Remove piston 602, replace grooved rings (fig. 13).
	h) Control air pressure 608 missing or too low.	h) Repair defect in the vehicle.
	i) No filler pump pressure or pressure too low although the oil is in order.	i) Measure filler pump pressure before oil cooler at test point 4x and after oil cooler at test point 2x at full input speed and with filled converter (see 10, figures 2 and 17). If filler pump pressure is too low, remove and clean filter 561.
	k) No filler pump pressure at test point 4x (see 1.1) or pressure too low. Pressure relief valve 516 blocked in open position.	k) Remove filler pump, free piston in pressure relief valve.
	1) Filler pump defective.	1) Remove and inspect filler pump.

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Fault	Possible cause	Remedy
2. Insufficient tractive effort.	a) See 1. a - d.	a) See 1. a - d.
	b) Main control piston 601 blocked in intermediate or speed II position.	b) Remove main control piston 601 (see 1. f and fig. 13).
	c) Engine does not reach full throttle speed.	c) Take corrective measures on the engine.
	d) Labyrinth seals worn, filler pump pressure at test points 2x and 4x (see 1. i) sufficient, but drops considerably when the transmission is filled.	d) Remove and dismantle transmission (see 3.2.3, Major Overhaul).
3. Oil gets too hot.	a) Main control piston 601 blocked in the wrong gear.	a) See 1. f or 2. b.
	b) Governor 62 does not shift to speed II. Control pin 622 in the governor jammed.	b) Remove governor. Control pin 622 must be easy to move. Dismantle the governor and free the control pin, if necessary (fig. 14).
	c) Oil cooler or heat exchanger clogged or cooling unit defective.	c) Repair oil cooler, heat exchanger or cooling unit.
	d) Filter 565 contaminated. Control pressure too low, main control piston 601 does not shift to speed II.	d) Remove and clean filter 565.
	e) Driving below the specified min. continuous speed at full engine throttle.	e)Reduce trailing load.
4. Vehicle does not reach the speed range for gear II.	a) See 3. a, 3. b, and 3. d.	a) See 3. a, 3. b, and 3.d.
	b) Engine does not reach full throttle speed.	b) Repair the engine.
	c) Control pressure in line 522 missing or too low. Pressure relief valve 526 blocked.	c) Check control pressure at test point 8x. (see 10 and fig. 15). Min. pressure 5-6 bar. If pressure is too low, remove and inspect valve 526 or free the piston.
	d) Control pump 52 defective.	d) Measurements as under 4 c. If there is no pressure, remove control and filler pumps and inspect the control pump.

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Fault	Possible cause	Remedy
5. Interruption of tractive effort during speed-shifts with abnormal engine lugging or racing.	a) Air pressure to primary influence unit too low or piston 654 jammed. Speed-changing takes place too early.	a) Check engine governor and readjust, if necessary. Free piston 645.
	b) Shift point of governor 62 incorrectly adjusted. Check shift point I-II and II-I during a test ride at full input power.	b) Remove governor 62 (see fig. 14) and check dimension X on governor. If necessary, readjust shift point according to instructions on drwg. 3.285-1441.
6. Tractive effort exists although master controller is in zero position. Reversing mechanism cannot be shifted.	a) Main control piston 601 or pilot control piston 602 jammed.	a) See 1 f.
	b) Control air line 608 to main control 60 not relieved.	b) Check vehicle control.
7. Reversing mechanism cannot be operated although the conditions mentioned under 2.4 are fulfilled.	a) Piston 383 in standstill detector valve 38 blocked in upper or deflected position.	a) Remove valve 38 and free piston 383.
	b) No control air in lines 301/302 to reverse gear operating cylinder 30.	b) Check vehicle control
	c) Piston 309 in operating cylinder 30 sticking or sealing rings leaking.	c) Remove cylinder 30 and after that switch 305. Check piston 309 and sealing rings.
8. The electronic monitoring system signals a fault in the reversing mechanism.	a) Switches 305 in reverse gear operating cylinder 30 defective.	a) Remove cover from cylinder 30, check switches.
9. Engine speed can be accelerated with the controller already when there is a tooth-on-tooth situation.	a) Switches 305 for end position monitoring incorrectly adjusted or burnt.	a) Check switches (see 8 a).

10. Since oil pressures can be different in transmissions of different power rating, they are not specified in the Operating Instructions. In order to be able to judge whether the oil pressures measured (actual value) are correct, please contact Voith Heidenheim for target values stating the transmission number.

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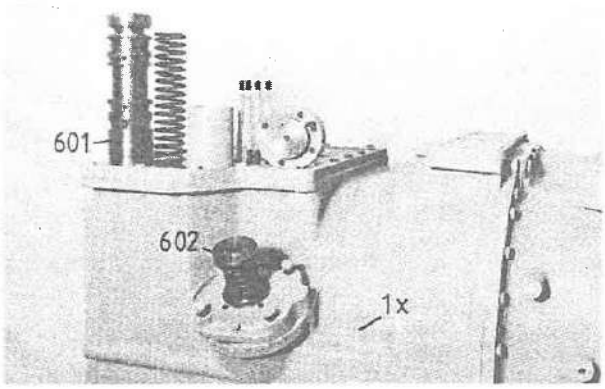

Fig. 13

60 Main control valve removed
601 Main control piston
602 Pilot control piston

1x Test point for converter shell pressure

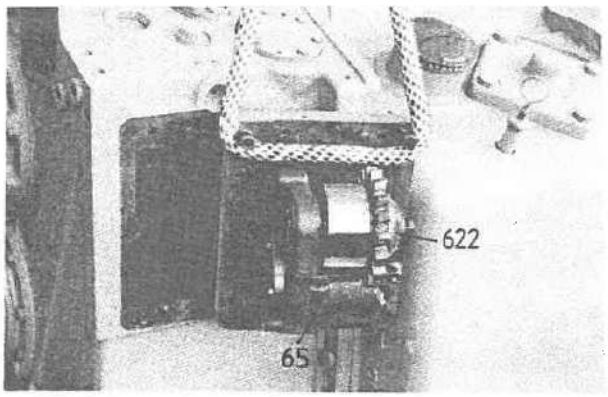

Fig. 14

Governor 62 removed

65 Primary influence unit
622 Control pin

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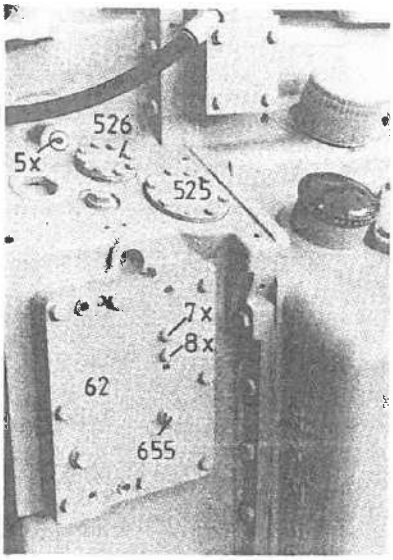

Fig. 15

62 Governor
525 Non-return valve
526 Pressure relief valve - control pressure
655 Compressed air connection for primary influence

5x Test point for lubricating pressure
7x Test point for control pressure before governor
8x Test point for control pressure behind governor

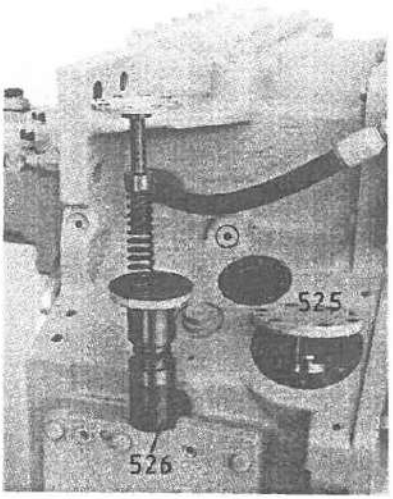

Fig. 16

525 Non-return valve removed
526 Pressure relief valve - control pressure removed

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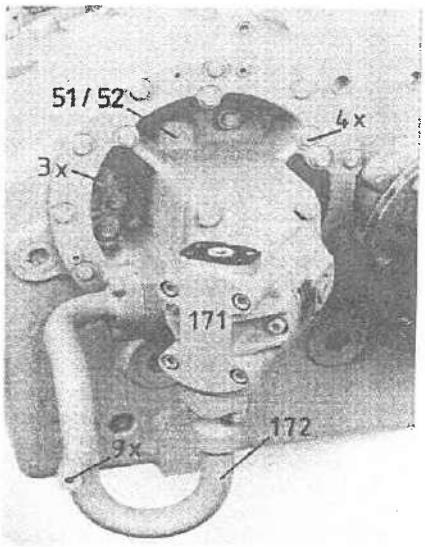

Fig. 17

51	Filler pump
52	Primary control and lubricating pump
171	Hydrostatic pump
172	Supply line
3x	Test point in intake passage of filler pump
4x	Test point for filler pump pressure before oil cooler
9x	Test point in intake passage - hydrostatic pump

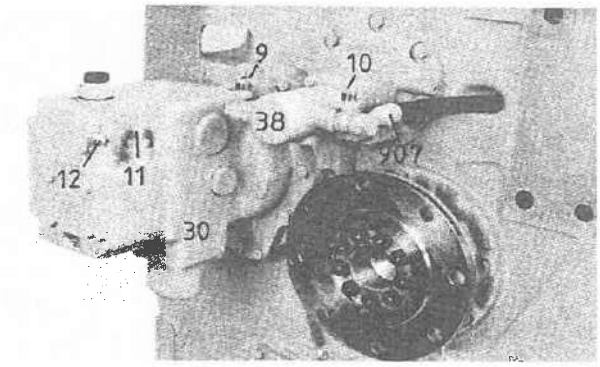

Fig. 18

30	Reverse gear operating cylinder
38	Standstill detector valve
301	Control air line (11) Direction of rotation A
302	Control air line (12) Direction of rotation B
381	Control air line to (9) standstill detector valve
382	Control air line from (10) standstill detector valve
907	Control air line from standstill detector valve to rotary actuator

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4.2 Testing and adjusting the governor

(See adjustment instructions on drwg. 3.285-1441 in the appendix)

Each governor supplied with or for a VOITH transmission has been adjusted on a governor test stand. The adjustment has proven to remain stable over many years. In few cases has readjustment after a major overhaul been necessary.

Governor adjustment should only be checked on a special test stand available from us where gearshift conditions can be simulated. It should only be effected by a VOITH specialist or a specialist trained by VOITH since it requires special knowledge. Adjustment can be checked, and, if necessary, corrected by the specialist using the data given in the Vehicle Owner Sheet and the Adjustment Instructions (see drwg. 3.285-1441 appended).

4.3 Before removal of a damaged transmission:

If a damage in the transmission is suspected because of unusual noise or chips found in the filters, check whether the primary or the secondary transmission side is affected (blocked). For checking the primary side, disconnect the connection to the engine from the input flange of the transmission and turn the flange by hand. The secondary side can be checked in the same way by disconnecting the cardan shaft and trying to turn the output shaft manually. Moreover, a damage in the VOITH transmission may be visible through the openings for the governor and main control valve or any other openings closed with covers.

5. Permissible work during the guarantee period

During the guarantee period, it is only permissible to carry out the minor remedies mentioned under 4. Major interference with the VOITH transmission, however, is not permissible, since it deprives the owner of his rights under the guarantee.

5.1 Repairs, spare parts supplies, and machining

a) The guarantee period for new spare parts is 6 months from the date of delivery.

b) In the case of repairs, major overhaul, and machining by VOITH, the guarantee is limited to the scope of the work performed and its professional performance. It expires 12 months after termination of the repair, overhaul, or machining independent of whether the turbo transmission has been taken into service again immediately afterwards or has been stored as a spare unit.

c) For repairs, major overhaul, or machining carried out externally, the guarantee is limited to the scope of the work performed and ends 6 months after its termination (see also "b").

d) No guarantee can be assumed for damages caused by the vehicle control system after the resumption of operation or for repairs of objects not covered by the scope of the contract.

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6. Appendix

Key to item numbers

1	Primary parts, circuits
10	Input shaft
101	Input gear
102	Pinion
103	Primary shaft
11	Converter (speed I)
111	Pump impeller
112	Turbine wheel
113	Reactor
114	Permanent drain port
115	Filling passage
116	Draining passage
15	Coupling
151	Primary coupling wheel
152	Secondary coupling wheel
153	Permanent drain ports
154	Filling passage
17	Hydrostatic pump drive
171	Hydrostatic pump
172	Supply line to 171
173	Return line from 171
2	Secondary parts
20	Output shaft
201	Output gear
22	Intermediate shaft
221	Gear on 22
222	Gear on 22
23	Secondary shaft
231	Coupling gear for driving direction B
232	Coupling gear for driving direction A
3	Reversing mechanism
30	Reverse gear operating cylinder
301	Control air line to 30
302	Control air line to 30
303	Spring-loaded selector mechanism
304	Spring-loaded selector mechanism
305	Limit switch
306	Centre position locking pin
307	Throttle
308	Throttle
309	Selector piston
310	Selector rod
311	Self-aligning ball bearing
312	Double lever
313	Sliding shaft
38	Standstill detector valve
381	Control air to standstill detector valve
382	Control air from standstill detector valve
383	Piston
384	Valve plate
385	Sensor finger
386	Breather
5	Pumps, filters, cooler
51	Filler pump
511	Driving gear on 10
512	Intake line
514	Discharge line to oil cooler
515	Driving gear for 51 and 52
516	Pressure-relief valve
52	Primary control and lubricating pump
521	Intake line
522	Discharge line
524	Discharge line to secondary lubricating pump
525	Non-return valve
526	Pressure relief valve control pump
54	Secondary lubricating pump
541	Driving gear for 54
542	Intake line
544	Discharge line
545	Non-return line
56	Oil filter
561	Pleated filter - filler pump intake
562	Pleated filter - secondary lubricating pump
563	Throttle for disposable filter
564	Disposable filter
565	Pleated filter discharge side behind oil cooler
57	Oil cooler
574	Outlet to oil cooler
575	Inlet from oil cooler
576	Supply line to main control
58	Lubricating points
582	Main lubricating line
6	Control parts
60	Main control valve
601	Main control valve
602	Pilot control piston
608	Control air to 600

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62	Governor
621	Centrifugal weights
622	Control pin
623	Lever
624	Thrust piece (see drwg. 3.285-1441)
639	Driving gear for 62
64	Control oil line
641	Control oil line to governor
642	Control oil line to main control
65	Primary influence unit (see drwg. 3.285-1441)
651	Threaded sleeve
652	Adjusting pin
653	Spring
654	Piston
655	Compressed air line to primary influence unit
69	Parts for emergency operation of main control valve 60
691	Adjusting screw for manual emergency operation of main control valve 60 for speed I
692	Screw plug
8	Miscellaneous
801	Dipstick
802	Breather filter
803	Oil filler neck
804	Oil drain valve
805	Temperature sensor
90	Rotary actuator
901	Actuating cylinder
902	Piston
903	Push rod
904	Contact roller
905	Lever
906	Spring
907	Compressed air line to 90
908	Throttle
909	Air tank
910	Throttle
911	Non-return valve
912	Actuating disc

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Test point plan for turbo transmission T 311 r

Test point no.	Connection thread	Designation	
1X	M14 x 1.5	Converter shell pressure	Fig. 13
2X	M14 x 1.5	Filler pump pressure behind oil cooler	Fig. 2
3X	M14 x 1.5	Intake passage - filler pump	Fig. 17
4X	M14 x 1.5	Filler pump pressure before oil cooler	Fig. 17
5X	M14 x 1.5	Lubricating pressure	Fig. 15
7X	M8	Control pressure before governor	Fig. 15
8X	M8	Control pressure behind governor	Fig. 15
9X	M14 x 1.5	Intake passage - hydrostatic pump	Fig. 17

Compressed air connections from external control

7 = 608	M16 x 1.5	to main control	Fig. 3
8 = 655	M16 x 1.5	to primary influence unit	Fig. 15
9 = 381	M16 x 1.5	to standstill detector valve	Fig. 18
10 = 382	M16 x 1.5	from standstill detector valve	Fig. 18
11 = 301	M16 x 1.5	to reverse gear operating cylinder, direction of rotation A	Fig. 18
12 = 302	M16 x 1.5	to reverse gear operating cylinder, direction of rotation B	Fig. 18

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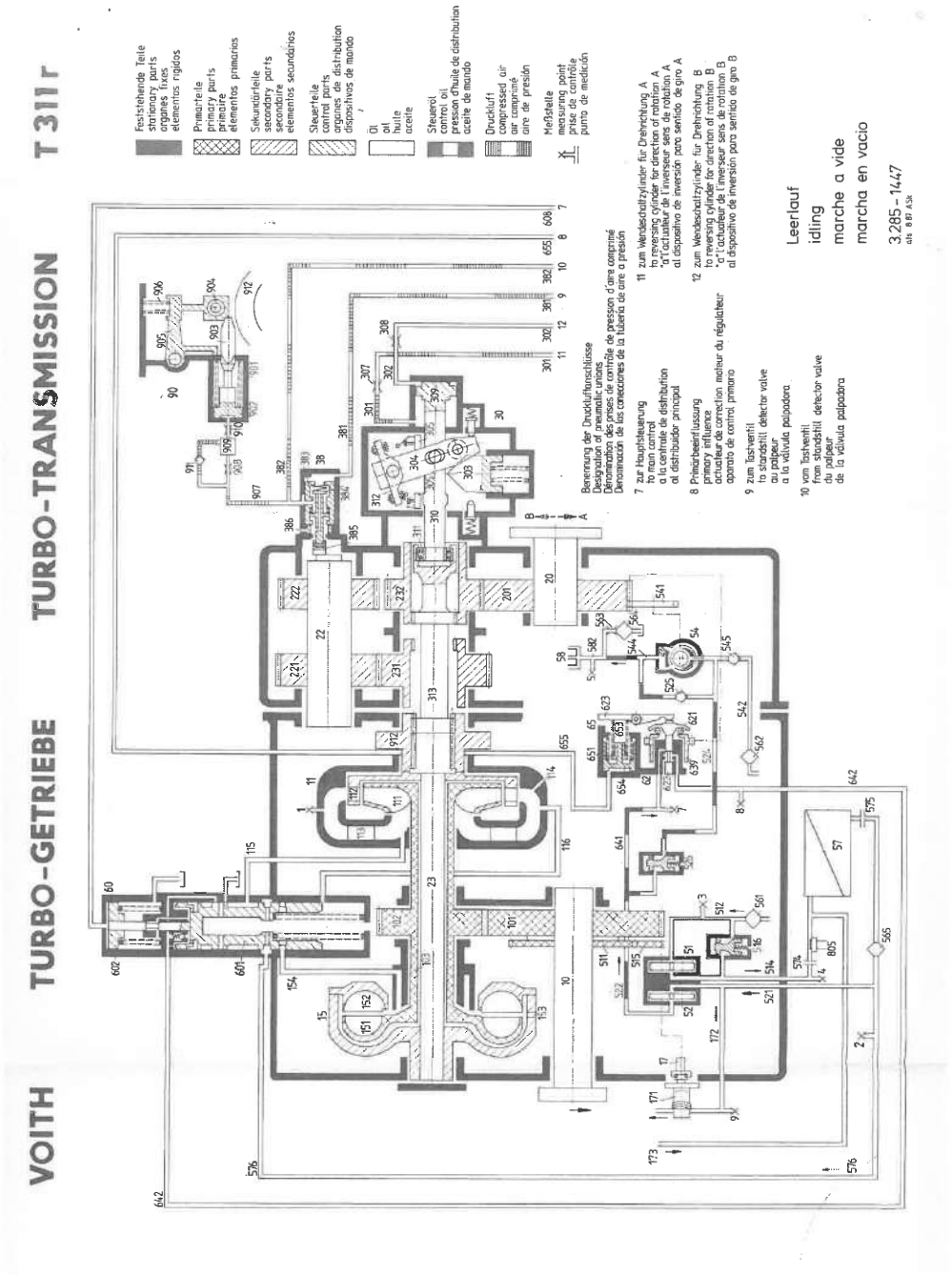

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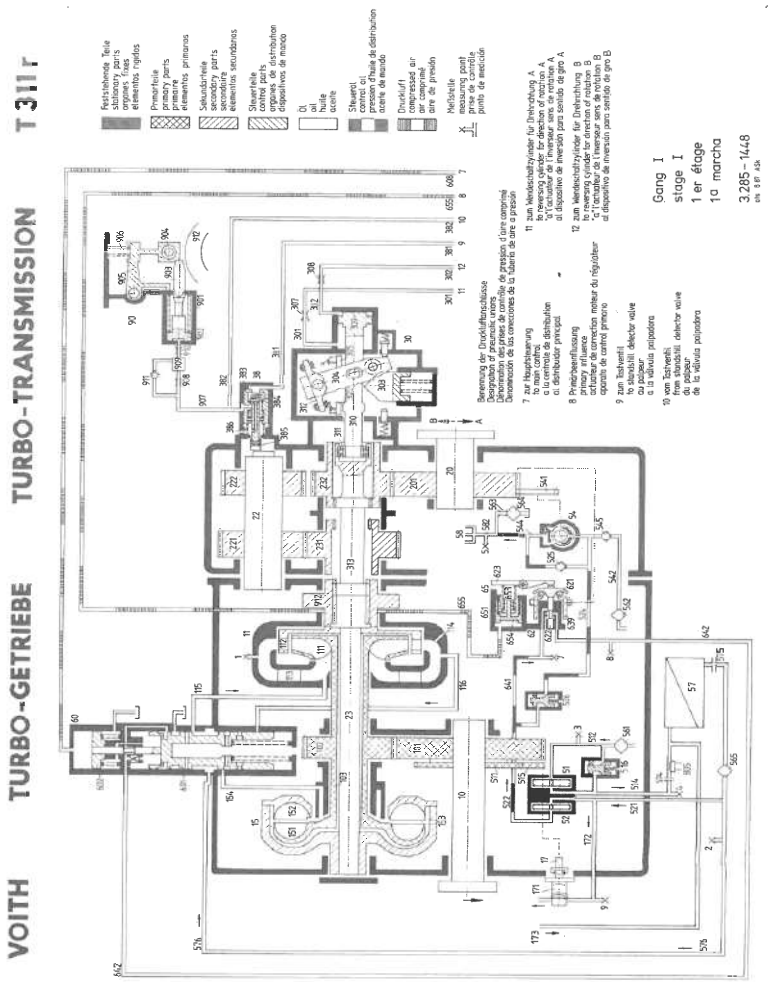

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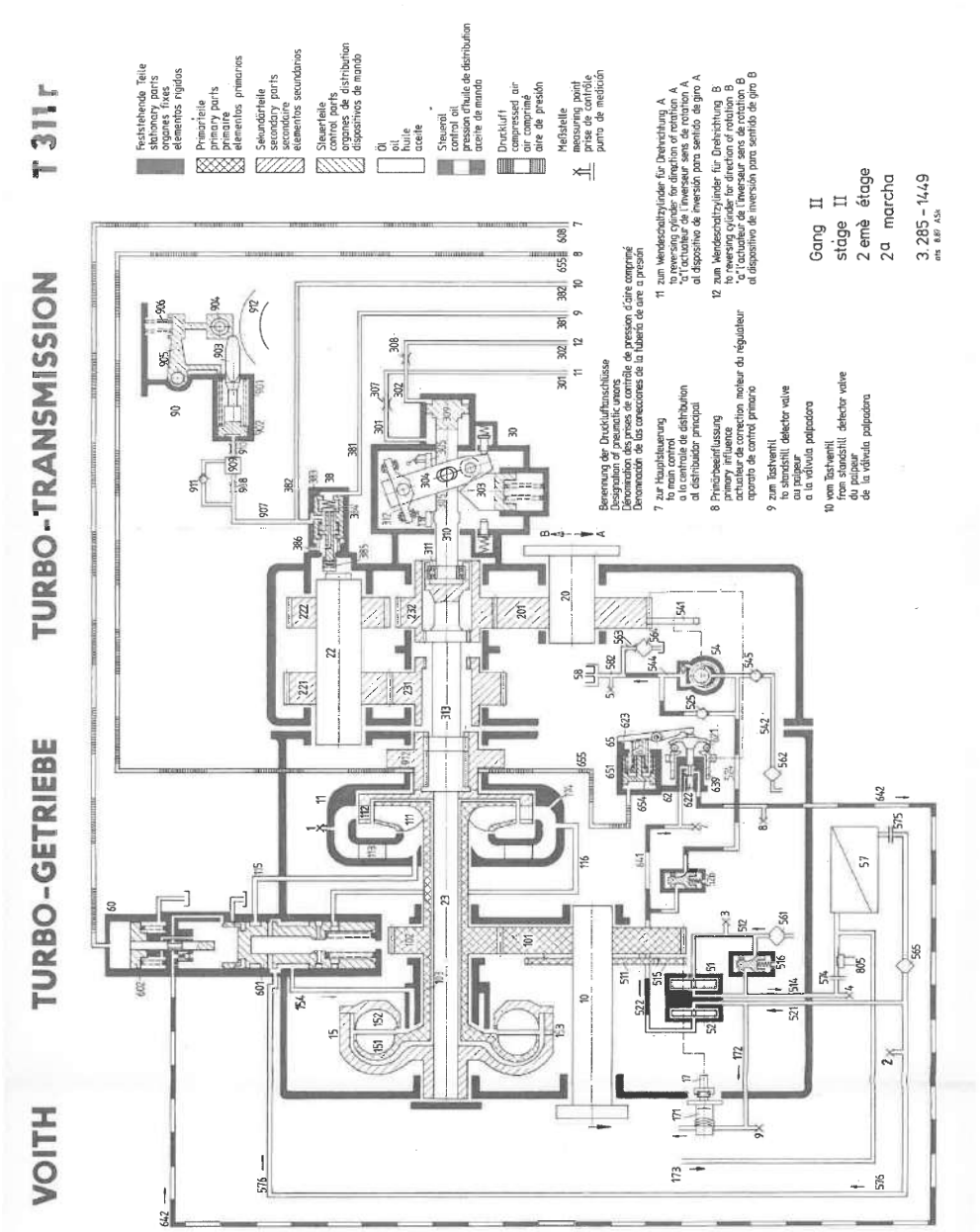

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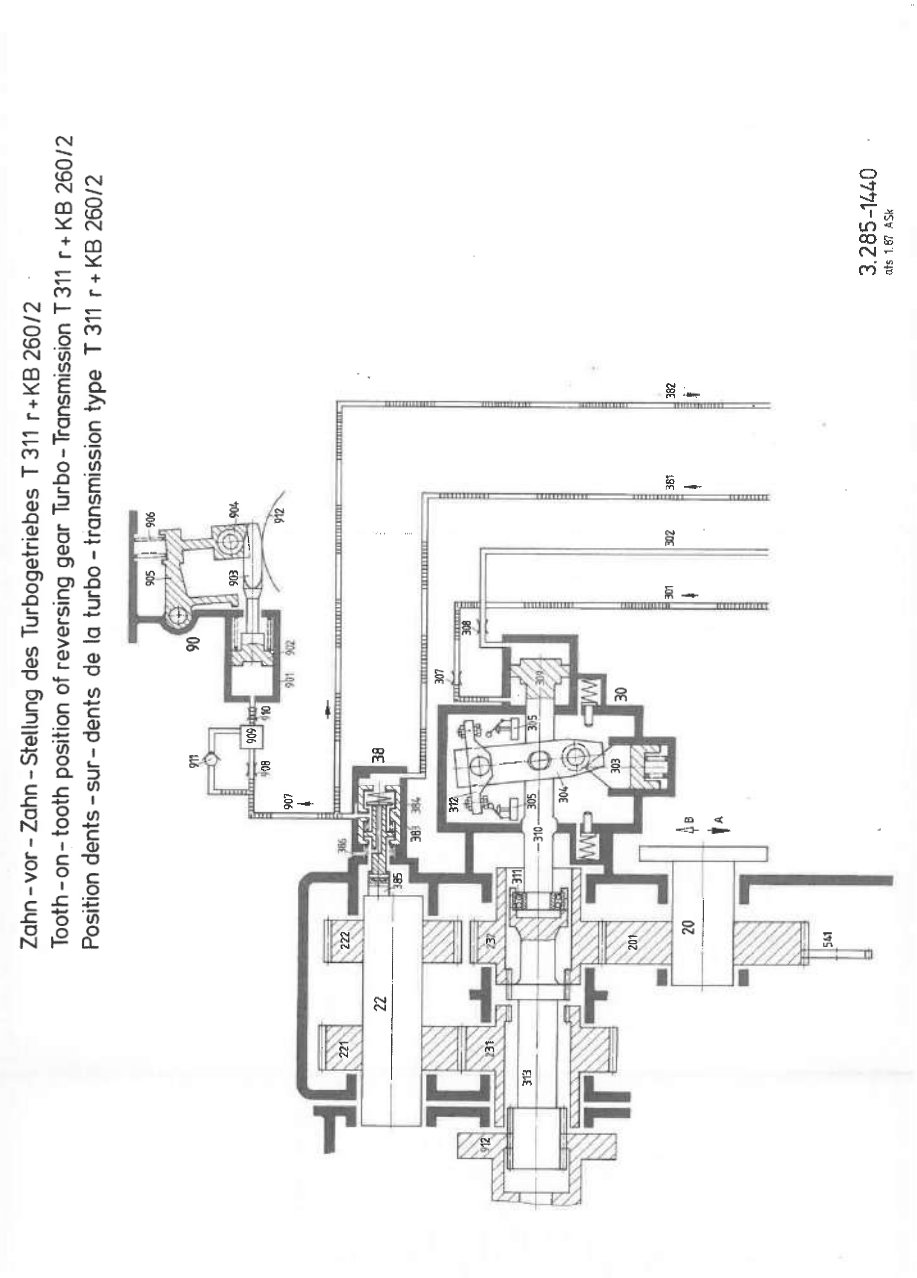

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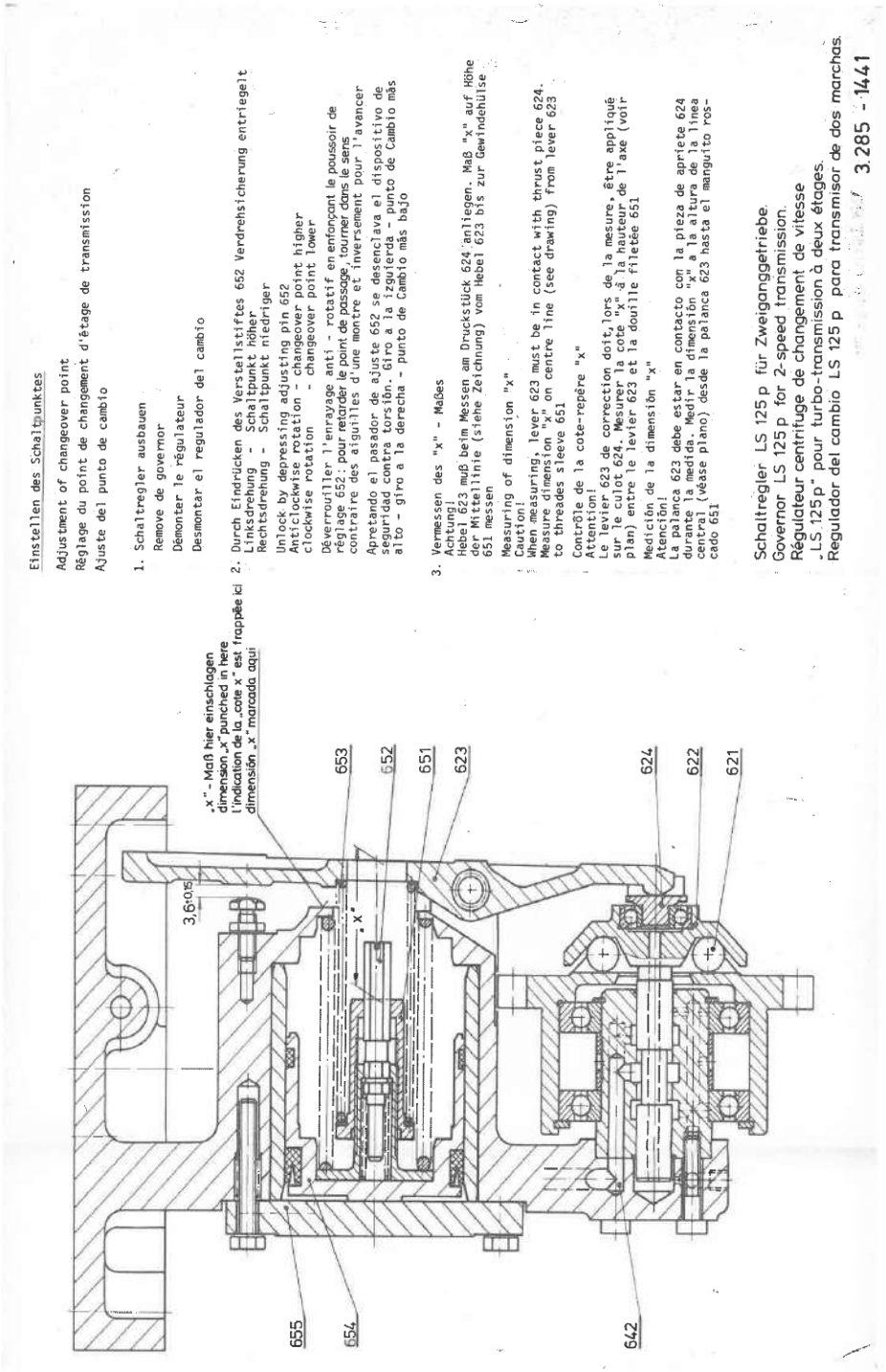

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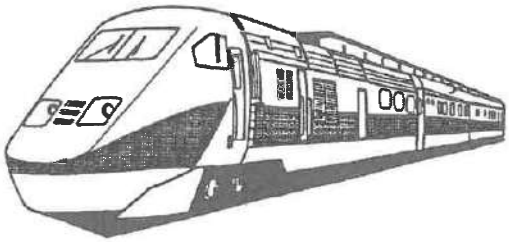
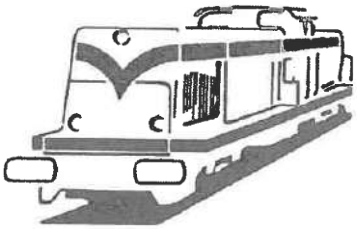
Kraftübertragungsöle für Voith-Turbogetriebe und Drehmomentwandler

- Power Transmission Oils for Turbo Transmissions and Torque Converters
- Huiles pour turbo-transmissions et transformateurs de couple Voith
- Aceites de transmisión de fuerza para turbotransmisores y convertidores de par Voith
- Transmissionsoljor för Voith turbotransmissioner och momentomvandlare





GP 663

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In der Aufstellung werden alle Öle genannt, die den Anforderungen des Voith-Zulassungsverfahrens 3.90-8 genügen. Es wird dabei unterschieden zwischen:

Öle mit nachgewiesener Bewährung über 5000 Betriebsstunden und

Öle ohne nachgewiesene Betriebsbewährung.

Neugetriebe unter Gewährleistung dürfen nur mit Ölen, deren Betriebsbewährung nachgewiesen ist, betrieben werden.
Der jeweils neueste Stand wird auf Rückfrage angegeben.

Oils specified in the list have all satisfied the requirements of the Voith serviceability test 3.90-8. However, the following differentiation is made:

Oils with proven operational serviceability over a period of 5000 hours and

Oils without proven operational serviceability.

New transmissions under warrenty may be operated only with oils which have proven successful in service.
The currently valid state can be given on request.

	Lieferfirma Supplier Marque Çasa proveedora Leverantör	Bezeichnung Designation Désignation Denominación Beteckning
AGIP	Agip	Agip BLASIA 32
ARAL	Aral	Aral Degol BG 32
BP	BP	BP Energol HL-XP 32 BP Energol HLP 22S
BP	BP	BP Energol HLP 32S
CALTEX	Caltex	Torque Fluid 32
elf	Elf	ELF TRANSMISSA 32
Esso	ESSO	ESSO TORQUE FLUID N 45
FINA	FINA	FINA HYDRAN VT 32

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La liste indique toutes les huiles qui sont passées par la procédure d'homologation Voith suivant la fiche technique No. 3.90-8. La distinction a été faite entre:

Les huiles qui ont fait leurs preuves pendant plus de 5000 heures de fonctionnement et

Les huiles qui n'ont pas reçu la sanction de l'expénence dans la pratique.

N'utiliser que des huiles éprouvées en fonctionnement pour les nouvelles transmissions sous garantie.
La nouvelle édition sera fournie sur demande.

En la relación se indican todos los aceites que cumplen las condiciones exigidas en el procedimiento de admisión Voith 3.90-8. Con este motivo se distingue entre:

Aceites que comprobadamente han dado bueno resultados durante más de 5000 horas de servicio y

Aceites que han estado en servicio sin dar buenos resultados.

Nuevas transmisiones amparadas por garantía deben functionar sólo con aceites que comprobadamente han dado buenos resultados en el servicio.
El respectivo estado más reciente se indica sobre consulta.

L listan aterfinnes alla oljekvaliteter som gådkänts enligt Voiths provningsförfarande 3.90-8. Man skiljer därvid mellan:

Oljor som bevisat sin användbarhet under mer än 5000 driftstimmar.

Oljor som ej bevisat sin användbarhet under drift.

Nya växlar med garanti får endast drivas med i praktiken beprövade oljar.
Det som i varje enskilt fall är aktuellt, anges på förfrågan.

	Lieferfirma Supplier Marque Çasa proveedora Leverantör	Bezeichnung Designation Désignation Denominación Beteckning
FUCHS	FUCHS MINERALÖLWERKE	RENOFLUID TF 1500
INDIANOIL	Indian Oil Corp. Ltd.	Servo Torque 10
Mobil	Mobil Oil	Mobilfluid 125
JS	Ölwerke Julius Schindler	Frontol Turbogetriebeöl JS
TB	Oy Teboil	Fluid TH 10254
ENERGOINVEST	Rafinerija Modrica	Reduktol HKT 30
Shell	Shell	Shell Tegula Öl 32
SUNOCO	Sun Oil	Sunoco Turbogear Oil BS 7624

VOITH

	Lieferfirma Supplier Marque Çasa proveedora Leverantör	Bezeichnung Designation Désignation Denominación Beteckning
TEXACO	Texaco	Torque Fluid 32
TOTAL	Total	Total Azolla 32
UK ECUBSOL	UK Mineralölwerke Wenzel und Weidmann	UK ECUBSOL Turbo 32
VALVOLINE	Valvoline	Valvoline M5-C 600 B
wintershall	Wintershall Mineralöl Gmbh	Wintershall Wiolan HF 32
WISURA	Wisura Mineralölwerk	Wisura Kineta 32V

Annexure -12

Details of items to be checked during Safe to Run Examination (TXR)

ANNEXURE-A

Item to be checked during Periodic Safety Inspection of Tower Wagon (OHE Inspection Car) in 45 days/4500 km, whichever is earlier. Additional checks if required may be added with the approval of PCEE.

S.N.	Parts to be inspected	Specific points require attention
1.	Wheel and Axle	Tapping of all wheels to be done and observed for any crack.
		Check the axle box cover for any abnormal heating.
		Clean the Axle box properly.
		Check the tightness of axle box cover bolts and split pins.
		Check for loose axle and other axle defects.
		Check for unusual wear and grooves on the wheel/tyre tread.
		Apply the wheel/tyre tread defect gauges and check for all wheel/tyre tread defects like sharp flange, thin flange, root wear, hollow wheel/tyre tread and thin wheel/tyre tread etc.
		Check the wheel gauge.
		Check the Wheel diameter.
		Check the laminated leaf Spring for any damage.
2.	Brake System	Check the leakage test: a. MR leakage. b. BP leakage. c. FP leakage.
		Working of Air dryer.
		Setting of Brake pipe pressure, MR pressure, BC pressure & FP pressure.
		Brake performance Check: a. A9 performance check w.r.t time. b. SA-9performance check w.r.t.time. c. D1 performance check w.r.t time.
		Application of D-1 emergency.
		Any application of emergency brakes engine comes to idle.
		A-9 Capacity test.
		Sensitivity test of distribution.
		Clearance between brake block & wheel.
		Brake cylinder piston stroke of all cylinder.
		Loading & unloading of compressor.
		MR Safety valve.
		Working of Auto drain valve.
		Working of Horn, wiper, sander.
		Check Parking Brakes.
		Check Hoses/Pipes condition.
		Brake work properly/not working properly.
3.	Under-frame	Check Sole bar/head stock.
		Check Springs.
		Check Structural members.
		Check Driving gear.

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		Centre Pivot mounting bolts.
		Check Under-frame fittings.
		Check oil level in oil bath of side bearer.
4.	Bogie	Check Bogie side frame, Transom, longitudinal, bolster etc all welded locations.
		Check Primary Suspension.
		Check Secondary Suspension.
		Check Brake rigging
5.	Checking of all Mechanical Safety items i.e. Coupling, Buffer, Rail-guard, Horn, marker light, Head light, Flasher light, Speedometer for their intactness & functioning and attend any other problem entries written in the log book of Tower wagon (OHE Inspection Car).	

	29/4/21
CEDE/WR	ED(TI)/RDSO

Annexure-13

Summary of works done during Daily and Monthly Schedule for 8 W DETC and DHTC

[A] Daily Schedule :

S.No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
	Part - I: Maintenance Schedule for Engine & Compressor			
1	**MAINTENANCE SCHEDULE OF ENGINE**			
1.1	Check previous days engine log book & attend defect if any.			
1.2	Fuel water Separator-Drain.			
1.3	Lubricating oil level- check			
1.4	Coolant level-check			
1.5	Air intake restriction – check the red band indication.			
1.6	Water pump and alternator drive belts: Check belt tension and condition of belts for cut, fretting, cracking etc.			
1.7	Level of oil in hydraulic Tank- check			
1.8	Air Tanks and Reservoirs- Drain.			
1.9	Check leakage of Fuel, Lube oil, Hydraulic Oil, Water, exhaust air supply and rectify wherever is required.			
1.10	Fuel oil level: Check and top-up			
1.11	Fuel tank: Check for leakage			
1.12	Check cables and connections of 24V starter battery			
1.13	Check and record battery cranking voltage			
1.14	Check for any loose nut, bolt or fastener. Tighten those if required.			
1.15	The engine shall run at rated speed for at least 30 minute.			
1.16	Check gauge and indicators for engine speed, ammeter, lube oil temperature, lube oil pressure, water temperature indicator and fuel indicator in driver' s cab			

1.17	Clean the engine after shut down and cooling down fully.			
1.18	Ensure that any hose/conduit/wiring should not be in contact with hot surface of engine and its accessories			
1.19	**MAINTENANCE SCHEDULE OFCOMPRESSOR:** The maintenance schedule of compressor shall be similar as of engine as mentioned above as compressor is engine mounted.			
	Part – II: Maintenance of Tower Wagon - Hydraulic, Electrical Transmission & Controls System:			
2	**MAINTENANCE OF TOWER WAGON- ELECTRICAL TRANSMISSION & CONTROLS SYSTEM:**			
2.1	Inspect visually for any abnormal odor due to short circuit or fault.			
2.2	Check loose connection of cable and wiring.			
2.3	Check normal function of major and safety component.			
2.4	Check if any part/equipment is isolated and record in log book.			
2.5	Check if any safety is bypassed and record in log book.			
2.6	Clean all the parts specially Driver Desk, Lookout glass, Windows glass etc.			
2.7	Check the Batteries for any leakage			
2.8	Clean dirt or any oil on top of battery.			
2.9	Clean all the ventilators so that air circulation remains good.			
2.10	Check the suspension and securing nuts after every round trip.			
2.11	Inspect the terminal box of Auxiliary alternator for water tightness.			
2.12	Check for the proper application of SA9 Valve, A9 valve, Standby Brake Valve and Parking brakes. Car has to be moved only after these checks.			
2.13	Check that the Head light, Tail light, Flasher Light and Marker Light are functioning.			

2.14	Press the Lamp test switch Signal lamps light up simultaneously to indicate healthy filaments.			
2.15	Check initial charging time of the main reservoir (MR). It should take around 10 minutes. If it is unusually long, check the air brake piping for leakages.			
2.16	Check Main Reservoir (MR) pressure, Brake pipe (BP) pressure, FP, PB(Parking Brake) pressure.			
2.17	Check the functioning of the SA9 valve, A9 valve and D-1 Emergency Brake, Emergency Push Buttons.			
2.18	Check the operation of wipers, Horns and sand valve function by brief application and releases.			
2.19	Check operation of OHE sensing devise, Pantograph and Search light.			
2.20	Check operation of CCTV camera, if provided.			
2.21	Functioning of Speedometer to be checked in every schedule.			
3	**MAINTENANCE SCHEDULE OF DHTC**			
3.1	**FINAL DRIVE**			
	Check oil level with dipstick. The oil level must be between the maximum and minimum limits marks on the dip stick. The oil level to be topped up if necessary Clean the Axle drives to check for any leakages from the pipe joints and other places and correct them			
3.2	**Transmission, Final Drive, Gear Box and Cardan Shaft (in Engine Stopped condition):**			
3.2.1	Check flexible coupling fasteners for tightness.			
3.2.2	Check Cardan Shaft / Final Drive for any visual damage			
3.2.3	Check transmission-mounting fasteners for tightness.			
3.2.4	Check for all leakages especially at Final drive Gearbox joint faces and axle oil seal.			
3.2.5	Check oil level in final drive and top up if necessary			
3.3	**Transmission, Final Drive, Gear Box and Cardan Shaft (in Engine Running condition):**			
3.3.1	Check torque converter / transmission oil cooler & pipelines for visual defects & leakages. Rectify if necessary			

3.3.2	Check oil level in sump at idle (full throttle without load) and top up if required. Hot check - The transmission oil level should be checked while the engine is running at 1000 rpm after normal operating temperature (180 to 200 ° F (82 to 93°C) is reached. The transmission should be in neutral, and the vehicle should be standing on a level surface. The oil in the transmission sump should be level with the full petcock or plug or rear of the transfer gear housing. If the oil is not at full level, add sufficient oil to bring the level up to the full point. In the hot check if the oil is above the full level drain the excess oil			
3.3.3	Check the TC oil control pressure and record. If thepressureatlowidlespeedisoutofrange8.5–10.5kg/cm²,stop the engine. Check & top up oil if required. Carry out the check again. (If the record pressure is out of range, investigate and rectify.) Check the transmission main oil pressure when the transmission is in the normal operating temperature range of 180 to 200°F (82 to 93 °C) the transmission pressure should be checked at 1500 rpm of engine at output stalled the pressure range should be between 9 to 10.5 kg/cm² (If the recorded pressure is out of range investigate and rectify). Note:- The Transmission oil used in the transmission is very critical as it 1. Provides the working medium for the torque converter , controls , and clutch application 2. Transfers heat from the transmission to the cooler 3. Serves as a lubricant which carries rust inhibiting chemicals through the transmission 4. Carries contaminant to the filter.			

3.4	**Torque Arm (in Engine Stopped condition):**			
3.4.1	Check visually-all parts for visible defects, damages, fasteners, linkages, etc.			
3.4.2	Check the tightness & locking of fasteners.			
3.5	**Preventive Maintenance:** Note: Repeat Daily maintenance and follow the preventive maintenance			
4.	**PART-III MAINTENANCE SCHEDULE OF CAR BODY, UNDER FRAME, BOGIE, BRAKE SYSTEM, BRAKE RIGGING, LIFTING & SWIVELING PLATFORM etc.**			
4.1	**General & Common check:**			
4.1.1	Fill water in lavatory overhead tank.			
4.1.2	Brake System			
4.3	Drain condensate from automatic drain valves of brake system.			
4.4	Drain the moisture manually on daily basis.			
4.5	Drain condensate from all the air reservoirs, and filter through cut off cocks.			
4.6	Check the leakage of air pressure, if any, rectify the same.			
4.7	Check the brake application and relieving before leaving the depot. Also check parking brake application/release function.			
4.8	Horn, Oil levels, Radiator Water etc.			
4.9	Check the working of horns during starting.			
4.10	Check the oil level of axle drive, if found less, add upto maximum mark.			
4.11	Check the Transmission oil level in the oil tank, if found less, add upto maximum mark.			
4.12	Ensure correct level of radiator water, lube oil in ADGB & fuel in tanks.			
4.13	WRA (Water Raising Apparatus) functioning			
4.2	**Bogie& Bogie frame**			
4.2.1	Examine visually the condition of bogie side frame, transom, longitudinal, bolster etc. at all welded locations.			
4.2.2	Examine rubber stopper/stop screw of axle box crown for damage/ missing /loose.			

4.2.3	Inspect brake hanger brackets for damages.			
4.2.3	Inspect safety brackets for brake hanger pins.			
4.3	**Primary Suspension**			
4.3.1	Visually examine axle box springs for breakage/damage.			
4.3.2	Check oil leakages in dashpot through defective seals/vent screws.			
4.3.3	Visually examine axle box clearance.			
4.4	**Secondary Suspension**			
4.4.1	Visually examine bolster springs breakages/damages.			
4.4.2	Examine vertical shock absorbers for damages.			
4.5	**Brake rigging**			
4.5.1	Check brake-rigging arrangement for any defects/deficiencies.			
4.6	**Draw gear**			
4.6.1	Check conditions of the screw coupling and its components and replace if required.			
4.6.2	Examine visually draft key locking pins.			
4.7	**Buffing gear**			
4.7.1	Visually examine buffer plungers for damage/drooping/stroke length.			
4.8	**Running gear**			
4.8.1	Examine visually axle box for grease oozing out, warm axle box if any.			
4.8.2	Visually inspect axle box covers.			
4.9	**Maintenance of Lifting and Swiveling platform:**			
4.9.1	Check Hydraulic oil level and top up if necessary			
4.9.2	Check oil level in gear box. Top up if required			
4.9.3	In case, OHE car is not in use for longtime, check for all operations ten times, before deployment in actual service. Also check manual operation.			

Note: Function of Speedometer to be checked in every schedule

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[B] Monthly Schedule (With Engine stopped):

S.N.	Item	Details of work to be carried out
	MAINTENANCE OF TOWER WAGON- ELECTRICAL TRANSMISSION & CONTROLS SYSTEM:	
16.	Contactor and Relays	(vii). Inspect visually. (viii). Manually operate contactor to check operation. (ix). Check interlock of contactors. (x). Check operations of contactors. (xi). Clean contactors (xii). Check contactors contact tips for pitting.
2	Resistor & blocking diode	Check the condition and function of all resistors and diode and record it.
3	High and low voltage circuit	Check for ground & record insulation resistance of power Circuit.
4	Master controller	Clean and inspect contact, fingers. Check mechanical Interlock.
5	Control equipments shunts.	Check condition and flexibility; replace worn frayed broken or corroded braided shunt.
6	Control equipments	Check terminal connectors & connections and tighten if required. (i) Clean contactors. (ii) Replace contact tips if worn or pitted.
7	Engine RUN/STOP switch	Check and clean contact
8	Batteries	x) Clean dirt or any oil on top of battery. xi) Clean all the ventilators so that air circulation remains good. xii) Keep all terminal tight, clean and apply Vaseline petroleum jelly. xiii) Check the batteries for any water leakage. xiv) Check the batteries connection xv) Ensure that vent plugs with float guide is clean and not broken. xvi) Check specific gravity of electrolyte and maintain at 1.245±0.005. xvii) Check the water level for topping up with DM water. Top up the DM water as per the requirement i.e. twice in summer season and once in winter season in a month based on the float guide indicator.

		xviii) Check the battery Voltage in off line at no. load. Battery voltage shall be above 2.1 V/cell or 8.4 V per mono black, if less, then charge the batteries.
9	Cable Connections	Check for loosening adjoins on terminal board and equipment.
10	Load Ammeters	Check operation and check for loose connection.
11	Traction Motor	(i) Brush off loose dust or dirt before removing commutator cover. (ii) Clean the commutator V-ring. (iii) Remove any copper beads from the commutator surface with fine caborandum cloth. Deposits from dirty or greasy hands should be removed by a solvent. (iv) Examine the brush gear and clean the insulating rod & support pin insulator. (v) Check that the brush springs sits correctly on the brushes and that the springs are in good condition. (vi) Check carbon brushes for wear. (vii) Fit new brushes in place of worn out carbon brushes or any one which are unlikely to last until the next inspection. See technical data for minimum length and brush grade. (viii) Bed all new brushes to the curvature of the commutator. (ix) Check the brushes for mechanical damage, breakage of flexible, etc. Fit new brushes if necessary. (x) Check that the flexible are firmly secured to the brush holder. (xi) Check brushes for freedom in the brush-holder and if stick ring cleans both the brush and the brush-way in the holder. (xii) Do not soak the brush, as solvent will eventually ooze out, affecting the commutator and causing the brush to jam in the holder. (xiii) If the brush appears to be excessively slack in the brush-holder, check the brush size and discard the brush or the holder as the case may be. (xiv) If brush holders have to be removed from the machine, slip thin; clean press board between each brushholder and the commutator to avoid damaging the commutator surface. (xv) On replacing brush-holders check the clearance between the underside of the brush-holder and the commutator. See Technical Data. (xvi) Look carefully for any signs of flash over, overheating, loose connections or damaged insulation. (xvii) Top up Gear case to the level of gear oil filler unit. See Technical Data for Grade of lubricant.

		(xviii) Top up axle suspension bearing lubrication oil and cardium compound in traction motors, gearbox. xxxiii) Check the temperature of pinion. xxxiv) Check the Armature Bearing & Suspension Bearing of Traction Motor by thermo vision camera. xxxv) Blow out machine using clean dry compressed air. xxxvi) Take particular care to direct air under the commutator in order to remove dirt lodged in the armature core ducts. xxxvii) Check tightness of all brush gear bolts. xxxviii) Check tightness of bolts securing axle caps/Suspension Tube and gear case. xxxix) Check air inlet bellows for cracking, tearing or collapsing. Renew, if necessary. xl) Check for leakage from the Gear case and Axle caps. Top up the bearings with the recommended quantity of bearing grease. Top the roller suspension bearing with grease. xli) Top the armature bearing with grease. Refer to the recommended quantity of the bearing grease. xlii) Check all external leads for chaffing. xliii) Measure Insulation Resistance, it should not be less than one Mega ohm. xliv) Clean the grease escape drain from P.E. outer bearing cap and P.E. end shield. xlv) Check for any unusual sound in every schedule. xlvi) Check all terminal connections.
12	**Traction Alternator**	CGL make Traction Alternator model C1009A1: At the outset, it may be emphasised that the routine maintenance of Traction Alternator is much simpler due to the absence of Commutator and its brush-less arrangement. Routine maintenance of Traction Alternator therefore, mainly includes periodic cleaning and inspection of the machine. It is recommended that the period of inspection should be more frequent in the initial period of service, and schedule can be subsequently relaxed based on experience. Brush off loose dust or dirt before removing cover. xi) Brush off loose dust or dirt before removing cover. xii) Check tightness of connections. xiii) Check for any loose hardware especially on the rotating rectifier assembly.

		xiv) Wipe offs loose dirt on the outside surface of the alternator with clean filter free cloth. xv) Remove stubborn accumulation of dirt using xylem. xvi) Clean all ventilating parts with filter and compressed air at pressure of 1.75 to 2.8 kg/Cm^2 . xvii) Clean inside of alternator using dry compressed air of a pressure of 1.75 to 2.8 kg/Cm^2 . xviii) Check for any unusual sound. xix) Normalfunctioning of Traction Alternator to be ensured after every schedule. xx) Check all terminal connections. Note: For other make, similar instructions may be followed as per their OEM manual.
13	**Power Rectifier (Ruttonsha)**	Except for blower, the rectifier unit as such is static equipment with no moving parts, hence little maintenance is required. However, regular inspection is necessary if trouble free operation is required.
		Check for any unusual sound.
		Open the side panels and clean the dust &soots collected on panels and within the unit with dry compressed air or any other suitable means.
		Check all electrical connections and mechanical assemblies. If found loose, refit it.
		Check air speed at outlet of each rectifier duct. It should be minimum 5 to 6 mts./ second at outlet.
		Check healthiness of rectifier fuses. Failure of fuse will be indicated by ejected plunger of corresponding Trip Indicator Fuse. If found blown, replace both main and trip indicator fuse after rectifying cause of fuse failure.
		Clean the Insulators with cloth/brush.
		Check conditions of resistors and capacitors. Replace if found damaged. Note: It is to be noted that there is possibility of loose connection, if terminal of components are disconnected from circuits, hence, only one terminal of component (lug/nut-bolt) should be disconnected at a time to measure the value of capacitor and resistor by using Digital Multimeter carefully. After measuring the value, the opened terminal should be reconnected properly/tightly, then open/disconnect one terminal of another component. Do not disconnect all the terminal of the all components at a time so as to avoid possibility of wrong connection inadvertently.
		The fan is brushless type hence it does not need any specific maintenance.
		In case of failure of diode, please follow following removal & refitting procedure.

		Removal of Diode: Unscrew the lead of diode from busbar. Remove the diode by removing the Allan bolts using suitable key. Clean the diode with clean cloth. Check its healthiness. If found defective, use new one to replace it.
		Mounting of Diode: Clean the base of diode with clean cloth. Apply a thin layer of silicon oil or good quality contact grease. Clean the surface area of heat sink on which diode is to be placed. Using same/same size Allan bolts refit the diode. Initially tighten bolts alternately half to one turn at a time so that diode is clamped with equal force all over. Finally, using torque wrench complete tightening of the bolts. The specified torque limit is 1.7 to 2 KN. Connect the end of lead on busbar. Note: For other make, similar instructions may be followed as per their OEM manual.
14	**Auxiliary Alternator (for charging of 110V battery)**	A) Alternator: 3.0. Check the suspension and securing nuts after every round trip. 4.0. Inspect the terminal box for water tightness. B) Regulator Box (RRU) : 3. See that all securing fasteners are held properly. 4. Keep the cover tightly closed. Ingress of water and dust in the regulator box will damage the equipment beyond repair. **2.** Do's and Don'ts for the equipment: B. Alternator: 7. Open up the terminal box and clean up the dust if any accumulated in it. 8. Check up the tightness of connection. 9. Keep the terminal box tightly closed. 10. The field connection on the alternator terminal box should not be reversed. 11. Use cable sockets and cable glands for connections. 12. Never give separate excitation to the field. It will damage the regulator component. It will damage the regulator component. **B.**Regulator:

		7. Please Don't disturb the setting on the voltage potentiometers. 8. Please Don't open the regulator box unless a defect is observed. 9. Please Don't use a megger to test the components .Use a multi meter. 10. If earth resistance is to be measured, disconnect the leads form alternator and load. Short circuit all the seven terminals, before using a megger. 11. Please Don't reverse the field terminal connections. 12. Use only HRC fuses in phase and field circuits.
15	**Charging Alternator (for charging of 24V battery)**	Maintenance of the charging system is limited to simple tasks designed to keep the system in good shape by eliminating the buildup of dirt and corrosion. The diodes in the alternator function as one-way valves and the transistors in the regulator operate as fast switches, both are accurate and sensitive. They do not wear and never require adjustment but because they are sensitive to voltage change and high temperature the following precautions are vital to prevent them being destroyed. xiii) Keep the alternator reasonably clean with a cloth wet in kerosene (paraffin) or white spirit. Ensure that ventilation slots or air spaces are clear and run obstructed. xiv) Keep the regulator housing clean and ensure that cooling air pass freely over the housing. xv) Ensure that the driving belt on the alternator has correct tension as, too slack will cause belt to slip and too tight will shorten the life of the belt. xvi) Check the mounting bolts for tightness. xvii) Always identify a lead to its correct terminal when disconnecting or reconnecting. Any lead short circuit or wrong connection giving reverse polarity will immediately and permanently ruin the transistors and diodes. xviii) Never connect a battery in to the system without checking for correct polarity and correct voltage. Short circuiting or reverse polarity no matter how brief will cause immediate and permanent damage to transistors and diodes, besides possible damage to the loads. xix) Never disconnect a lead without first stopping the alternator and turning any switches in the circuit to the ' OFF' position. xx) Never disconnect the battery while the alternator is running. This will

		cause a voltage surge in the charging system that will immediately ruin the diodes or transistors. xxi) Always ensure that the regulator is mounted with the terminals vertically down. xxii) Always ensure that the regulator mounting is such that it is not subjected to direct water splash. xxiii) Always ensure that the alternator is not mounted close to the exhaust manifold without any protection. xxiv) Brush off loose dust or dirt before removing cover. Note: For detailed description OEM manual may be followed.
16	**MAINTENANCE SCHEDULE OF FINAL DRIVE**	
	Monthly (15000 Kms Whichever is earlier)	Tighten all the fasteners (external) including the fasteners for cardan shaft shafts torque arm and if there is any excessive loosening, investigate for the reason. Clean the breather and re-fit.
	Part – III: Maintenance Schedule of standard examination of car body, under frame, bogies, brake rigging, Lifting & Swiveling Platform etc.	
17	**Monthly Maintenance Schedule of Car Body, Under Frame, Bogie, Brake System, Brake Rigging, Lifting & Swiveling Platform Etc.**	
		Repeat all items of Daily Schedule
17.1	Car Body	Car body should be washed both from outside and inside.
17.2	Shell	i. Visually check body panels/end walls for damages. ii. Visually inspect window bars for damage/missing. iii. Examine body side doors for proper working/damages. iv. Inspect door handles for damages/missing.
17.3	Under frame	i. Check condition of head stock/sole bar. ii. Visually inspect center pivot cover.
17.4	Bogie	
17.5	Bogie frame	i. Examine oil level in side bearer oil-bath and oil-filling cap replenish oil if needed. ii. Inspect axle box safety straps/ loops for damage/breakage/ missing. iii. Inspect bolster safety straps/loops for damage/ breakage /missing. iv. Check visually BSS hanger brackets.
17.6	Primary Suspension	i. Visually examine axle box springs for breakage/damage.

		ii. Visually examine dashpot oil filling special screw for deficiency. iii. Check oil leakages in dashpot through defective seals/vent screws. iv. Add specified grade of oil in dashpot. v. Visually examine axle box clearance.
17.7	Secondary Suspension	i. Visually examine bolster springs breakages/damages. ii. Visually examine Bolster lower spring beam. iii. Visually examine BSS hangers, hanger blocks, BSS pins. iv. Visually examine equalizing stay rods and pins (small and big). v. Visually check rubbing plate. vi. Visually examine Equalizing stay brackets. vii. Examine and attend safety loops of bolster. viii. Check and attend safety loops of Equalizing stay rod. ix. Examine vertical shock absorbers for damages.
17.8	Brake System	i. Externally clean the brake system pneumatic pipes and check for leakages. If required tighten the end fittings. ii. Check the mounting fasteners of Air reservoir/ Distributor valve/ relay valve magnet valve and other brake system equipments iii. Check and attend brake block adjuster. iv. Examine and attend brake levers. v. Examine and attend brake hanger lever brackets. vi. Check functioning of Parking Brake
17.9	Brake rigging	i. Check brake-rigging arrangement for any defects/deficiencies. and check tread brake wherever tread brake units are provided. ii. Examine brake beams breakages/ damages. iii. Check and attend brake beam safety wire ropes/safety straps. iv. Check and attend brake shoe head and key and replace if necessary. v. Check and replace worn brake blocks. vi. Visually inspect brake hangers, brake gear pins and cotters/split pins and replace if necessary. vii. Visually inspect damaged/missing brake gear bushes and replace if

		necessary. viii. Examine lever hanger pins.
17.10	Draw gear	i. Check and replace damaged/missing split pins/ cotter/rivets. ii. Examine draw hook, draw bars and rubber pads for damages. iii. Check conditions of the screw coupling and its components and replace if required. iv. Check condition of draw beam and locating pins on it. v. Examine visually draft key locking pins.
17.11	Buffing gear	i. Visually examine buffer plungers for damage/drooping/stroke length. ii. Examine buffer mounting bolts and attend if necessary. iii. Examine visually buffer casing for cracks/damages.
17.12	Running gear	i. Examine visually axle box for grease oozing out, warm axle box if any. ii. Visually examine wheel tyre profile and thickness of tyre and check with tyre profile gauge if they appear to be near condemning limit. iii. Visually inspect axle box covers. iv. Inspect wheel tread for shattered rim, spread rim, shelled tread, thermal cracks, heat checks.
17.13	Seats and berths	i. Disinfect the seats and frames. ii. Examine the holding/securing brackets for seats and berths and attend if necessary. iii. Examine and repair damaged upholstery cushions and curtains. iv. Seats and frames should be cleaned. v. Cushion should be cleaned with duster. Oil or head stain and dirty spots if any should be cleaned with mild soap solutions and wipe dry.
1714	Doors	i. Examine doors for proper functioning and securing with hinge pivots. Doors should not graze with floor or doorsill plates. ii. Examine door locks, latches firmly secured with correct sized screws and properly/smoothly engaging in their slot. The tongue of gravity type latch should be in proper alignment with its slot plate. iii. Visually examine window shutters for smooth working and proper

		locking.
17.15	Windows	i. Check window-balancing mechanism for proper function. ii. Examine window safety catches for proper engagement in their slots. iii. Check lavatory banjo shutters for damage/missing. iv. Window bars should be provided and fixed in prescribed manner and replaced if damaged.
17.16	Interior fittings	i. Examine laminated panels and moldings for damage/cracks. ii. Examine tower bolts of backrests for proper working. iii. Examine ventilation grills for damages. iv. Examine racks/bunks for breakage.
17.17	Lavatory and lavatory fittings	i. Intensive cleaning of lavatory pans and commode with cleaning agent ii. Check lavatory hinge door for proper function iii. Examine lavatory door latches/ tower bolts for proper function iv. Examine push cock and flush valve for proper function v. Check and attend leakage in pipes, pipe fittings. vi. Clean drain grills and drain holes in bathroom and wash basin if found chocked vii. Check and replace damaged/missing mirrors / shelves / soap dishes viii. Examine squatting pans and foot rest for damages
17.18	Monthly Maintenance of Lifting and Swiveling platform:	i. Repeat all Daily schedule ii. Lubricate bearing housing iii. Check and tighten if necessary all holding bolts of outer telescopic structure, cylinder flange, tilting head, gear ring, pinion, bearing housing, gear box, slewing motor, bearing housing supports, etc. iv. Clean telescopic railing square pipes and apply light film of grease / oil for smooth up and down motion. Also check railing locking arrangement for smooth functioning. Oil if necessary. v. Check electrical cable insulation vi. Apply grease on all Nylon pads vii. Apply grease on gear & pinion after cleaning the teeth and surface

Note: Function of Speedometer to be checked in every schedule.

Annexure-14

CONTACT DETAILS OF NEAREST AUTHORIZED SERVICE OFFICE AND SERVICE MANAGER OF M/S CUMMINS

Sr No	ZONE	DEALER SHIP NAME	CITY	State	CONTACT PERSON	ADDRESS	TEL NO. OFFICE	FAX NO	Mobile No.	AREA COVERED	E-mail
1	EAST	Eastern Diesel Sales & Service	Silchar	Assam	Mr.PO Polson (GM Service) Mr.PP John (HOD)	SONAI ROAD, P.O. - LINK ROAD, (POST BOX NO.49) CACHAR , SILCHAR - 788 006 ASSAM	Single Point Contact 9854080955 / 03842 - 225100 / 225892	03842-225853	P O Polson (GM Service) 9435070799 Mr.PP John (HOD) 9854080959	**Assam districts:-** Cachar, Hailakandi, North cachar hills & Karimkanj. **NE states:-** Tripura, Mizroam & Manipur.	popaulson721@gmail.com johnsons@bsnl.in
2	EAST	Garuda Power Private Limited	Kolkata	West Bengal	BS Jayant / DR Deshpande	Joka Industrial Plaza, Diamond Harbour Road, Post : Joka Kolkata - 700104	033-24381028 / 033-24380165	033-24381029	BS Jayant 94340-09385 (HOD) DR Deshpande 7044074201 (HOD)	East Sikkim, North Sikkim, South Sikkim, West Sikkim, Bankura, Birbhum, Burdwan, Darjeeling, East Midnapore, Hoogly, Howrah, Jalpaiguri, Koch Bihar, Kolkata, Maldah, Murshidabad, Nadia, North Dinajpur, North24-parganas, Puruliya, South Dinajpur, South24-parganas,	gppl@garudapower.com

										West Midnapore	
3	EAST	JAIKAR TECHNO PRIVATE LIMITED, DHANBAD	Dhanbad	Jharkhand	RS CHAHAL	Katras Road, Opposite Super Bazar, Dhanbad-826001 (Jharkhand).	0326 -2304398 / 2301451	0326-2304398	R S CHAHAL - (HOD) 94 311 21923 J.S. Chahal (HOD) 94 311 24541	Bokaro, Dhanbad, Dumka, Giridih	jkdiesels@gmail.com
4	EAST	JAIKAR TECHNO PRIVATE LIMITED, HAZARIBAGH	Hazaribagh	Jharkhand	RS CHAHAL	PTC Road, Korrah, Hazaribagh , PIN - 825 301 JHARKHAND	06546- 266497 / 266553	06546-266947	R S CHAHAL (HOD) 94 311 21923	Hazaribagh	jkd_haz@sify.com
5	EAST	JAIKAR TECHNO PRIVATE	Jamshedpur	Jharkhand	RS CHAHAL	NH-33, Pardih (Near Sahara City), P.O-M.G.M , Mango, Jamshedpur- 834012 Jharkhand	0657-2363776, 2363778	0657-2363776	R S CHAHAL (HOD) 94 311 21923	Bokaro, East Singhbhum	jkd_jsr@sify.com

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		LIMITED , JAMSHEDPUR									
6	EAST	JAIKAR TECHNO PRIVATE LIMITED , MUZAFFARPUR	Muzaffarpur	Bihar	A S CHAHAL	Satpura Colony, Aghoriabazar Post Office RAMNA, Muzaffarpur - 842002 BIHAR	(0621) 2273226 / 27	NA	A.S. Chahal (HOD) 94 311 24509	Araria, Champaran, Darbhanga, Gopalganj, Katihar, Kishanganj, Madhepura, Madhubani, Muzaffarpur, Paschim Champaran, Purbi Champaran, Purnia, Saharsa, Samastipur, Saran, Sheohar, Sitamarhi, Siwan, Supaul, Vaishali	jkdmuz@gmail.com
7	EAST	JAIKAR TECHNO PRIVATE LIMITED , NOAMUNDI	Noamundi	Jharkhand	RS CHAHAL	Main Road, P.O- Noamundi Bazar, Dist - Singhbhum(West) PIN- 833218 , JHARKHAND	SPC- 9279832991 - Samanti) (9234662979- JB Sahu)	NA	R S CHAHAL (HOD) 94 311 21923 SWAPAN GHOSH (Branch Manager) 94 311 10164	Singhbhum	jkd_nmd@sify.com

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8	EAST	JAIKAR TECHNO PRIVATE LIMITED, PATNA	Patna	Bihar	R S CHAHAL	M-3/21 SRI KRISHNAPURI,NEAR BASAWAN PARK, PATNA 800001, BIHAR	0612-2541277 , 3263520 / 21 SPC - 930481-4959 (Anu Singh) 93048-14950 (Vinod) / 93048-14966 (Smaeer)	0612-2541277	R S Chahal (HOD) 94 311 21923	Aurangabad, Banka, Begusarai, Bhabua, Bhagalpur, Bhojpur, Buxar, Gaya, Jahanabad, Jamui, Khagaria, Luckeesarai, Munger, Nalanda, Nawada, Patna, Rohtas, Sheikhpura, Deogarh, Pakaur, Sahibganj	jkdieselsptn@gmail.com
9	EAST	JAI KAR TECHNO PRIVATE LIMITED, BHUBANESHWAR	Bhubaneshwar	Odisha	Jaspinder Singh Chahal	6C & 6D SECTOR A, ZONE B, MANCHESWAR INDUSTRIAL ESTATE BHUBANESWAR-751010	SPC : Sasmita Kund 7894455740	0674-2587358	Jaspinder Singh Chahal (HOD) 94 311 24541 PK Chakraborty (GM) 7894455731	Balangir, Baleshwar, Bauda, Bhadrak, Cuttack, Gajapati, Ganjam, Jagatsinghpur, Jajpur, Kalahandi, Kendrapara, Kendujhargarh, Khordha, Koraput, Malkangiri, Mayurbhanj, Nabarangapur, Nayagarh, Nuaparha, Phulabani, Puri,	spc.jtplbbsr@gmail.com

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										Rayagada, Sonapur	
11	EAST	Garuda Power Private Limited	Korba	Chhattisgarh	DC KULKARNI	1st FLOOR, ALKA COMPLEX TRANSPORT NAGAR, KORBA 495679 -, CHHATTISGARH	8120009082 / 9926099711 SPC NO. 9434752598 / 8420007075	07759 225927	DEEPAK C KULKARNI (HOD) 98 261 34707	Bilaspur, Champa - Janjgir, Jashpur, Korba, Korea, Raigarh, Surguja, Shahdol, Umaria	ashwani.shukla@garudapower.com gautam.sarkar@garudapower.com
12	EAST	Garuda Power Private Limited	Rourkela	Odisha	Abhyuday Kulkarni	TCI Chowk, Back Side of Safeexpress, Vedvyas Rourkela , Pin No: 769041 , Dist.: Sundargarh Odisha	SPC : Suhrita Basu Mallick 8420007075	N/A	Abhyuday Kulkarni (HOD) 9178456285 BK Chakraborty (Head Customer Support): 9178456255	Angul, Bargarh, Deogarh, Dhenkanal, Jharsuguda, Sambalpur, Sundargarh	s.basumallick@garudapower.com
13	EAST	Sachin Sales and Service Pvt Limited	Guwahati	Assam	Mr.Avinash Ketkar (GM Service) Mr Jayanta Sharma (HOD)	1, August Kranti Path, Beltola - Khanapara Road, Beltola, Guwahati - 781 028	Single Point Contact (Dealer Customer Care) 9435196481 / 0361-2229024 / 25	0361-2229561	Avinash Ketkar (GM Service) 9706009306 Mr Jayanta Sharma (HOD) 9706009345	**Assam districts:-** Kamrup metropolitan/South, Marigaon, Nagaon, Karbi Anglong, West Karbi Anglong & Hojai. **NE states:-** Nagaland & Meghalaya.	avinash.ketkar@jsgroup.net.in Jayanta.sharma@jsgroup.net.in

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14	EAST	Jaikar Techno Private Limited	Ranchi	Jharkhand	Mr. Swapan Ghosh	Plot No.43, Near Imam Kothi, Old Hazaribagh Road, Kokar, Ranchi 834 009 , Jharkhand		N/A	Swapan Ghosh 9234550164	Chatra, East Singhbhum, Garhwa, Giridih, Godda, Gumla, Koderma, Lohardaga, Palamau, Ranchi	jaikartechno.ranchi4@gmail.com
15	EAST	Sachin Sales & Service Private Limited	Jorhat	Assam	Mr.Supriyo Charbroty (Service manager) Mr Jayanta Sharma (HOD)	1, August Kranti Path, Beltola - Khanapara Road, Beltola, Guwahati - 781 028	Single Point Contact (Dealer Customer Care) 9435136459 / 0361-2229024 / 25	0361-2229561	Supriyo Chakrbroty (Service manager) 9706009307 Mr Jayanta Sharma (HOD) 9706009345	**Assam districts:-** Golaghat, Jorhat, Charaideo, Majuli Island & Sivasagar. **Nagaland districts:-** Zuhenbutto & phek.	Supriyo@jsgroup.net.in Jayanta.sharma@jsgroup.net.in
16	EAST	Sachin Sales & Service Private Limited	Tinsukia	Assam	Mr.Pulak Boruh (Operation manager) Mr Jayanta Sharma (HOD)	Gilapukhari Road, Bordoi Nager, Tinsukia, 786125	Single Point Contact (Dealer Customer Care) 9435108802 / 03742309806/ 2300878	0374-2305343	Pulak Boruh (Operation manager) 9706009310 Mr Jayanta Sharma (HOD) 9706009345	**Assam districts:-** Tnsukia & Dibrugarah. **Arunanchal Pradesh:-** Anjaw, Changlang, Dibang Valley, East Siang, Lohit, Upper Siang & West Siang.	pulak.boruah@jsgroup.net.in Jayanta.sharma@jsgroup.net.in

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17	EAST	Garuda Power Private Limited	Tezpur	Assam	Mr.Souren Sen (HCS) S N Bagchi (HOD)	EX POLICE LINE , TEZPUR, DIST SONITPUR 784 001, ASSAM	Single Point Contact (Dealer Customer Care) 943505775 / 03712 - 220936	NA	Mr.Souren Sen (HCS) 9435563058 S N Bagchi (HOD) 94350 81479	**Assam districts:-** Darrang, Dhemaji, North Lakhimpur, Sonitpur, Bongaigaon, Kamrup Rural, Barpeta, Rangiya, Goalpara, Kokrajhar, Baksha, Dhubri, Chirang, Nalbari, Udalguri, South Salmara-Mankachar, Barpeta & Bishwanath. **Arunanchal Pradesh districts:-** East Kameng, East Siang, Lower Subansiri, Tawang, Upper Subansiri, West Kameng & Papumpare.	samarendra.bagchi@yahoo.com souren.sen@garudapower.com
18	NORTH	Excel Diesel	Lucknow	UP	AK Pandey	B-2/390, Sector A, Sitapur Road Scheme, Aliganj, Lucknow 226 021 UTTAR PRADESH	0522 4152300 / 4152317 SPC - 9793839000, 9793846000	0522-4152301	AK Pande (HOD) 99 355 93565 Ritesh Singh, (MGR SER) - 99 355 93576	Azamgarh, Bahraich, Ballia, Balrampur, Barabanki, Basti, Deoria, Faizabad, Gonda, Gorakhpur,	admin@exceldiesel.com

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										Hardoi, Kushinagar, Lucknow, Maharajganj, Maunathbhanjan, Pratapgarh, Rae Bareli, Sant Kabir Nagar, Shravasti, Sidharthnagar, Sitapur, Sultanpur	
19	NORTH	Gulati Diesels	Karnal	Haryana	Ajay Gulati	Plot No.18 / 3, H.S.I.D.C., Industrial Area, Karnal-132001, Haryana	0184 - 2221600 SPC - 98122-09023 - Mahendra Khurana	0184-2221600	Ajay Gulati (HOD) 98 120 43138 Amit Gulati (HOD) 98 123 55555 Rajesh Bareja (Service Head) 98 122 09014	Fatehabad, Hisar, Jind, Kaithal, Karnal, Kurukshetra, Panipat, Sirsa, Yamunanagar	RohtashKalyan@gulatidiesels.com
20	NORTH	Jakson Enterprises	Agra	UP	Rajiv Hooda/ Pradyumn Pathak	46-B, LAJPAT KUNJ KHANDARI ROAD AGRA 282005	0562-2962461 8057901427 - SPC		08057901401 - Prashant Trivedi (Branch Manager)	Mainpuri, Mathura, Etah, Firozabad, Agra	-
21	NORTH	Jakson Enterprises	Meerut	UP	Rajiv Hooda/ Pradyumn Pathak	A4, Pallav Puram, Phase-1, Modi Puram Meerut.	Pramod Sharma- 8057901549 SPC-8057901480		Umesh Chaudhary (DGM) 08057901456	Meerut, Bagpat, Bijnor, Muzzafar Nagar, Saharanpur	-
22	NORTH	Jakson Enterprises	Jhansi	UP	Rajiv Hooda/ Pradyumn Pathak	B-19, Avas Vikas Colony, Nandan Pura Jhansi- 284003	05102480083 9792971560 - SPC		9792971549 - LK Shukla (Service Manager)	Jhansi, Lalitpur, Mahoba, Jalaun, Auraiya, Etawah, Banda	arvind.pandey1@jakson.com

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23	NORTH	Jakson Enterprises	Haridwar	Uttaranchal	Rajiv Hooda/ Pradyumn Pathak	N 11, Shivalik Nagar, Haridwar, Uttranchal, Pin Code 249403	01334-232552 SPC- Preeti 8057901548		Avneesh Sharma- 8057901546	Haridwar, Uttar Kashi, Tihri, Chamoli	avneesh.sharma@jakson.com
24	NORTH	Jakson Enterprises	Dehradun	Uttaranchal	Rajiv Hooda/ Pradyumn Pathak	216, Saket Colony, Ajabpur Kalan, Dehradun	08057901440 - Katar Singh		08057901440 - Katar Singh	Dehradun	
25	NORTH	JAI KAR TECHNO PRIVATE LIMITED	Mohali	Punjab	KS Chahal	E-220, PHASE - VIII B INDUSTRIAL FOCAL POINT MOHALI 160071	0172-4323333	0172-4323300	K S Chahal (HOD) 98 726 62200 KULBHUSHAN RAI (COO) 98 154 21182	Chandigarh, Ambala, Panchkula, Hoshiarpur, Patiala, Rupnagar, SAS Nagar (Mohali) , SBS Nagar (Nawanshahar) , Fatehgarh Sahib	serviceadvisor.chd@jaikar.com
26	NORTH	JAIKAR TECHNO PRIVATE LIMITED	Singrauli	MP	R S Chahal	New Market, PO: Singrauli, Dist. Singrauli (MP) Pin- 486 889.	07805- 268712 07805- 268718 SPC - 9755085240 (Vijayrao)	07805-268711	Akhar Ansari SER - 94 253 31809 Bharathan - 09753216324 R S Chahal - (HOD) 09431121923	districts of Mirzapur & Sonebhadra in the state of Uttar Pradesh and Sidhi in the state of Madhya Pradesh	rajinder_schahal@sify.com
27	NORTH	Svam Power Plants Pvt. Ltd.	Noida	UP	Sudhir Malhotra	Svam Power Plants Pvt. Ltd. A-107, Sector-63 Noida-201301.	Noida Tel: 0120-4792444 (30 lines)	N/A	Mr.Sudhir Malhotra, (HOD) Mobile no. +91 9810017488	Bulandshahr, Gautam Budh Nagar, Ghaziabad	svam.noida@svampower.com parts.noida@svampower.com

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											service.noida@svampower.com
28	NORTH	Pal Engineers	Jammu	J&K	Prashant Luthra	Sewa Complex, Opposite Fire Station, Gangyal, National Highway Jammu 180 010	0191-2484028, 2484029 SPC - 9697045744	0191-2484059	Prashant Luthra (HOD) 98100-06669 Sudhir Mehra (GM) - 9858414152	Anantnag, Chilas, Gilgit, Gilgit Wazara, Jammu, Kashmir North, Leh-Ladakh, Mirpur-Muzaffarabad, Punch, Riasi , Kargil , Pulwama , Doda-Kistwar , Udhampur , Budgam , Baramula , Bandipura , Kupwara , Srinagar ,Kathua , Rajauri , Ramban , Ganderbal	service_paleng@luthragroup.net
29	NORTH	Pal Engineers	Baddi	HP	Prashant Luthra	SC0 013,Block A, M1 Plaza, Jharmajri, Baddi, DIST. Solan - 173205, Himachal Pradesh	01795 - 271360 , 61, 62 SPC - 88946-11222	01795 - 271359	Prashant Lutra (HOD) 09810006669 Lalit Kapoor - 8894789801	Bilaspur, Chamba, Hamirpur, Kangra, Kinnaur, Kullu, Lahul & spiti, Mandi, Shimla, Sirmaur, Solan, Una	service@palengineers.in

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30	NORTH	Rajasthan Diesel Sales & Service	Udaipur	Rajasthan	Vijay Bagrecha	E-39/40, Mewar Industrial Area, Road No.5, Udaipur- 313003 (Rajasthan).	0294 - 3051400 / 0294 - 3051401 Service - 3051413, 3051415 , 3051414 Parts - 3051406 , 3051407	0294-2491697	Vijay Bagrecha (HOD) 94 141 65573 GR Sharma (Service Manager) 94141-65571	Mandsaur, Neemuch, Ajmer, Banswara, Baran, Bharatpur, Bhilwara, Bundi, Chittaurgarh, Dhaulpur, Dungarpur, Jalor, Jhalawar, Karauli, Kota, Pali, Rajsamand, Sawaimadhopur, Sirohi, Udaipur	spc@rdssudr.com headoffice@rdssudr.com fieldservice@rdssudr.com
31	NORTH	Sudhir Sales & Services Limited	Ludhiana	Punjab	Mr. Naveen Sehra	Verma Arcade, B XX - 2027, Gobind Nagar, PAV Road, Ludhiana - 141001	0161-4386000 to 4386008	N/A	997199 5995 (Kunal Malhotra) 98 760 32506 (NAVEEN SEHRA)	Amritsar, Bathinda, Faridkot, Firozpur, Gurdaspur, Jalandhar, Kapurthala, Ludhiana, Mansa, Moga, Muktsar, Sangrur , Fazilka , Pathankot , Taran-Tarn , Abohar , Barnala	spc@sudhirgroup.com

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32	NORTH	Svam Power Plants Private Ltd.	Faridabad	Haryana	Sudhir Malhotra	A-3/2, Nehru Ground, Neelam Bata Road, N.I.T Faridabad-121001 (Haryana)	0129 - 4028316, 4028317, 402318, 4028319 (Faridabad). 0124-4139000 (Gurgaon) Ashok Nijhara, VP 98 100 22321 S Mukherjee, Service 98 104 32220 Anil Gupta, Service 98 104 46483	0129 - 4028320	Sudhir Malhotra , MD 98 100 17488	Bhiwani, Faridabad, Gurgaon, Jhajjar, Mahendragarh, Rewari, Rohtak, Sonipat	svam.fbd@svampower.com
33	NORTH	URSS Techservices Private Limited	Jaipur	Rajasthan	Rajeev Singh	B-2, Jayanti Market, M I Road, Jaipur 302 001.	0141 - 2367884 / 2367883 / 2367890	0141-2362559	98 290 67884 (HOD) Rajeev Singh 9829069884 Mr. Venugopalan (Service Managers)	Alwar, Barmer, Bikaner, Churu, Dausa, Ganganagar, Hanumangarh, Jaipur, Jaisalmer, Jhunjhunun, Jodhpur, Nagaur, Sikar, Tonk	spc@urssjpr.com venugopalan.mp@urssjpr.com parts@urssjpr.com
34	SOUTH	Maniranjan Diesel Sales & Service Pvt Ltd. Bangalore	Mysore	Karnataka	Tanveer Khan (HOD)	No.34-B, Industrial Area, Bannimantap 'A' Layout, MYSORE - 570015 KARNATAKA	0821 - 2496290 / 2492006 / 2496205 / 2496206	0821-2498367	Tanveer Khan (HOD) 98 440 69052 Mr.WAJAT KHAN 98459 39359	Chamarajnagar, Chikmagalur, Hassan, Kodagu, Mandya, Mysore, Nilgris	deshmukh@maniranjan.com tanveer@maniranjan.com

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35	SOUTH	JN Machineries Private Limited	Madurai	TN	A SUDHIR / K Nagarajan	Natham Road, Marani vilakku, Oomachikulam,Madurai - 625 014. TAMIL NADU	0452 - 2681765 / 2680001	0452-2681515	A.Sudhir (HOD) 98 947 83483 K Nagarajan (HOD) 99 944 93933	Ariyalur, Dharmapuri, Dindigul, Kanniyakumari, Karur, Madurai, Namakkal, Perambalur, Pudukkottai, Ramanathapuram, Salem, Sivaganga, Theni, Tiruchirappalli, Tirunelveli, Tuticorin, Virudhunagar	jnmmdu@jnmachineries.com
36	SOUTH	Powerica a limited Service Division	Pondicherry	Pondicherry	P RAMNATHAN (HOD)	No. 481, Ground Floor, Vazhuthavur Main Road, Muthirapalayam, Pondicherry - 605 009	0413 - 2274242 SPC No. is 0413 - 3247365	0413-2279292	S Mullainathan - 8754466522 K.Raghunath - 9840278416	Pondicherry, Karaikal, Nagapattinam, Cuddalore, Villupuram, Tanjore, Kumbakonam, Tiruvarur	s.mullainathan@powericaltd.com k.raghunath@powericaltd.com
37	SOUTH	Maniranjan Diesel Sales & Service Pvt Ltd.	Bangalore	Karnataka	C.N.Deshmukh (HOD)/Ashirwad Deshmukh	NO 1/7 NGEF Quarters,Near ESI Office,NGEF layout,Byappanahalli,Bangalore 560038	080 - 40906464 / 080 - 40906463	080 - 25203035	C.N.Deshmukh/Ashirwad Deshmukh - 94 484 96939 MG Kulkarni (Ser. Mgr) 94 484 96912	Bangalore, Tumkur ,Hosur, Ramnagar,Channapatna,Chikabllapur, Kolar	deshmukh@maniranjan.com, ashirwad@maniranjan.com

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		Bangalore									
38	SOUTH	Maniranjan Diesel Sales & Service Pvt Ltd. Coimbatore	Coimbatore	TN	N D THAKUR	101 Shastri Nagar, Opp. Kovai Medical Center, Aerodrome, P. O. Coimbatore 641014	0422 - 4520251, 4520252, 4520253	0422 - 4520254	N.D.Thakur (HOD) 94 437 17531 S.Rajgopalan - 98 940 17593	Tirupur, Coimbatore, Erode, Krishnagiri(Hosur Taluka),	mrdss@md3.vsnl.net.in
39	SOUTH	Naveen Diesels	Cuddapah	AP	Atul Krishna	D NO.1/2113-1, New RTC Bus stand,Railway station road, Prakash Nagar, KADAPA 516004	SPC - 08562 - 258010 SA -9493896327 (Suresh)	08562 258012	Atul Krishna (CEO) 94 938 96324 P.D.Sanjeev (Dy.GM) 94 938 96315	Chittoor, Cuddapah, Kurnool, Nellore	ekbkadapa@gmail.com
40	SOUTH	Powerica Limited (Service Division)	HUBLI	Karnataka	P RAMNATHAN (HOD)	NO 72, ANURADHA SHANTI COLONY (SOUTH) OLD INCOME TAX OFFICE ROAD VIDYA NAGAR City : HUBLI, District : DHARWAD ,State : KARNATAKA	0836-2271262 SPC - 96 864 47105	0836-2271013	Mr.CS Patil 9663309437	Bagalkot, Belgaum, Bidar, Bijapur, Dharwad, Gadag, Gulbarga, Haveri	csp@powericaltd.com

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41	SOUTH	The Primemovers	Shimoga	Karnataka	K R RAJASEKHAR (HOD)	Plot No.42 & 43, Mandli -Kallur Ind.Estate, Shimoga-577202 (Karnataka)	08182 - 223412 , 220635 99801-79949 - Divya	08182-220615	KR.Rajasekhar (HOD) 98 458 44688 B.V.Suresh - Ser Ex - 98 458 88355	Chitradurga, Dakshina Kannada, Davangere, Shimoga, Udupi, Uttara Kannada	hod@theprimemovers.co.in
42	SOUTH	Srinivasa Sales & Services Pvt Limited	Hyderabad & Vijayawada	AP & Telengana	Mr.M. Venugopal	# 27-33-46, Gudavallivari Street, Governorpet, Vijayawada-520002 (AP.)	(Vijaywada) Single point contact 08666514444 ---------- (Hyderabad) SPC - 8297563185 / 040 - 67174444	0866-2575335	M VENUGOPAL 8886456789 (HOD) M Gokul (VP) 8886712345 Sunil Saw (Head Service) 8297124444	Adilabad, East Godavari, Guntur, Hyderabad, Karimnagar, Khammam, Krishna, Mahbubnagar, Medak, Nalgonda, Nizamabad, Prakasam, Rangareddi, Srikakulam, Visakhapatnam, Vizianagaram, Warangal, West Godavari	adminvja@srinivasaservices.com
43	SOUTH	Sunitha Sales & Service Private Limited	Cochin	Kerala	KARTHIK JOB / C V Ganesh	PB NO. 20, HILL PALACE ROAD, NEAR RAILWAY OVER BRIDGE, TRIPUNITHURA, KOCHI - 682 301 KERALA	0484 - 2777177 / 2775760 / 2775761	0484-2775900	P.N. Job (HOD 98 954 52177 Karthik Job (HOD) 98 470 12808 C.V.Ganesh 98 470 54777	Alappuzha, Ernakulam, Idukki, Kannur, Kasaragod, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad,	kochi@ssscummins.co.in

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									Pramod Kumar (Ser,. Mgr) - 9388924471	Pathananthitta, Thiruvananthapuram, Thrissur, Wayanad, Lakshadweep	
44	SOUTH	Sunny Diesel Sales & Service	Port Blair	A & N	V THIAGARAJAN	Reg. Office: 27, DasmeshMarket, Dr. Diwan Singh Gurudwara Line, Port Blair-744101. Phone No.03192-231558 Adm.Office: Survey No. 4/2, Prothrapur, Garacharma (Post), Port Blair-744105 Phone No. 03192-251119, 250395 Fax No. 03192-250558	03192 - 213430 / 251119	03192 - 250558	MR V Thiagarajan (HOD) - 94 342 81145 MR PANDIAN 93 320 33088	Andaman and Nicobar	andamansdss@gmail.com
44	SOUTH	The Primemovers	Shimoga	Karnataka	K R RAJASEKHAR (HOD)	Plot No.42 & 43, Mandli -Kallur Ind.Estate, Shimoga-577202 (Karnataka)	08182 - 223412 , 220635 99801-79949 - Divya	08182-220615	KR.Rajasekhar (HOD) 98 458 44688 B.V.Suresh - Ser Ex - 98 458 88355	Chitradurga, Dakshina Kannada, Davangere, Shimoga, Udupi, Uttara Kannada	hod@theprimemovers.co.in

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45	SOUTH	Powerica Limited (Service Division)	Hospet	Karnataka	P RAMNATHAN (HOD)	Ground Floor, Krishna Inclave no. 353, Station Road, Hospet-(Karnataka).	08394 - 221601	08394-221602	Mr. Wison Fernandes 9480849510	Anantpur, Bellary, Koppal, Raichur	wilson.fernandes@powericaltd.com
46	WEST	POWERICA LIMITED, (SERVICE DIVISION) TALOJA	Mumbai	Maharashtra	K. Raman	B-8, MIDC Industrial Area , Taloja, Dist Raigad, Maharashtra - 410208	022-27405650	022 - 27412221	K RAMAN MOB-09967137017	Greater Mumbai, Thane	k.raman@powericaltd.com
47	WEST	Deccan Sales & Service Private Limited	Indore	MP	R S Patil	W. A. 107 & 108, Sector "A", Scheme No. 94, RING ROAD, Near Bombay Hospital, INDORE - 452 010, MADHYA PRADESH	0731 - 3924200,3924201,3924209 SPC 0731- 3259101 spc.indore@deccandiesels.com	0731-2553979	R. S. Patil - CMD 98270-39095, 93762-29890 Praveen Yadav - CEO 98270-39097 Pawan Sharma - Ser Mgr 93007010102	Alirajpur, Badwani, Burhanpur, Dewas, Dhar, Indore, Jahbua, Khandwa, Khargone, Ratlam, Shajapur, Ujjain	spc.indore@deccandiesels.com
48	WEST	Deccan Sales & Service Private Limited	Vadodara	Gujarat	R S Patil	276/3, GIDC INDUSTRIAL ESTATE, MAKARPURA, VADODARA - 390010, GUJARAT	0265 - 3042555 /4 / 3 /2 / 6 / 8 /9 SPC : 07878009009	0265 - 3042555	Sudhir Shejwalkar Operation Head 93762-29893 Vikas Patil Service Manager 9328606927	Bharuch, Dahod, Narmada, Panchmahal, Surat, Vadodara	spc.gujarat@deccandiesels.com

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49	WEST	Madhunil Engineering Services Pvt Ltd.	Navi Mumbai	Maharashtra	BHARAT KULKARNI	Plot W.109-B, MIDC T.T.C Area Khairne, Thane-Belapur Road, Navi Mumbai-400709	022-27680678	022-27682047	Bharat Kulkarni (HOD) 98 211 46393 Jeevan Gaikwad (Mgr. Service) 98 704 99810	Raigarh	kulkarni@madhunil.com
10	EAST	Karm Sales and Service	Raipur	Chhattisgarh	KDR MISHRA	BARKAT PLAZZA, NEAR LUKKAD PETROL PUMP, RING ROAD NO.02, HIRAPUR, RAIPUR :492010 (C.G.)	0771-4015100 / 9617772564 MOBILE NUMBER AFTER OFFICE HOUR : 9617772565 (AFTER 06.00 P.M TO MORNING 8.30 A.M.)	0771-4015151	K.D.R. Mishra (HOD) 94252-37050, 9617772560 P K Deva - 98 935 52708 (Jabalpur)	Bastar, Dantewada, Dhamtari, Durg, Kanker, Kawardha, Mahasamund, Raipur, Rajnandgaon, Balaghat, Chhindwara, Dindori, Jabalpur, Katni, Mandla, Narsimhapur, Panna, Rewa, Satna, Seoni, Amravati, Bhandara,	service@karmsales.com ; cildbusupport@karmsales.com
50	WEST	Karm Sales and Service	Nagpur	Maharashtra	KDR MISHRA	W-46 MIDC Hingna Road, Nagpur-440016 (Maharashtra).	(Nagpur) (07104) 237544 / 235244 / 646066/67 ---------- (Jabalpur) 0761-4005574, 4082981	07104-235245	K.D.R. Mishra (HOD) 94252-37050, 9617772560 R Ramkumar - 9011017167 (Nagpur)	Chandrapur, Gadchiroli, Gondiya, Nagpur, Wardha, Yavatmal	kdr@karmsales..com rajasekaran.ramkumar@cummins.com

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51	WEST	Sudhir Sales & Services Limited	Ahmed abad	Gujarat	MS. KRITIKA SETH	B/501, 5TH FLOOR, SAFAL PEGASUS, OPP. KIRAN MOTORS, PRAHLAD NAGAR, AHMEDABAD - 380006, GUJARAT	079-66170003 / 4	079-66170005	MANISH DWIVEDI GM OPERATIONS 8980122522 RAVI PANCHAL - SERVICE MANAGER 9978722522	Ahmedabad, Amreli, Anand, Banas, Banas Kantha, Bhavnagar, Gandhinagar, Jamnagar, Junagadh, Kachchh, Kheda, Mehsana, Patan, Porbander, Rajkot, Sabar Kantha, Surendranagar	spc.guj@sudhirgroup.com
52	WEST	Trident Services Private Limited	Pune	Maharashtra	SANJAY TANDON / V NAGESHWARAN / SAMPAT HARPALE	1st Floor, "KAMADHENU" 106/A Senapati Bapat Road, (Opp. Chatushringi Temple), PUNE - 411 016	020 66266222 , 66266223 66266200 , 98814 98040 25671243 / 25671244 / 25653032 / 25653036	020-25671245	Sanjay Tandon (HOD) 98 220 41149 V Nageshwar (HOD) 98 220 02930 Sampat Harpale (HOD) 98 505 50120 Vivek Ballal (GM SER) 98 505 50140 Avinash Kulkarni (Service Manager) 98 50550121	Kolhapur, Pune, Ratnagiri, Sangli, Satara, Sindhudurg	tridents@eth.net

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53	WEST	Trinity Mahalasa Durga Sales & Services	Panjim	GOA	D V Talekar / Suresh Rau / Partha Talekar	Pandit Niwas , Near PWD office,Baina,Vasco Da Gama, Goa 403802	0832-6650137 0832-6720300 SPC - 96 577 22684	0832 2514072	DV Talekar (HOD) 96 577 22661 Partha Talekar (HOD) 96 577 22666 Prashant Kamat (Ser Mgr) - 96 577 22667	GOA	mahalasadurga@eth.net
54	WEST	Trinity Mahalasa Durga Sales & Services	Aurangabad	Maharashtra	Suresh Rau	C 220, MIDC INDUSTRIAL AREA PANDHARPUR VILLAGE : WALUJ AURANGABAD 431 136 MAHARASHTRA	0240 6624472 / 6624473	0240 - 6624623	S S RAU (HOD) 96 577 22577 , 94 229 44647 Indrajit Rau (HOD) 96 577 22555 Praksah Zodge (Serv. Mgr) - 96 577 22553	Ahmednagar, Akola, Aurangabad, Bid, Buldhana, Dhule, Hingoli, Jalgaon, Jalna, Latur, Nanded, Nandurbar, Nashik, Osmanabad, Parbhani, Solapur, Washim	info.agd@trinitymahalasa.com
55	WEST	Deccan Sales & Service Private Limited	Vapi	Gujarat	R S Patil	PLOT NO. 2908/1, BEHIND TELEPHONE EXCHANGE, GIDC CHAR RASTA VAPI - 396195, GUJARAT	0260-6545598 , 99 SPC : 07878009009	0260-2430986	Abhish Dharmadhikari Branch Head 9510582555 Gopal Patil Service Manager 9327406902	Bharuch, Dahod, Narmada, Panch mahal, Surat (including the area of Hazira, Sompapur, Dummas, Magdala), Navsari Vadodara, The	spc.gujarat@deccandiesels.com

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										Dangs & Valsad (Including Vapi), in the state of Gujarat, Union Territory of Daman & Diu, Dadra & Nagar Haveli.	
56	NORTH	Jakson Enterprises	Kanpur	Uttaranchal	Rajiv Hooda/ Pradyumn Pathak	Magarwara, , Dist Unnao, Uttar Pradesh _ 209862	0515- 2833666 SPC- 9919222207		Rakesh Srivastava- (Branch Manager) 9919222208	Kapur, Fatehpur, Allahabad, Varanasi, Kannauj	rakesh.srivastava@jakson.com
57	NORTH	Jakson Enterprises	Varanasi	Uttaranchal	Rajiv Hooda/ Pradyumn Pathak	M- S2 /644 Varuna Vihar Colony, Sikraul, Varanasi, Uttar Pradesh 221 002	SPC- 9919222207		Pappu-7720028489	Kapur, Fatehpur, Allahabad, Varanasi, Kannauj	pappu.kumar@jakson.com
58	NORTH	Jakson Enterprises	Allahabad	Uttaranchal	Rajiv Hooda/ Pradyumn Pathak	Varuna Vihar Colony, Sikraul	SPC- 9919222207		Subhajeet Basak- 9792971504	Kapur, Fatehpur, Allahabad, Varanasi, Kannauj	subhajeet.basak@jakson.com
59	NORTH	Sudhir Sales & Services Limited	Bhopal	MP	Naveen Shehra	Varanasi,	0755-4226667	0755-4226663	Ravindra Nimbalwar- 9827706235	Betul, Bhind, Bhopal, Chhatarpur, Damoh, Datia, Guna, Gwalior, Harda, Hoshangabad, Morena, Raisen, Rajgarh, Sagar,	spcbhopal@sudhirgroup.com

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										Sehore, Shajapur, Sheopur, Shivpuri, Tikamgarh, Vidisha	
60	NORTH	Svam Power Plants Pvt. Ltd.	New Delhi	Delhi	Sudhir Malhotra	Uttar Pradesh	Delhi Tel: 011-49481333 (30 Lines) ---------- Okhla Tel: 011-49481222 (30 Lines)	N/A	Mr.Sudhir Malhotra, (HOD) Mobile no. +91 9810017488	Delhi state	svam.un@svampower.com parts.udyognagar@svampower.com service.udyognagar@svampower.com ---------- svam.okh@svampower.com parts.okhla@svampower.com
61	NORTH	Svam Power Plants Pvt. Ltd.	Noida	UP	Sudhir Malhotra	PIN-221002	Noida Tel: 0120-4792444 (30 lines)	N/A	Mr.Sudhir Malhotra, (HOD) Mobile no. +91 9810017488	Bulandshahr, Gautam Budh Nagar, Ghaziabad	svam.noida@svampower.com parts.noida@svampower.com service.noida@s

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											vampower.com
62	NORTH	Svam Power Plants Private Ltd.	Faridabad	Haryana	Sudhir Malhotra	A-3/2, Nehru Ground, Neelam Bata Road, N.I.T Faridabad-121001 (Haryana)	0129 - 4028316, 4028317, 402318, 4028319 (Faridabad). 0124-4139000 (Gurgaon) Ashok Nijhara, VP 98 100 22321, 7042198369 Subhas Verma (GM Services, Faridabad) 9810175250 Anil Gupta, Service, Gurgaon, 98 104 46483, 7042198375	0129 - 4028320	Sudhir Malhotra , MD 98 100 17488	Bhiwani, Faridabad, Gurgaon, Jhajjar, Mahendragarh, Rewari, Rohtak, Sonipat	svam.fbd@svampower.com
63	SOUTH	Powerica Limited (Service Division)	Chennai	TN	P RAMNATHAN (HOD)	A23, Thiru Vi Ka Industrial Estate, Guindy, Chennai - 600032 (TN)	044-42424444	044-43519046	Mr. V L Anantharaman (COO) 9500002288	Ambattur, Sriperumbudur, Ekkaduthangal, Vellore,	vl.anantharaman@powericaltd.com

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									Kanchipuram	

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DESIGNATION	SSE/TI/TW	Dy.Dir./TI-1	Director/TI-1

Guidelines for overhead hopper/chute/crane loading/unloading of rakes in electrified sidings

1. **OBJECTIVE** :

- To provide a solution for overhead loading at freight terminals in electrified territory.
- To minimize the rake loading time thereby improving wagon turnaround time.
- To ensure safety of personals involved in loading
- Improvement in system as a whole.
- To optimise utilization of the crew.

2. **Background**: At most of the existing overhead freight loading points (using hopper/tray for loading the wagons), no uniform way of placement of wagons, its loading & withdrawal after loading exists. In fact, it is not possible to place empty wagons for loading under hopper with the incoming rake due to non availability of OHE near the loading area. Most of the loading at such points attract multi mode systems with dependency on each other. In addition, manual system (winch) is adopted to place the wagon right under the loading point (Hopper/tray), thus it takes lot of time for entire rake loading.

With the increase in the number of sidings and electrification of yard lines in the vicinity of loading lines, it has become imperative to introduce a system by which smooth placement, safe loading & speedy withdrawal of freight rake is possible. Though, there are few systems already in use over Indian Railways, however, no standard arrangement exists, which can be straight way adopted after carrying out clearance study.

To standardise the loading arrangements in the electrified sections, guidelines for overhead hopper loading of freight trains in electrified sidings are being issued.

3. **Layout of the siding**: The placement of rake shall depend upon the layout of the yard lines in the vicinity of loading area. Generally, three types of layouts, as shown in Fig 1, 4 , drawing No. TI/DRG/OHE/SWL/RDSO/00010/08/0 have been considered and these systems call for separate methods of OHE layout for placement of empty rake in loading area & its withdrawal after loading. These are covered under Scheme-I, II, III & IV.

4. **Scheme-I**

4.1 Issues involved: The major issues involved in finalising the arrangement in this scenario (Fig. 1) are:

a) To maintain the statutory clearance between the contact wire and fixed structure.
b) To ensure adequate vertical electrical clearance from lowest part of the loading arrangement (hopper/tray) to the top of the contact wire of tram way type OHE.
c) To avoid direct falling of loading material on the contact wire.
d) To provide signal (audio-visual) to alert the personnel's working in the loading area, on energisation of OHE.
e) To provide electrical isolation to loading area including hopper/tray.

4.2 Layout of siding: Tentative layout to be adopted for such a siding shall be as shown in the drawing given in Fig 1.0 with focus on the loading area arrangement.

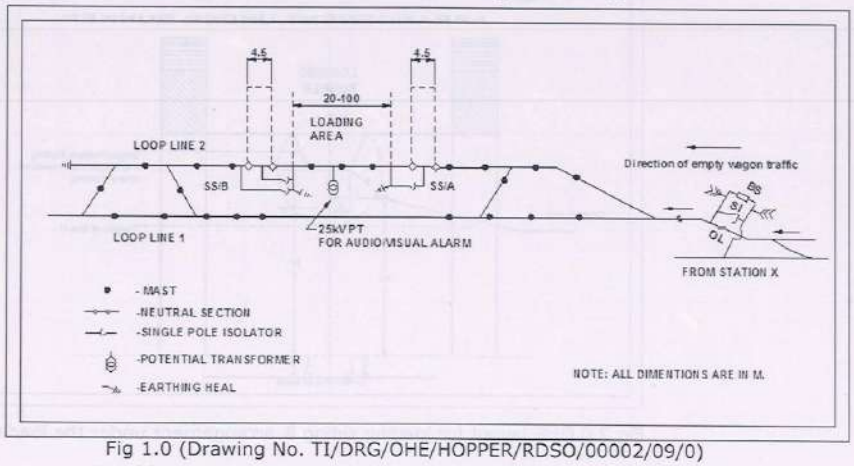

Fig 1.0 (Drawing No. TI/DRG/OHE/HOPPER/RDSO/00002/09/0)
Yard layout & location of electrical equipments in case of Scheme-I

4.3 **Methodology:** Basic methodology for streamlining the placement of rake, its loading & withdrawal shall consist of following:

a) Tram way type OHE to be adopted.
b) 27 mts span may be adopted under the loading area with one mast erected near the loading point to minimise the effect of contact wire push up.
c) Stagger of contact wire in the loading area to be kept as 400mm to avoid obstruction of falling material to OHE.
d) Vertical electrical clearance from lowest part of the loading arrangement (hopper/tray) from the top of the contact wire of tram way type OHE to be kept as minimum 250mm.
e) To further improve the electrical clearance, Fibre Reinforce plastic (FRP) lining shall be provided on the surfaces of the hopper, which are near to contact wire. Siding owners may even be perused to use insulating material like FRP for the entire loading tray/hopper.

4.4 **Electrical equipments:** OHE layout in loading area is shown in Fig 2.0 (Sketch No. TI/SK/OHE/CHUTE/RDSO/00002/09/0 & minute details of OHE under loading area are shown in Fig 3.0 (Sketch No. TI/SK/OHE/HOPPER/RDSO/00001/09/0).Following electrical equipments shall be used:

a) **Section insulators** for isolating the OHE under the loading area.
b) **Single pole isolator with earthing heel** shall be provided in the direction of empty traffic movement for isolating the area under the loading zone & feed the OHE between section insulators.
c) **Double pole isolator with earthing heels** to be provided on the other end of loading point to isolate the loading area & feed the OHE in loading area.
d) **Potential transformer** shall be connected with the OHE of the loading area & on OHE energisation, it shall provide 100V output to operate 100/230V relay, whose output shall be supplied to the audio-visual system i.e hooter & flashing lights, to warn the staff present in the loading area.
e) **Earth pits** shall be provided for grounding of various fixed structures.
f) Structure bond for earthing of the mast.
g) Traction mast.
h) Tram way type OHE.

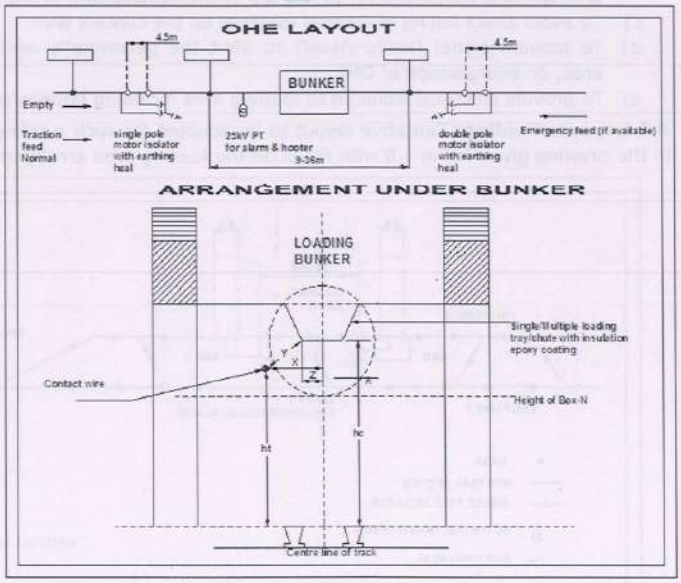

Fig 2.0 OHE layout for loading siding & arrangement under the loading area

4.5 **Earthing** :Following shall be ensured:

a) All metallic structures shall be connected to the earth pit.
b) Both the isolators should be provided with earthling heel & each earthing heel should be connected to a separate earth pit.
c) Corresponding mast should also be connected directly to earth.
d) Track under the loading area shall be connected to separate earth pit.
e) Hoper/tray should also be connected to earth.

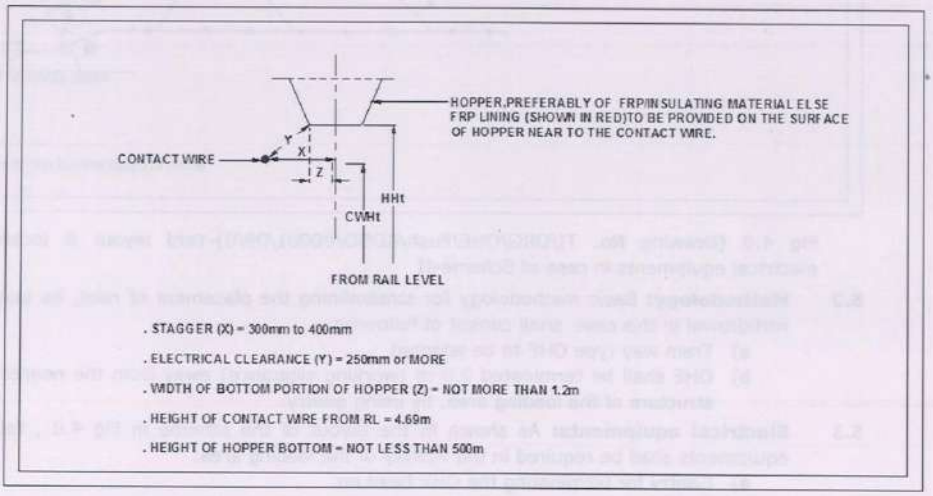

Fig 3.0 Details of critical dimensions of OHE arrangement under bunker

4.6 Safety:

a) For the safety of personnel's working in loading area, audio visual signal's functioning at the instant on energisation of the loading area shall be ensured.
b) Protective screen covering the loading area to be provided on both the sides to prevent falling of loading material or any other foreign material on the OHE.

4.7 Scheme of operation

After entering into loading line at the loading point, train must be stopped near "engine stop board" provided near isolator SS-A.

a) It must be confirmed from loading in-charge that nobody is available near loading pit for unloading the material or any other work inside the loading pit.
b) Both the isolator (First SS-A & then SS-B) shall be closed after which loading pit shall be energized by 25kV a.c.
c) As soon as loading pit is energized an audio visual signal shall indicate the energisation of loading pit.
d) The train shall be moved through loading pit with the help of electric locomotive.
e) After the engine crosses the loading area, & on entering into the loading yard, Isolator SS-B & SS-A must be opened in sequence.
f) Thereafter, permission to loading pit incharge for loading of material in empty wagon lying underneath the hopper shall be granted.
g) Once loading is complete, engine shall be detached, moved through crossover & attached on the loaded rake from the station "X" end, to proceed toward station "X".
h) SSE/OHE/of the section or his authorized representative must give training for operation of isolators to all guards, who shall be working on the loading area section.

5.0 Scheme -II

5.1 Issues involved: The major issues involved in finalising the arrangement in this scenario (Fig.4) is to maintain the minimum clearance of 2.0 mtr. between OHE & fixed structure and take safety precautions, as per site requirement.

5.2 **Layout of siding:** Tentative layout to be adopted for such a siding shall be as shown in the drawing given in Fig 4.0 below.

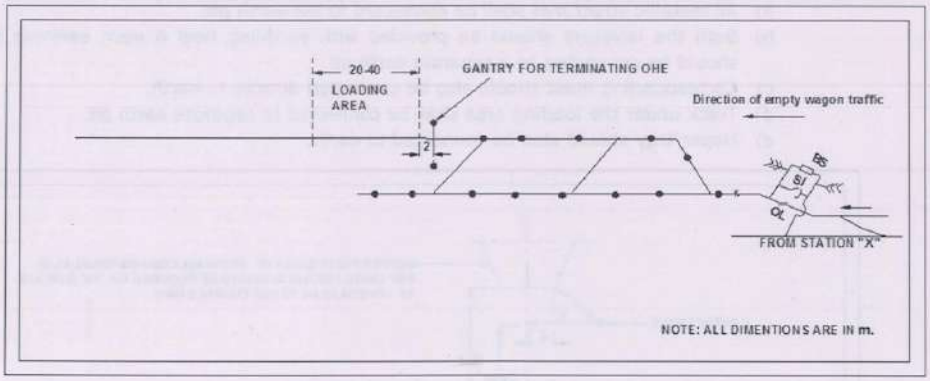

Fig 4.0 (Drawing No. TI/DRG/OHE/Push/RDSO/00001/09/0)-Yard layout & location of electrical equipments in case of Scheme-II

5.2 **Methodology:** Basic methodology for streamlining the placement of rake, its loading & withdrawal in this case shall consist of following:

a) Tram way type OHE to be adopted
b) OHE shall be terminated 2.0 m (working clearance) away from the nearest fixed structure of the loading area, by using gantry.

5.3 **Electrical equipments:** As shown in the layout of the scheme in Fig 4.0 , following equipments shall be required in the vicinity of the loading area:

a) Gantry for terminating the OHE head on.
b) Earth pits shall be provided for grounding of the loading area.
c) Structure bond for earthing of the gantry.
d) Tram way type OHE

5.4 **Earthing :** Following shall be ensured:

a) All metallic structures shall be connected to the earth pit.
b) Both the isolators should be provided with earthling heel & each earthing heel should be connected to a separate earth pit.
c) Corresponding mast should also be connected directly to earth.
d) Track under the loading area shall be connected to separate earth pit.

5.5 **Safety**: Protective screen covering the loading area to be provided on both the sides.

5.6 **Scheme of operation**:

a) The empty rake with electric locomotive shall be stopped short of fouling mark of the last crossover near the loading area. Locomotive shall be detached from the empty rake & moved through the crossover. It shall thereafter be attached to the rear of the rake so that movement can be done in pushing mode.
b) Once the first empty wagon reaches just below the hopper/tray, guard shall give permission to loading pit incharge for loading of material in empty wagon lying underneath the hopper.
c) By putting locomotive in creeping mode at 3 kmph continuous loading shall be carried out so that entire rake is loaded in about 2-2.5 hours, the loading time shall however depend upon the hopper discharge rate.
d) Once the loading is complete, the train can be moved straight way toward the station "X", without wasting any more time in shunting.

6.0 <u>Scheme-III</u>

6.1 Issues involved: The major issues involved in finalizing the arrangements in this scenario **(drawing No. TI/DRG/OHE/SWL/RDSO/00010/08/0)** is to ensure the complete swings of bracket assemblies with conductors towards structures up to 70 degree parallel to the track from centre line of the structures with the help of motorizing arrangement, so that top loading with the help of cranes/lifter is possible.

6.2 **Methodology:** Basic methodology for streamlining the placement of rake, its loading & withdrawal shall consist of following:

a) Conventional OHE to be adopted between overlaps for minimizing the sag in contact wire. Tramway OHE shall be merged with conventional swiveling OHE at the either ends of loading areas.

b) 9.5 mts span may be adopted under the loading area

c) Stagger of contact wire in the loading area to be kept as maximum 300mm.

d) Vertical/horizontal electrical clearance from lowest part of the loading arrangement (crane arm) from the top of the conduit pipe bolt of OHE bracket to be kept as minimum 250mm.

6.3 Electrical equipments: 5HP motor as shown in drawing No. TI/DRG/OHE/SWL/RDSO/00004/ 08/0 to collapse the OHE and isolators shown in drawing No. TI/DRG/OHE/SWL/RDSO /00007/08/0 to isolate the loading area.

6.4 Earthing: Following shall be ensured:

e) All metallic structures shall be connected to the earth pit.

f) Both the isolators should be provided with earthling heel & each earthing heel should be connected to a separate earth pit.

g) Corresponding mast should also be connected directly to earth.

h) Track under the loading area shall be connected to separate earth pit.

6.5 Safety: (i) Ensure that the drum of motors is locked after swiveling the OHE.

(ii) Protective screen, covering the loading area to be provided on both the sides.

(iii) A.C. Traffic movement shall be restricted to 10kmph.

(iv) The OHE must be dead when the wind velocity is more than 75kmph.

(v) Isolator must be open before OHE is to swing, by operating the motors.

(vi) Loco with raised pantograph in the overlap zone is not allowed during operation of earthing heel isolator.

6.6 Scheme of operation:

(i) This swiveling OHE permits shunting with electric traction when in normal position and allow loading in wagons from the top, when pulled away from normal position. The OHE is pulled away from its normal position towards structures and brought back to its normal position with the help of motorized arrangement.

(ii) When OHE is in energized condition, loco with the entire rake shall be moved under the OHE. The Single Pole isolator with earthing heels shall be switched off after switching off DJ of locomotive and lowering of the pantograph.

(iii) The OHE is then swiveled with the help of motorized arrangement. When the switch of motorized arrangement with limit switch No. 1 is 'ON' the bracket which is connected by the steel rope is pulled causing subsequent pulling of all brackets till OHE is Swiveled at 70 degree from the normal position. At the other end, SS wire rope which is connected to bracket is released during pulling of bracket assembly as the motorized arrangement No.2, is decoupled from speed reducer.

(iv) Same way, when OHE is required to bring its normal position, motor no 2 is operated and motor No. 1 is decoupled from the speed reducer by releasing the rope and brackets are pulled back to their normal position by motorized arrangement No.2. Thus , for taking the locomotive out the swivel OHE, the swiveled bracket assemblies shall be pulled in the opposite direction with the help of motorized arrangement till they are in normal position and the isolator shall then be switched on to make the swivel OHE live at 25 kV.

(v) The scheme to be adopted for in this scenario is elaborated in the drawings listed below:

S. N.	Description	Drawing no.
01	Special bracket for collapsible OHE	TI/DRG/OHE/COLLAP/RDSO/0001/99/0
02	General arrangement of fixing the special bracket assembly & suspension of contact wire	TI/DRG/OHE/COLLAP/RDSO/0002/99/0
03	General arrangement of suspension of contact wire (s) from existing bracket assembly of tram-way OHE	TI/DRG/OHE/COLLAP/RDSO/0003/99/0
04	Motorized arrangement for collapsing the OHE	TI/DRG/OHE/SWL/RDSO/00004/08/0
05	General arrangement for collapsing the OHE	TI/DRG/OHE/COLLAP/RDSO/0005/99/0
06	General arrangement of fixing of conduit pipe on special bracket assembly & connection of wire rope.	TI/DRG/OHE/COLLAP/RDSO/0006/99/0
07	General arrangement of Isolator connection to Collapsible OHE	TI/DRG/OHE/SWL/RDSO/00007/08/0
08	Special stay arm insulator for collapsible OHE	TI/DRG/OHE/COLLAP/RDSO/0008/99/0
09	Special Jumper Clamp	TI/DRG/OHE/COLLAP/RDSO/0009/99/0
10	General arrangement (LAY OUT PLAN) for the	TI/DRG/OHE/SWL/RDSO/00

7.0 Scheme-IV: Scheme will be applicable for use in Railway freight/coaching terminals (Railway Board letter no. 2003/RE/161/1 Vol-III/Pt. dated 10.08.2017.

7.1 Objective: The requirement of top loading of wagons, without the requirement of diesel loco, can be fulfilled, by providing 'Retractable rigid OHE system' in the Railway freight/ coaching terminals.

7.2 Issues: The main issues in provision of 'Retractable rigid OHE system' are
(i) Transition of the pantograph from existing OHE to rigid OHE and
(ii) Swivelling of bracket assemblies with OHE conductors towards structures/support up to a minimum of 70 degree along to the track from centre line of the structure to clear the wagon top width adequately.

7.3 This swivelling system will not have following items:
- Flexible cantilever assembly
- Tensioning device for giving tension in the conductor
- Contact & catenary wire with dropper arrangement similar to conventional or tramway OHE

7.4 Schematic arrangement of Retractable Rigid OHE system is shown in Figure 5.

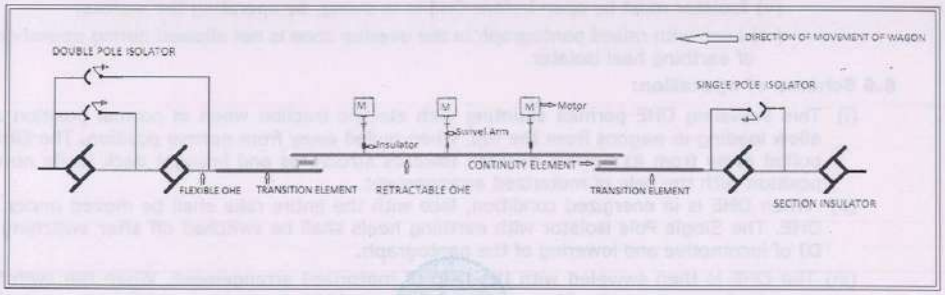

Figure-5

7.5 Retractable Rigid OHE system incorporate following components:

a) **Section insulators** for the isolation purpose as shown in figure 5 above.

b) **Double pole & single pole isolators with earthing heel** for the continuity of power and for isolation & earthing as shown in figure 5 above with suitable interlock with Retractable Rigid Conductor System(RRCS)'s operating system.

c) For movement of the pantograph from flexible OHE available in the siding to Rigid OHE, a **'Transition element'** will be provided. This transition element will be rigid type and will not be swiveling.

d) **Uninsulated Overlap** between 'Transition element (as per clause (c) above) and 'retractable rigid OHE (covering the loading area)'.

e) Retractable rigid OHE will have following components:

(i) **Conductor rail** (normally of aluminum) assembly, it should be of suitable electrical and mechanical capacity equivalent to existing OHE in the siding & it should be suitable for holding Contact wire as per RDSO specification.

(ii) **Copper Contact wire** as per RDSO specification.

(iii) Swiveling type OHE **Bracket assembly** with **insulator** for supporting conductor rail assembly.

(iv) **Motor gear unit**(s), to facilitate rotation of the Swiveling type OHE Bracket assembly.

(v) **Control System** (manual or centralized control panel) to control the operation of motor, Isolator and audio-visual signals etc. It may include other controls as per the system requirement of the siding.

(vi) Other parts of Electrical continuity system: **Jumpers, small parts** etc.

(vii) **Earthing and bonding**: All metallic structures, OHE structures, Isolators with earthling heel, Earth continuity from the insulator to the Rail & Earth pit to be ensured as per Earthing & Bonding code. Track under the loading area shall be connected to earth pit. An aerial protection cable (APC) will interconnect all swing arms together in order to guarantee equi-potentiality on any point of

Retractable Rigid Conductor System (RRCS). APC will be connected on each end to the SILO main earthing points.

(viii) Swivel of the OHE Bracket assembly should be minimum 70 degree from centre of track.

(ix) Siding owner would have to provide earthing of all metallic parts of the loading equipment.

f) Design requirements: System shall have following design features:

(i) Standard height of OHE shall be 5.6m.

(ii) Electrical clearance from the live RRCS system and pantograph to the earthed structure shall be as large as possible (minimum value is specified in the IRSOD) depending upon the site condition and as decided by the EIG.

g) **Safety Features:** System shall have following safety features:

(i) For the safety of personnel's working in loading area, audio visual signal's functioning before energisation of the loading area shall be ensured.

(ii) Motor operation shall be locked after Retracting the OHE in either position.

(iii) Loco with raised pantograph in the overlap zone is not allowed during operation of isolator with earthing heel.

(iv) Isolator must be open before swinging of OHE.

(v) Suitable arrangement to prevent the falling of loading material dust on the OHE should be incorporated.

(vi) The normal position of the swivelling type rigid OHE (see coloured part of figure 5) would always be kept in position away from the track i.e. not above the track.

7.6 Operating Sequence:

(i) Initially, the position of the swiveling type rigid OHE will be as mentioned in 7.5 g(vi) above i.e. away from the track.

(ii) Empty rake with electric loco approaching for top loading shall be stopped before entry point of loading area which will be before single pole Isolator. At the Entry point a sensor or Indicator (engine stop board) shall be provided.

(iii) Retractable Rigid OHE shall be allowed to rotate forward over the track with the help of motorized arrangement.

(iv) Both the Isolator shall be switched-on (First Single Pole Isolator and then Double Pole Isolator) to make the OHE between the isolators live at 25 kV. Before energization of OHE an audio visual signal shall indicate the energisation of OHE under the loading area.

(v) Then, empty rake with electric loco will be moved through the loading area (i.e. through energized Retractable OHE).

(vi) The loco will stop outside of loading area and beyond the double pole isolator so that the pantograph will remain in energized OHE even after the opening of the double pole isolator and the first empty wagon is positioned below the chute for filling of wagon.

(vii) Retractable Rigid OHE will now be de-energized and earthed through Isolators (First Double Pole Isolator and then Single Pole Isolator) and discharge rod may be additionally provided.

(viii) Commencement of loading shall be synchronized with the traversing mechanism of the chute. After completion of rake loading, the traversing chute will be retracted back automatically to parking position.

(ix) The above guidelines are not exhaustive, shall be suitably examined by the EIG and suitable guidelines issued.

7.7 Drawings: The following drawings (an indicative list) shall be part of the documents & drawings to be provided by the manufacturers and suppliers:

S. N.	Description
01	General arrangement (Layout and plan) for the Retractable Rigid OHE inside & outside the loading area with location and connection to transition element, Isolator, Jumper etc.
02	Interfacing arrangement between 'flexible OHE' to 'fixed Rigid OHE'.
03	Interfacing arrangement between 'fixed Rigid OHE" and 'Retractable Rigid OHE'.
04	Drawing of Transition Element
05	Drawing of Conductor Rail
06	Drawing of Swiveling type bracket assembly
07	Drawing of Insulator for Retractable Rigid OHE

08	Motorized arrangement for Retractable Rigid OHE
09	Drawing of Isolator connection to Retractable Rigid OHE
10	Drawing of Jumper & Jumper Clamp with details
11	Earthing and Bonding arrangement under the loading area
12	Layout of loading area showing location of control room, structures, clearances, cable routing etc.

7.8 Documents: Specification, Standards, drawings of complete system, Transition element, conductor Rail, Insulator, motor, Jumper etc. and test to be performed shall be provided. Maintenance, operating and safety Instruction for swiveling OHE shall be provided. This is an indicative list, Railways may decide appropriately.

7.9 Contact wire, Isolator, Section-Insulator shall be as per RDSO Specification and procured through RDSO approved vendors.

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Government of India
Ministry of Railways
Research Designs & Standards Organisation
Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION No. TI/MI/00045

1. TITLE : Auto Tensioning Device (ATD) /Regulating Equipment.

2. APPLICATION: Gas Auto Tensioning Devices

3.0 OBJECTIVE:

3.1 ATDs are meant for regulation of tension in OHE conductors & one of the important equipment, which need special attention in respect of installation **as well as maintenance,** as improper installation & maintenance may lead to disturbed OHE profile, resulting in poor dynamic behavior of OHE, which may on occasion, cause panto entanglements at turnouts/cross-overs, neutral section etc. If installation and maintenance is carried out properly, performance of ATD can be improved to a large extent.

3.2 Southern Rly. reported problems with Gas ATDs erected on MRTS section Chennai, after rendering four to seven years service life. These failures were mainly due to leakage of nitrogen gas from high pressure end seal, leakage of gas and oil from the point of interface between pressure gauge & cylinder and pit marks on the surface of RAM. To arrest these failures, following maintenance instructions may be strictly followed.

4. DETAILS OF SPECIAL MAINTENANCE INSTRUCTIONS:

4.1 CHECKS BEFORE INSTALLATION

4.1.1 Check for cylinders: The cylinders are normally supplied fully retracted and uncharged and are supplied with the charging and installation kit comprising of ancillary items i.e tie bar assembly, crosshead, earthing strap etc.

4.1.2 Check for the position of ram: The ram is normally restrained in the retracted position with temporary straps.

4.1.3 Check for the serial number plate on the cylinder body. Serial number plate indicates the followings:

- Tension length & stroke for which the unit is designed i.e (CT1500-tension length/500-stroke)
- Number of filler rods inside the cylinder i.e (234)
- Cylinder identification number i.e (2336)

4.1.4 On receipt of equipment, the serial no. on data sheet and serial number of gas tensioner should be cross checked. Data sheet (supplied by the supplier) contains necessary gas charging and adjusting information required for correct installation. Cylinder identification number marked on the serial number plate & data sheet should be referred to ensure correct charging of the cylinder.

4.1.5 Cylinders should be handled carefully being bulky. While unpacking the unit, no damage to the paint finish on the cylinder body should be there. Most critical component of the cylinder being gas charging port & pressure gauge, these should be protected from accidental damage.

4.2 MONTHLY CHECKS AFTER INSTALLATION

4.2.1 Check for the earthing strap position, to allow unimpeded cylinder motion.

4.2.2 A faulty unit can be identified by visualizing the position of ram extension. As the temperature of the contact wire varies, the ram will move in and out of the cylinder. At low temperatures, the cylinder movement shall be away from mast, the extension(X) shall be more and the ram extension will be near to fully retracted position. However, at maximum temperature, the cylinder movement shall be towards mast, the extension (X) shall be less and ram extension will be near to fully extended position. Ram extension with respect to temperature is indicated at **annexure-A.** In product data sheet, detailed table of ram extension/extension viz-a-viz temperature shall be given by the supplier.

Cylinder tie bar may be painted to indicate different temperature as per data sheet for checking of abnormal variation in ram extension by foot patrolling staff from ground.

(a) If Ram extension is more than normal, it may be due to wire discontinuity, cable creep, displacement of anti creep point anchor or failure of the tensioner terminating the other end of the section.

(b) If Ram appears retracted more than normal , it may be due to :

1) Improper installation of unit. Check for installed pressure and ram extension with the installation data sheet. Adjust to suit.
2) Installation of unit at incorrect tension length. To use correct tension & stroke length, check these from the details indicated on serial number plate.
3) Unit may have gradual loss of pressure. In such case, tensioner's installed pressure should be topped up by a portable gas cylinder, readjust to the correct extension and recheck the cylinder pressure (as per data sheet). If the cylinder is retracted completely, it should be removed and replaced with an identical unit containing the same number of PVC rods.

(c) If Ram is fully retracted other than at low temperature, it indicates less pressure i.e. a failure of the tensioner, hence tensioner should be replaced with the identical unit having same number of filler rods and designed for same tension length and stroke.

4.2.3 If Ram is damaged in transit or as a result of severe corrosion, it will cause abrasion in service, the rubber seals in the oil seal area may also get damaged, leading to a leakage of oil from the seal area. Leakage of oil leads to damage of the main gas seal and leakage of gas, which will cause the ram to get fully retracted.

This can be noticed by the foot patrolling staff from the oil patch on the ground directly under the unit. Such failure of the gas tensioner calls for replacement with identical unit. Bellows may be provided to cover the extended portion of RAM such that it does not restrict the RAM movement caused by temperature variation.

4.3 ANNUAL CHECKS AFTER INSTALLATION

4.3.1 Tensioner pressure, should be checked and if found less, topped up with a portable gas cylinder as per the procedure laid down in installation & operating manual supplied by the manufacturer. Gas tensioner which do not have pressure gauge, shall be checked for loss of pressure annually under power block.

4.3.2 Check the length of ram against tension length and ambient temperature with the reference data sheet. If Ram Extension is not as per data sheet, fine adjustment can be made by tightening or slackening the nine tone adjuster in front of the crosshead indicated on the picture at **annexure-B**.

4.3.3 Extreme temperature conditions (Maximum), may cause the gas pressure to rise above the nominal and lead the pressure gauge, moving into the red zone(right of green). Extreme temperature conditions (Minimum) may cause the gas pressure to fall below the nominal and result in shifting of pressure gauge into the red zone (left of green).

Both these are temporary situations and the needle returns to the green area as and when the ambient temperature retunes to normal.

4.3.3 In summers, when ram extension is maximum, ram should be cleaned with dirt free soft cloth.

4.3.6 Ensure that the tie bar assembly, crosshead, and spacer are correctly fitted to the cylinder and that the earthing strap is fitted between the two support assemblies, allowing adequate freedom of motion over the complete cylinder stroke.

5.0 MAINTENANCE OF ATD RECORDS

The regulating equipment (ATD) should be maintained as per the maintenance instruction. OHE depot should keep up to date, records of all GATD's in their sections, as per the format given at **Annexure –C.** Storage instruction, Installation instructions , charging & discharging procedures shall be followed strictly as per the installation and operating manual supplied with the unit by the manufacturer.

6.0 AGENCY FOR IMPLEMENTATION

Railways and RE project units.

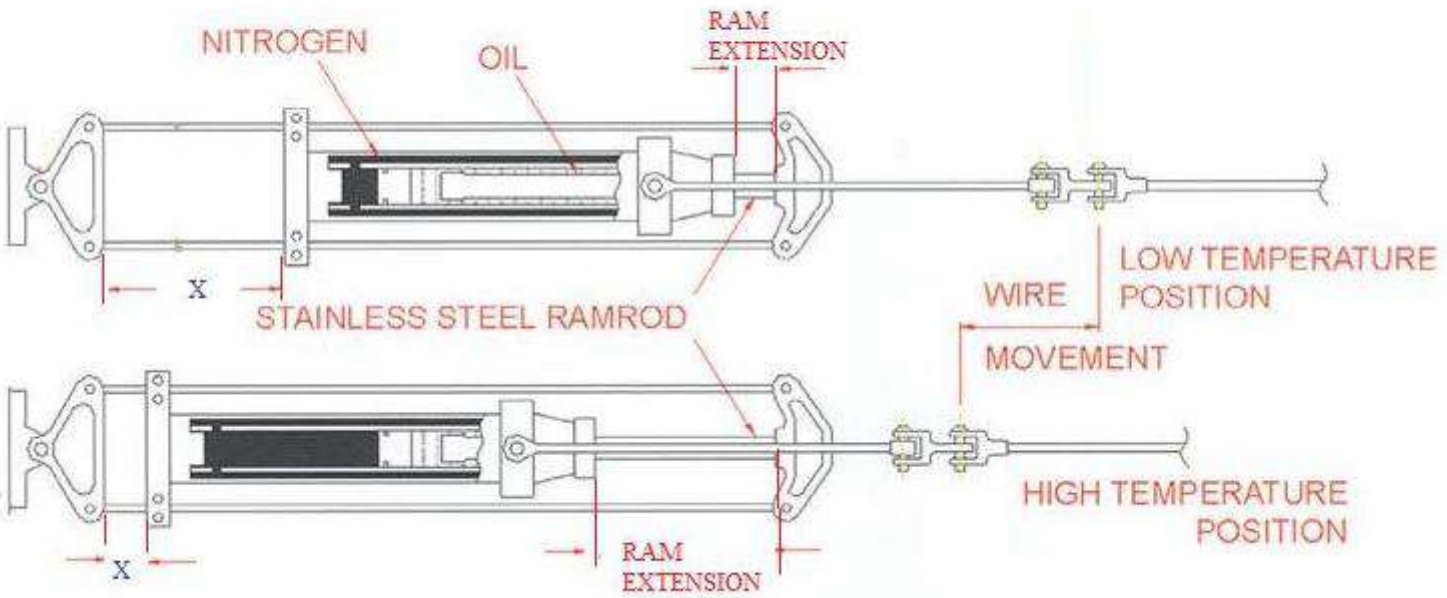
7.0 REFERNCE SPECIFICATION:

SPECIFICATION No. TI/SPC/OHE/GATD/ 0080(09/2008)

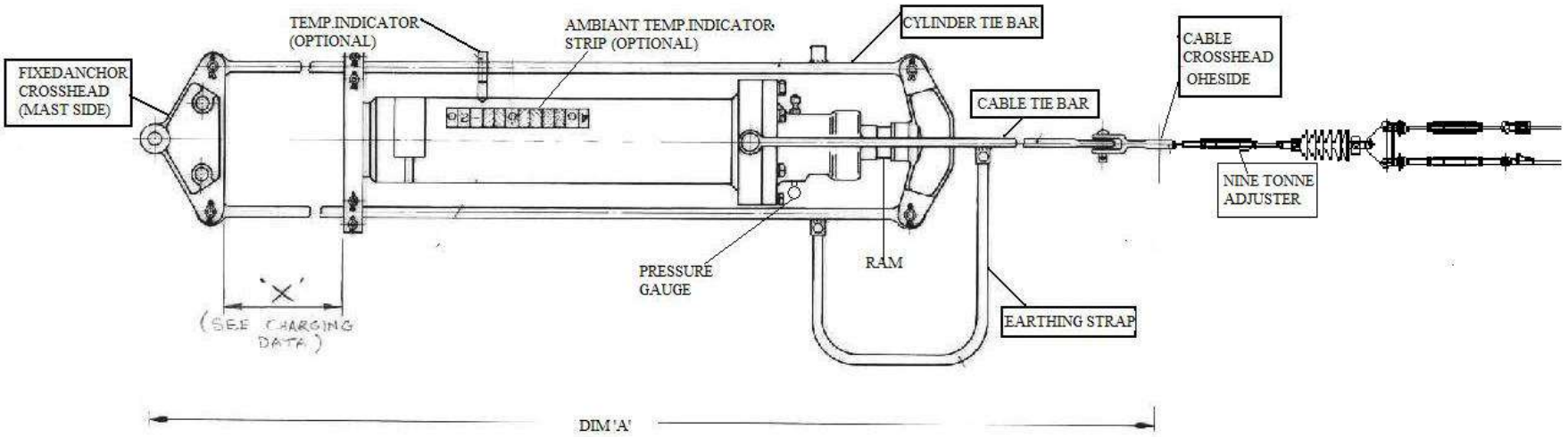
****

RAM EXTENSION & EXTENSION(X) WITH RESPECT TO TEMPERATURE

ANNEXURE-A



ANNEXURE-B



MODEL	STROKE	DIM" A"	MASS
CT 1500 - 500	500 MM	2418 MM	98 Kg
CT 1500 - 900	900 MM	3618 MM	120 Kg
CT 1500 - 1250	1250 MM	4668 MM	143 Kg

Annexure-C

Performance Report of GATD

Railway:-_____

Division:_____

Section:_____

Line reference(Up/Dn/Yard) :-_____

ATD make /model No./Serial no./No.of filler rods/Tension Length	Location	Type of anchor at other end	Date of Installation	Date of Inspection	Temperature indicator reading	Pressure gauge reading	Ram extension	Whether Ram extension is as per data sheet	Gas Leakage	Oil Leakage on RAM	Ram rod condition	Date of refilling of gas	Any other defect noticed	Action Taken If any

ELECTRICAL DEPARTMENT
Sl.No. 643
Dt. 5/11/12
E.CO. RLY. BHUBANESWAR

Telegram : 'RAILMANAK', Lucknow
Telex : 0535 - 2424 RDSO -IN
Fax : 91-0522-2465763
Telephone :91-522-2465762, Rly. 42801
E-Mail: edtiohe@rdso.railnet.gov.in

सत्यमेव जयते

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

No.ETI/OHE/CAT/Policy/12

Dated: 27.09.2012
28

The Chief Electrical Engineer,

1. Central Railway, 2nd Floor, Parcel Office Bldg., CST Mumbai-400 001
2. Eastern Railway, Fairlie Place, Kolkata - 700 001.
3. East Coast Railway, B-2, BDA Rental Colony, Chandshekharpur, Bhubaneswar 751 023 (Orrisa)
4. East Central Railway, Hajipur -844 101 (Bihar).
5. Northern Railway, Baroda House, New Delhi - 110 001
6. North Central Railway, B-Block, Subedarganj, Allahabad 211 033.
7. North Eastern Railway, Gorakhpur 273 001 (UP)
8. North Western Railway, Jaipur 302 017(Rajasthan)
9. South Western Railway, DRM Office, Hubli-852 024 (Karnataka)
10. Southern Railway, Park Town, Chennai - 600 003
11. South Central Railway, Railnilayam, Secunderabad -500 371.
12. South Eastern Railway, Garden Reach, Kolkata 700 043.
13. South Eastern Central Railway, Bilaspur 495 004
14. Western Railway, Churchgate, Mumbai - 400 020.
15. West Central Railway, DRM Office, Jabalpur-482 001(MP)
16. Central Organisation for Railway Electrification, Nawab Yusuf Road, Allahabad 211 001.

Sub: Special Maintenance Instruction (SMI) for taking precautions while splicing Insulated Cadmium Copper Catenary on 25 kV A.C. Traction System.

---

1. Insulated Cadmium Copper Catenary Cable is provided under Overline Structure to avoid flashover due to fall of foreign materials and electrocution of birds/ monkeys etc. on 25 kV A.C. Traction System. Insulated Cadmium Copper Catenary with Catenary splice is provided at both the ends of Cadmium Copper Catenary Wire as per SMI No.TI/MI/0047, Revision-0. While splicing, if proper care is not taken, it results to parting/failure of Catenary Wire.

2. Recently, there had been a case of parting of insulated Catenary Wire under ROB at Location No.329/40-42 between Srirangam – Tiruchchirappalli Town Stations of Southern Railway on 17.08.2012. The Insulated Catenary Wire was provided by Railway Electrification Organisation during initial electrification of Section on 22.03.2009.

3. Examination of failed catenary revealed that while removing the insulation over insulated catenary for splicing, it appears that 9 strands out of 12 in outer layer of catenary wire were damaged/cut. These were not noticeable as the same were covered by removed insulation sleeve and black tapping. The remaining 10 strands (3 from outer layer and 7 in inner layer) on tension got parted due to elongation and contraction cycle daily in the insulated catenary wire.

It is a case of poor workmanship due to which the copper strands of the outer layer stranded catenary wire were cut while cutting & removing the insulation from the insulated catenary wire for splicing and also used cut piece of sheath & insulation of insulated catenary and black tape on bare catenary wire.

4. Keeping above in view, SMI No.TI/MI/0047, Rev.0 for taking precautions while splicing insulated catenary wire on 25 kV A.C. Traction System under Overline Structure is enclosed herewith for information and implementation to avoid such type of failures.

(Hari Narayan)
For Director General (TI)

Encl: As stated above.

Copy to:
The Secretary (Elect.), Railway Board, Rail Bhavan, New Delhi 110 001.

Encl: As stated above.

(Hari Narayan)
For Director General (TI)

TI/MI/0047

सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SPECIAL MAINTENANCE INSTRUCTION (SMI) FOR PRECAUTIONS WHILE SPLICING INSULATED CADMIUM COPPER CATENARY ON 25 kV A.C TRACTION SYSTEM

SPECIAL MAINTENANCE INSTRUCTION NO.TI/MI/0047

SEPTEMBER, 2012

ISSUED BY

Traction Installation Directorate
RESEARCH DESIGNS & STANDARDS ORGANISATION,
MANAK NAGAR,
LUCKNOW-226011.

SPECIAL MAINTENANCE INSTRUCTION (SMI) FOR PRECAUTIONS WHILE SPLICING INSULATED CADMIUM COPPER CATENARY ON 25 kV A.C. TRACTION SYSTEM

1. OBJECTIVE

Insulated Cadmium- Copper Catenary Cable in place of bare Cadmium-Copper Catenary Wire is provided under overline structure to avoid flashover due to fall of foreign materials and electrocution of birds/monkeys etc. An adequate length of Insulated Cadmium Copper Catenary with Catenary splice (RI No. 1090) is provided at both ends of Cadmium-Copper Catenary Wire, as per Standard Maintenance Instruction (SMI) No. TI/MI/0036 Rev.0. While splicing, if proper care is not taken, it results to parting/ failure of Catenary Wire.

2. BACK GROUND

On 25 kV A.C. Traction System, failures of Insulated Catenary, under Overline structures are being reported. It is due to poor workmanship. While cutting & removal of sheath as well as insulation from insulated Catenary Wire, for making the provision of the splice at both ends, the copper strands of the upper layers of Stranded Catenary wire are being cut inadvertently due to poor workmanship. With the passage of time, there is an elongation & contraction cycle daily in the insulated Catenary Wire which results in parting of Insulated Catenary Wire in the long run.

3. PROCEDURE

To make sure that the splicing of Insulated Catenary Cable is provided properly, the procedure as detailed below is to be followed. The arrangement/procedure for Stripping Sheath & Insulation of Insulated Catenary Cable is mentioned as under with sketch:

i) Select the portion of a length properly from which outer sheath and insulation to be stripped off.

ii) Apply a round cut over the sheath by a sharp knife. Do not use hacksaw blade for insulation and sheath cutting.

iii) Apply longitudinal cut over the sheath from the circular cut to the end of the length. A knife with sharp curved tip is very effective for this job.

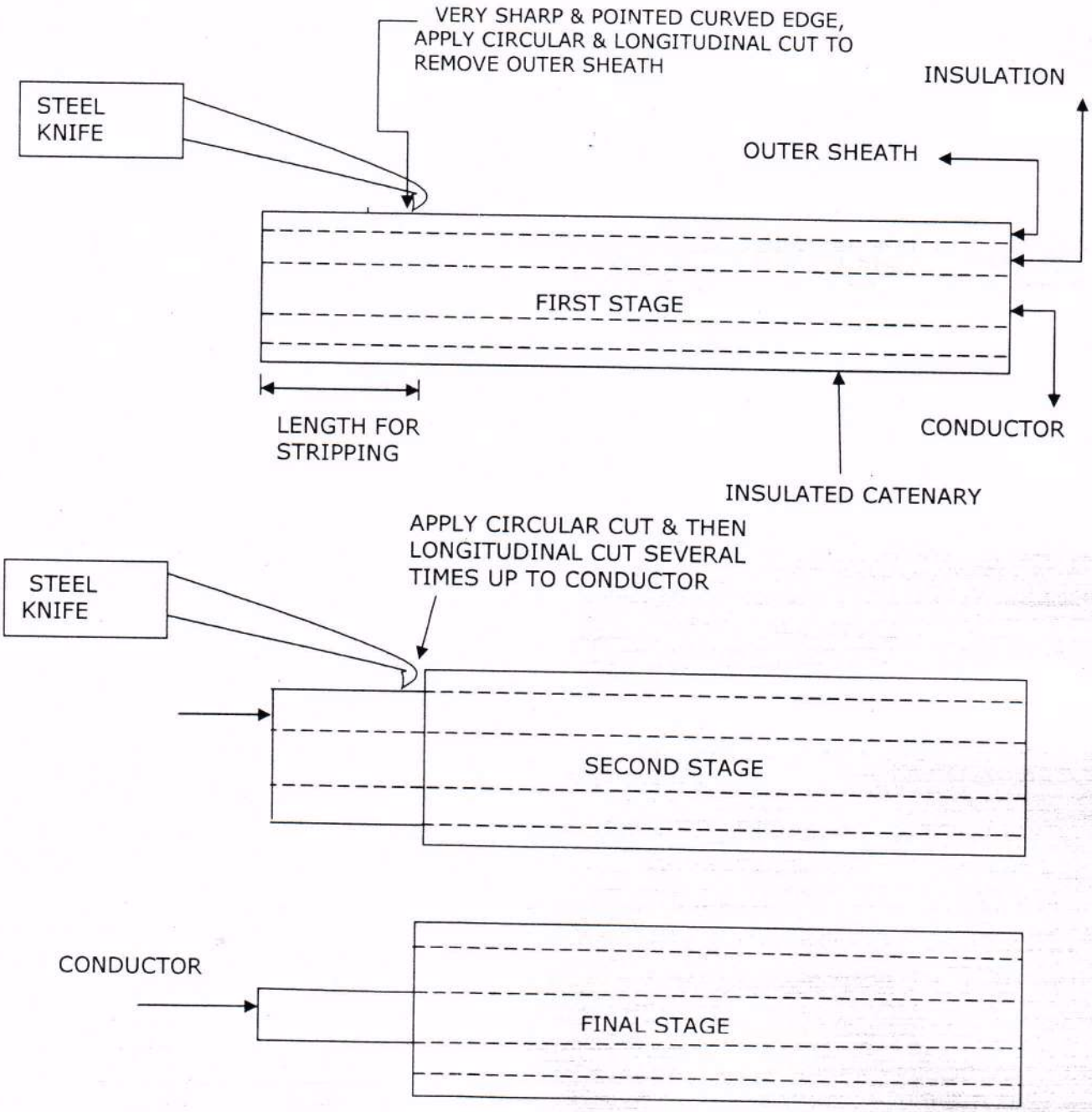
iv) It may require to apply the longitudinal cut several times to pierce through the sheath depending upon the sharpness of the knife.

v) After the cut, remove the sheath with ease.

vi) Apply similar process to remove the insulation also.

vii) Special care shall be taken while applying both circular and longitudinal cut on the insulation that the knife does not scratch the conductor. This can be avoided by leaving about 0.5 mm thickness of insulation near to the conductor without cut.

This much of insulation thickness tear off easily during removal of insulation already slitted by hand pressure.



SCHEMATIC DIAGRAM FOR STRIPPING of SHEATH & INSULATION OF INSULATED CADMIUM-COPPER CATENARY WIRE

Note: i) The above procedure is to be repeated for stripping of sheath and insulation at other end of insulated Catenary Cable also.

ii) Insulation of Insulated Catenary Cable is quite soft. Therefore, hacksaw machine should not be used while cutting the insulation as due to hand pressure it would either wholly or partially cut the strands of first layer of Catenary wire or will damage them resulting continuous discharge at point of cut.

4. MATERIAL SPECIFCIATION

i) The insulated Cadmium Copper Catenary Wire shall be as per RDSO Specification No. TI/SPC/OHE/INSCAT/0000 with A & C Slip No. 1

ii) The Cadmium Copper Catenary Wire shall be as per Specification No. ETI/OHE/50(6/97) with A & C Slip No. 1 to 3 or latest.

iii) The Catenary Splice (RI-1090) to be provided for joining the Insulated Cadmium Copper Catenary Cable and Cadmium Catenary Wire.

******

File No.RDSO-TI0LKO(PSI)/54/2020-O/o PED/TI/RDSO-Part(2)

Government of India,
Ministry of Railways
Research Designs & Standards Organisation,
Manak Nagar, Lucknow– 226 011

Telephone: 2465763 (O). 42805(Off.)
Fax : 91-0522-2465763
E-mail:dti.psi.rdso@gmail.com

सत्यमेव जयते

No. RDSO-TI0LKO(PSI)/39/2021-O/o PED/TI/RDSO Date: As signed

1. Central Railway, Station Building, Mumbai CST – 400 001.
2. Eastern Railway, Fairlie Place, Kolkata-700 001.
3. East Central Railway, Hajipur-844 101.
4. East Coast Railway, Bhubaneshwar-751 023
5. Northern Railway, Baroda House, New Delhi - 110 001.
6. North Central Railway, Allahabad-211 001.
7. North Eastern Railway, Gorakhpur-220 055.
8. North Frontier Railway, Mailgaon - 781 011.
9. North Western Railway, Jaipur – 302 017.
10. Southern Railway, Park Town, Chennai- 600 003.
11. South Central Railway, Railnilayam, Secunderabad-500 371.
12. South Eastern Railway, Garden Reach, Kolkata-700 043.
13. South East Central Railway, Bilaspur-495 004.
14. South Western Railway, DRM's Office, Hubli-580 028.
15. Western Railway, Churchgate, Mumbai-400 020.
16. West Central Railway, Jabalpur- 482 001.
17. Konkan Railway Corporation Ltd, Belapur Bhavan, Sector-11, CBD-Belapur, Navi Mumbai, Maharastra-400 614.

Sub: Regarding Revision of Maintenance Instructions for Provision of Disconnector Assembly to the Lightening Arresters.

*****

The frequent problems being faced due to present arrangement of Disconnector Assembly connected to the 42kV Lightening Arresters, have been reported by various Zonal Railways.

In view of the above, the 'Maintenance Instructions for Provision of Disconnector Assembly to the Lightening Arresters provided over 25 kV side of traction system' has been revised after considering feedback/suggestions from Zonal Railways. The copy of revised Instruction No. TI/MI/0048 Rev.02 is attached herewith for your information and further Necessary action, please.

यह सक्षम प्राधिकारी के अनुमोदन से जारी किया जाता है।

Digitally Signed by
Jitendra Kumar
Date: 22-03-2023 11:10:35
Reason: Approved

(जितेन्द्र कुमार)
निदेशक/क.सं.-3
कृते महानिदेशक/(क.सं.)

संलग्नक: As stated above

सत्यमेव जयते

भारत सरकार / Government of India

रेल मंत्रालय / Ministry of Railways

निर्देश संख्या टी आई/एम आई/0048 संशोधन 02

MAINTENANCE INSTRUCTION NO. TI/MI/0048 Rev.02

Maintenance Instructions for Provision of Disconnector Assembly to the Lightening Arresters provided over 25 kV side of traction system on Indian Railways

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक (पी एस व ई एम यू) Principal Executive Director /PS & EMU	21/03/2023
अनुशंसित Recommended by	कार्यकारी निदेशक (कर्षण संस्थापन) Executive Director (TI)	21.3.23

जारीकर्ता Issued by:

कर्षण संस्थापन निदेशालय, Traction Installation Directorate

अनुसंधान अभिकल्प एवं मानक संगठन RESEARCH DESIGNS & STANDARDS ORGANISATION

मानक नगर MANAK NAGAR

लखनऊ LUCKNOW – 226 011

(केवल आधिकारिक प्रयोग के लिए For official use only)

	20.3.23		20.03.2023		20/3/23
Prepared By	SSE(D-TR)	Checked By	ADE/TI-3	Issued By	Dir/TI-3

1.0 This MI superseded the earlier SMI no. TI/MI/0048 Rev.01 27.07.2021.

2.0 Scope:

The technical instructions compiled in this document are related to the installation/provision of disconnector assembly to the LA provided over 25 kV side of traction system of Indian Railways.

3.0 Objectives:

This disconnector is to be installed with LA provided at switching stations with a view to:

i. Provide tell-tale sign of failure and also
ii. Disconnect failed LA from OHE, thereby ensuring that tripping of the line does not occur and the system remains live.

4.0 Abbreviation

LA	– Lightening Arresters
kV	– Kilovolt
OHE	– Over Head Equipment
SMI	- Special Maintenance Instruction
PCD	- Pitch Center Dia

5.0 Background:

5.1 In the event of failure of LA on line if not accompanied by shattering of the hollow insulator, the line does not hold till failed LA is identified and physically isolated. This leads to serious traffic interruption. Hence a need is felt to install a Disconnector which will disconnect the LA from OHE upon failure; thereby ensuring that the traffic interruption does not occur and also permitting much faster restoration. Also, this device will give tell-tale indication for visual identification of failed LA.

5.2 In the earlier MI No. TI/MI/0048 Rev.01 dated 27.07.2021; it was mentioned to provide the Disconnector at the Top side of the LA. With this provision, failures were reported from Zonal Railways that even after operation of Disconnector, the disconnected jumper wire, which is still charged at 25 kV due to connected to OHE, hanging in air. Sometime this hanging jumper came in contact with nearby Mast and trip the line. Thus, the purpose of providing the Disconnector is not fulfilled. The issue was discussed with Railway Board and zonal railways in the monthly Failure analysis meeting and it was decided to revise the SMI for providing the Disconnector to the Line side of jumper.

5.3 Disconnector

Disconnector, often used on medium-voltage arresters, provide a visual indication of a failed LA by disconnecting it from the system. Once the LA has failed, the current continues to flow through the Disconnector, energizing a compound in the assembly, which ensures the Disconnectors breaks up and disconnects the connection of LA from OHE there by ensuring the line remains live. The disconnector may be an integral part of the LA or a separate unit installed in series with the LA installed. The advantage is that the line remains in operation after disconnection of the LA.

		20.03.2023			
Prepared By	SSE(D-TR)	Checked By	ADE/TI-3	Issued By	Dir/TI-3

The Disconnector assembly consists of Disconnectors &adaptor plate to connect the Disconnector with 25kV Line.

6.0 Applicable standards for Disconnector

This SMI is based on following standards, specifications and RDSO documents:

SN	Standard/reference	Subject
a.	IEC 60099- 4	Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems
b.	IEC 60099-5	Surge arresters-selection & application recommendation
c.	IS 3070 part-3	Lightning Arresters for Alternating Current Systems - Specification - Part 3: Metal Oxide Lightning Arresters without Gaps.
d.	IS 15086 part-3	Selection & application guide
e.	RDSO instructions TI/MI/0041	Maintenance instructions for Lightening Arresters
f.	RDSO Specification no. TI/SPC/PSI/MOGTLA/0101 (02/2015)	Specification for Metal Oxide Gapless Type Lightening Arrester for use on Railway Traction Sub Station and Switching Stations

7.0 PROCEDURE

i. **Initial Inspection:**
The Dis-connector and its associated components should be carefully inspected for physical damage of any kind. If any damage is found, it should not be installed and energised. Prior to installing the Dis-connector assembly, it is to be ensured that the Disconnector and its associated components are cleaned thoroughly using a soft cloth to wipe out any dust or other foreign particles present on the surface.

ii. **Installation:**
All electrical connections should be as short as possible but avoiding sharp bends and loops. Ensure that no excessive mechanical stress is applied to the Disconnector through the connection. The ground connection should be made to a permanent and effective low resistance ground, preferably the main system ground, and interconnected with structure wherever possible.

iii. **Base insulators are used to isolate the base end of the LA from ground.**

(a) Ensure that the mounting surface must be flat and level, so that the unit, when installed with base insulators, is standing true and vertical.

(b) Before start of installation, holes to be drilled on to the adaptor plate in order to match hole size& PCD of LA flange in use. Also holes to be drilled on to the top plate of the existing structure in the substation to match to PCD of adaptor plate such that the base insulators can be secured on to the structure. Ensure that the holes drilled should be sprayed with "Zinc Galvanizing Spray Paint" to prevent rusting.

(c) Base insulators must be bolted directly to the adopter plate mounting surface. Typical diagram of the same is shown below. Max torque value for tightening shall be 50 Nm.

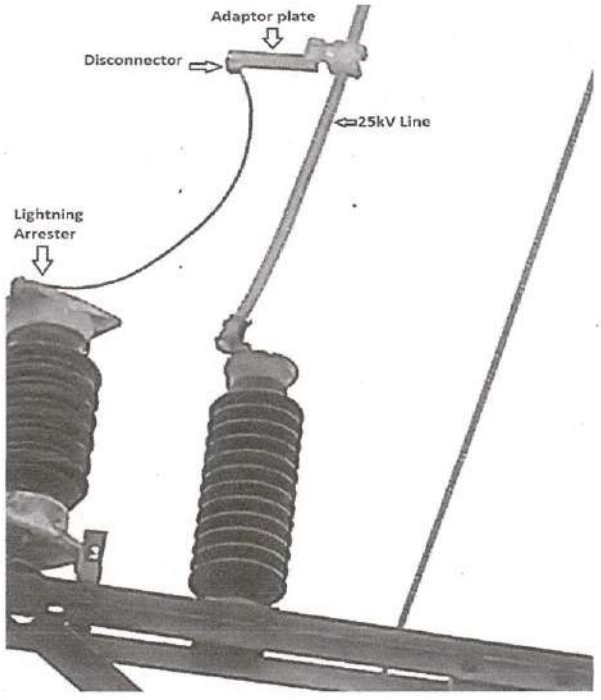
(d) LA is then assembled on top of the adaptor plate.

(e) Connect the disconnector adaptor plate to the 25 kV side. Assemble Disconnector to this plate. The Jumper wire which is conventionally connected between LA top terminal and OHE, is now to be connected between Disconnector and top of the LA terminal. The maximum torque shall be 30 Nm. Note that applying excessive torque may lead to breakage of Disconnector. Torque wrench to be used to ensure usage of correct torque.

(f) It must be ensured that the jumper from Disconnector to top terminal of LA should be of required length such that it should not touch any of the part after operation of the Disconnector.

(g) The earth lead of the LA is to be connected form one of the bolts of bottom flange of LA to surge counter. Flexible insulated cable of 35 mm^2 is to be used as lead for earth connection. It is required to use lugs on both ends of lead for connection.

8.0 A Photographs of a Location where the Disconnector on Top side of LA has been provided in IR is as below for reference.



****

Prepared By	SSE(D-TR) 20.3.23	Checked By	ADE/TI-3 20.03.2023	Issued By	Dir/TI-3

Government of Indian

Ministry of Railways

Research Design & Standards Organisation

Manak Nagar, Lucknow – 226011.

MAINTENANCE INSTRUCTION No. TI/MI/0049 Rev.1

1. **TITLE**: Tolerances and limits in 25KV AC OHE installation with 65/107sq-mm Catenary/ Contact wire with tension 1000kg/1000kg.

2. **APPLICATION**: Conventional/High Rise OHE Installations.

3.0 **OBJECTIVE**: To ensure reliable, failure free OHE and to ensure correct erection and maintenance practices.

4.0 **DETAILS OF SPECIAL MAINTENANCE INSTRUCTIONS**: Following tolerances and Limits are advised for adoption in Railway Electrification Projects/System at field level:

SN	**Item**	**Limits**
i	Register Arm Tube Projection	Push off location: 150-200 mm. Pull off location: It shall project over Contact Wire Plane.
ii	Bracket Tube Projection	150-200 mm
iii	Dip between Register Arm Tube & Steady Arm	250 - 300 mm on Tangent Track (BFB Steady Arm). 250 -320 mm on Curves (BFB Steady Arm & Bend Tubular Steady Arm)
iv	Difference between mainline Contact wire and the Crossover Contact wire at Support.	50 mm (minimum)
SN	**Item**	**Tolerances**
v	Encumbrance	±50 mm
vi	Length of 'A' Dropper (1st Dropper from Support)	±5 mm
vii	Spacing of 'A' Dropper (1st Dropper from Support)	±30 mm
viii	Length of Other Droppers	± 5 mm
ix	Spacing of Other Droppers	±50 mm
x	Stagger of Catenary Wire	± 30 mm
xi	Height of Catenary Wire	±50 mm
xii	Height of Contact Wire at support	As per Para 7.3 of Appendix I of ACTM Vol.- II Part II
xiii	Stagger of Contact Wire	± 10 mm
xiv	Position of Compensation Plate	It shall be in vertical Plane
xv	3-Pulley Modified Regulating Equipment. (i) Tolerance in X value (ii) Tolerance in Y value	 ±50mm ±150 mm

5.0 **Maintenance of Records**: In the concern Equipment Register as Erected SED.

6.0 **Agency for Implementation**: Railways, Construction Organizations and Railway Electrification agencies.

7.0 **References** :(i) Maintenance Instruction No. TI/MI/0049, effective from 17.05.2021.
(ii) ACTM para No. 7.3 Erection tolerance of Vol.II, Part II.

******

Government of India
Ministry of Railways
Research Designs & Standards Organisation, Manak Nagar, Lucknow - 226011

MAINTENANCE INSTRUCTION NUMBER TI/MI/0050-Rev. 1

1. TITLE: Prevention from Bird Menace on Traction Installations (OHE, PSI).

2. APPLICATION: Traction Installations [Overhead Equipment (OHE), Power Supply Installation (PSI)].

3. OBJECTIVE: Prevention from following kinds of bird-menace on traction installations

2.1 **Clustering of birds**: It causes tripping, parting of conductors.
2.2 **Bird nesting:** Collection of metal parts, cloth pieces, leaves and sticks for making the nest by the bird causes tripping and parting of conductors.
2.3 **Bird droppings:** It causes damage to insulator's surface resulting in flashover of the insulator, tripping of OHE supply and supply failure.

4. MAINTENANCE INSTRUCTIONS: To achieve above objective, following maintenance instruction shall be adopted.

4.1 Preventing the birds from gaining access for nest forming by provision of anti bird High density polyethylene (HDPE) monofilament netting type III,UV stabilized as per IS 16008(part-2)-2016/PVC virgin HDPE Net preferably in black colour inside the existing fabricated structures (fabricated masts, Portal/TTC uprights/boom, fabricated Drop arms, gantry booms etc.).

4.2 The main properties of High density polyethylene (HDPE) monofilament netting type III as per IS 16008-2016 are as given below:

SN	Characteristics	Requirement	Method of test
1.	Mass g/m^2 , min	310	IS-1964
3.	Shading Percentage	70-80	Annex C of IS 16008
4.	Average Breaking strength of shade net fabric (strip method, 325mmx50mm test piece with gauge length of 200mm) N, Min		Annexure-B of IS 16008 and IS-1969 (Part-I)
	(a) Warp way	450	
	(b) Weft way	1700	
5.	Retention of breaking strength after UV exposure, N, Min	85% of original actual value of fabric	Annex. B IS-1969 (Part-I)
6.	Bursting pressure, kgf/cm^2, Min	30	IS 1966 (Part 1 or Part 2)
7.	Colour fastness to artificial light for coloured sheds	4 or better	IS 2454

4.3 The main properties of UV stabilized PVC virgin HDPE polymer Net are as follows:

Tensile Strength (KN/M): 4.0 (ASTM D638)

Mass:: 510 GCM

Aperature Shape: Hexagonal

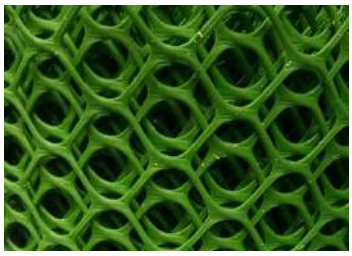
Aperature Size:28X28

Melting point:130^oC

Density: 0.94-0.96 g/cm

Specific Gravity: 0.50-0.60 g/cm

Colour: Preferably Black Colour



HDPE Net

Shade Net 70-80%

4.4 Preventing formation of nests by obstruction the birds from sitting for nest forming by providing PVC pipes of smaller diameter and varying lengths (2 to 4 m, depending on area to be covered) in vertical and horizontal condition(depending on location e.g. upright or boom). Provision of Yellow & Red reflective sticker on PVC pipe/portal joints to scare birds.

NOTE: Following precautions shall be ensured for 4.1, 4.4 above for net/ pipe:

(i) These shall be fixed inside the fabricated structure and not outside.

(ii) These shall be tied with UV Resistant Nylon Cable tie to prevent slipping or movement or falling due to wind etc. Use of metal wire is prohibited. The Specification of cable tie is as given below:

Material: Nylon 6.6
Colour: Preferably Black
Loop Tensile strength min.: 80 kg
Max. Bundle Diameter: As per requirement
Length: As per requirement
Width: 9mm
Thickness min. :1.8mm
Operating Temperature: -25°C to +85°C
Testing Standard: BSEN 62275:2019

(iii) Initially Anti Bird Net with Cable ties should be erected in bird prone areas on some structures as decided by PCEE for trial purpose and six month performance feedback should be submitted to RDSO for proliferation of use.

(iv) Cable ties used for fixing shall not hang outside the structure.

(v) Arrangement should be provided for full length of boom, drop-arm and upto bracket-insulator for portal upright & fabricated mast upright.

(vi) Holes of the net will not be very small to reduce the weight for carrying and lifting during installation as well as to reduce the effect of wind.

(vii) Diameter of the pipe shall be kept small for its oscillation with low winds. Pipe should be in level while in horizontal condition. Arrangements should be completed prior to nesting season to get more benefit.

4.5 **Redundant Cross-arms on super-mast**: Redundant Cross-arms over super-masts of old RC wire are available projecting over the stay insulator. These cross- arms facilitate sitting of birds on it, which makes bird's dropping falling over the insulator. Redundant Cross-arm available toward stay insulator shall be got removed.

4.6 Depot should identify the types of birds, duration of nesting season, bird nest zone in their jurisdiction and staff should be nominated for timely removal of bird nest. Collected metal wire should be disposed preferably at depot in closed container.

4.7 The patrolling staff should pass immediate message to the maintenance gang, TPC for removing Birds' nests, stray wire pieces affecting healthiness of OHE.

4.8 **Overline structure**:

(i) The catenary should be so erected as to have maximum clearance from the over-line structure to reduce the possibility of birds perching on the catenary wire/ Contact wire causing earthed fault.

(ii) For Overline structures having lesser clearances, arrangement as per the directive of Railway board/ RDSO (e.g. provision of contact wire in-place of catenary wire) should be adopted.

4.9 Bird Guard shall be provided on Transmission towers as per RDSO Drawing No TI/SK/BG/RDSO/00001/08/0 & TI/SK/BG/RDSO/00002/08/0 which were issued to railways vide RDSO letter TI/OHE/INS/GEN/08/7 Dated 18.11.2008.

4.10 **Catenary wire inspection**: For every case of insulator flashover or direct short-circuit from the cantilever assembly, condition of catenary wire inside the 'Suspension clamp' shall be checked to confirm that catenary wire is healthy. For this, as an immediate measure, to identify the hot spot inside the suspension clamp due to strands cut, help of binocular and thermal imager should be taken. Permanent rectification as per standard guidelines shall be adopted for strands cut locations. Availability of Packing saddle (RI No. 1174) with Catenary suspension clamp (RI No.

1160) as given in RDSO drawing No. RE/33/P/1160 Rev. K should be checked. For prevention of Bird faults RDSO SMI No. TI/MI/0059 should be followed.

4.11 **Bonds**: Availability as well as tightening of all types of bonds on both ends of all OHE structures (mast, portal,TTC etc.), Rails, Buried rail, earth pit, PSI structures (supports of PSI equipment, connection between equipment and structure etc.) is very important. Improper tightening (loose condition) will result into either no action or delay in relay operation which is undesirable. In addition, ground potential will rise and may cause equipment failure. It is more relevant for Bird related cases since the résistance will vary depending on the medium causing fault.

4.12 **Elimination of redundant metal wires on track and nearby:** Metal wires used by the birds for making nest causes problem while carrying it as well as during nesting. These metal wires should be got removed from the track and all nearby places by all concern departments(e.g. GI wire cut pieces of wagon door closing/sealing/binding etc)and use of Nylon wire/rope in-place of metal wires will be suggested. Awareness shall be made to all departments. Periodical drive should be conducted.

4.13 Extra projection of bracket tube towards portal boom should be identified & cut.

4.14 Cantilever arrangement on the chair fitting should be observed for clearances between chair and live tube of cantilever. Clearances should be increased on all possible locations with standard arrangement.

4.15 Use of metal wire, metal pipe, metal boxes, wire brush, CD& metal mesh etc. is prohibited.

4.16 Any measure other than mentioned above for prevention of Bird Menace, may be adopted as per the local condition with the approval of CEE of concerned Zonal Railway.

5.0 MAINTENANCE OF RECORDS:

5.1 Location wise record of 4.1, 4.5, and 4.9 shall be ensured to verify the locations where net/pipe is provided. It will assist for failure analysis also.

5.2 For 4.8 above, existing records of Overline structure shall be verified at SSE and ADEE level to short list the locations & lines over which such instruction need to be implemented. Such list shall be finalized and implemented with the approval of Divisional head of traction distribution.

6.0 AGENCY FOR IMPLEMENTATION: Railway TRD maintenance Organisation.

7.0 Sample Photos:

PORTAL BOOM NYLON NET DROP ARM

NYLON NET

JAPAN RAILWAY-NYLON NET ON PORTAL BOOM & DROP ARM

HDPE NET ON PORTAL

HDPE NET ON TTC

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भारत सरकार, रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन,
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2465732रेलवे, Railway: 42804
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ई-मेल/E-mail : dtiohed.rdso@gmail.com

No.TI/OHE/FTGFE/16 Dated, the 8th December, 2017

To,

The Chief Electrical Engineer,

(i) Central Railway, Station Building, Mumbai CST - 400 001.
(ii) Eastern Railway, Fairlie Place, Kolkata-700 001.
(iii) East Central Railway, Hajipur-844 101.
(iv) East Coast Railway, Bhubaneshwar-751 023.
(v) Northern Railway, Baroda House, New Delhi - 110 001.
(vi) North Central Railway, Allahabad-211 015.
(vii) North Eastern Railway, Gorakhpur-273 012.
(viii) North Frontier Railway, Maigaon - 781 011.
(ix) North Western Railway, Jaipur - 302 017.
(x) Southern Railway, Park Town, Chennai- 600 003.
(xi) South Central Railway, Railnilayam, Secunderabad-500 371
(xii) South Eastern Railway,Garden Reach, Kolkata-700 043.
(xiii) South East Central, Railway, Bilaspur-495 004.
(xiv) South West Railway, DRM's Office, Hubli-580 028.
(xv) Western Railway, Churchgate, Mumbai-400 020.
(xvi) West Central Railway, Jabalpur- 482 001.
(xvii) Central Organisation for Railway Electrification, Nawab Yusuf Road, Allahabad-211000.
(xviii) Konkan Railway,

Sub: Maintenance Instruction No. TI/MI/0051 for "INSTALLATION OF ENDING CLAMP AS PER RDSO DRG. NO. ETI/OHE/P/1120, ETI/OHE/P/1130 AND ETI/OHE/P/1140 FOR CATENARY WIRE, FEEDER WIRE AND LARGE SPAN WIRE RESPECTIVELY".

Ref: This office letter No. TI/OHE/FTGFE/16 dated 31.05.2017.

The subject Maintenance Instruction for installation of ending clamps is enclosed herewith for implementation.

This is issued with the approval of ED/TI, RDSO.

Encl: As above.

08/12/17
नीरज कुमार वर्मा
निदेशक(डी-ओएचई)
[कृते महानिदेशक(कर्षण संस्थापन)

COPY TO:The Executive Director (EEM) Railway Board, New Delhi-110001:For Kind information please.

SN76

Government of India

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Ministry of Railways

Research Designs & Standards Organisation

Manak Nagar, Lucknow-226011

MAINTENANCE INSTRUCTION NO.TI/MI/0051

Maintenance Instructions
For
INSTALLATION OF ENDING CLAMP AS PER RDSO DRG. NO. ETI/OHE/P/1120, ETI/OHE/P/1130 AND ETI/OHE/P/1140 FOR CATENARY WIRE, FEEDER WIRE AND LARGE SPAN WIRE RESPECTIVELY FOR 25 kV AC TRACTION ON INDIAN RAILWAYS

	Prepared By	Checked By	Approved By
Signature			DT.I/OHE-D
Date	7/12/2017	7.12.2017	For EDTI 08.12.2017

Issued by:

Traction Installation Directorate,
Research Designs & Standards Organisation
Manak Nagar, Lucknow- 226011

TITLE: MAINTENANCE INSTRUCTION FOR INSTALLATION OF ENDING CLAMP AS PER RDSO DRG. NO. ETI/OHE/P/1120, ETI/OHE/P/1130 AND ETI/OHE/P/1140 FOR CATENARY WIRE, FEEDER WIRE AND LARGE SPAN WIRE RESPECTIVELY.

SMI No. TI/MI/0051

1.0 **Scope & Application**: This instruction stipulates the guidelines for correct installation of ending clamp as per RDSO DRG. NO. ETI/OHE/P/1120, ETI/OHE/P/1130 and ETI/OHE/P/1140 for catenary wire, feeder wire and large span wire respectively, similarly for other stranded conductors to prevent failures of conductor and/or Ending Clamp caused by wrong fitment of conductor or incorrect assembling of Ending Clamp or usage of wrong part of Ending Clamp, particularly cone. Scope also covers periodical training of staff and supervisors. This maintenance instruction does not include guidelines for the failures contributed due to poor quality of conductor or Ending clamp and helps in avoiding failure on account of improper installation.

2.0 **Cause of failures:**
Failure analysis revealed that 150 sqmm feeder wire ending clamp was used in place of 130 sqmm feeder wire ending clamp which resulted in slipping of 130 sqmm large span wire from ending cone.

3.0 **DETAILS OF SPECIAL MAINTENANCE INSTRUCTIONS:**

3.1 **RDSO Drawings:** Following details covered in Drawings referred in 'Scope & application' should be carefully noted. These details should be ensured while assembling Ending clamp with the conductor, failing which it may result into failure.

(i) Position of Joint cone with respect to Ending Clamp body: Joint cone is shown touching Ending Clamp Body.

(ii) Position of inner & outer strands of conductor with respect to Joint cone/Ending clamp body/Joint socket: Strands are not touching ending clamp body and have a gap of about 2 mm. Strands are just beyond the Joint socket.

(iii) Position of collar of joint socket and Ending clamp body (when seen from outside): (refer drawing) are not touching each other and have a gap.

3.2 The drawings mentioned in 'Scope & Application' are suitable for a particular type of conductors only (namely Catenary wire, Feeder wire and Large span wire respectively) and are not interchangeable.

3.3 All sub-assemblies mentioned in respective drawings of ending clamps for Catenary wire , feeder wire and large span wire are stamped with part no. During assembly it is to be ensured that correct part no is used as per respective drawings mentioned in Para 1.0.

For ready reference, details of ending clamps assemblies and subassemblies along with part nos are tabulated below:

SN	Assembly	Drawing no	Sub assembly	Drawing no	Part no
1	Catenary Ending clamp (65 mm2)	ETI/OHE/P/1120	Catenary ending clamp body	ETI/OHE/P/1121	1121
			Catenary joint cone	ETI/OHE/P/1094	1094
			Catenary joint socket	ETI/OHE/P/1092	1092
2	Feeder ending clamp (150 mm2)	ETI/OHE/P/1130	Feeder ending clamp body	ETI/OHE/P/1131	1131
			Feeder joint cone	ETI/OHE/P/1104	1104
			Feeder joint socket	ETI/OHE/P/1102	1102
3	Large span wire ending clamp (130 mm2)	ETI/OHE/P/1140	Feeder ending clamp body	ETI/OHE/P/1131	1131
			Large span wire joint cone	ETI/OHE/P/1143	1143
			Feeder joint socket	ETI/OHE/P/1102	1102

Note: 1. Note carefully the part numbers used for different assemblies.
2. There have been failures when wrong joint cone have been used.
3. This should be understood from drawings and physical appearance.

3.4 Image of Ending Clamps assemblies and sub-assemblies along with details as per part no. table of para 3.3 should be shown in display Board in all OHE depots.

3.5 Training:

(i) Supervisor and staff should get hands on training for 3.1, 3.2 above. Officer in charges should conduct test after the training.

(ii) First tensile load Test on conductor should be conducted and then tensile load test should be conducted on "Conductor-ending clamp assembly" at depot similar to the testing of loading appliances. Tensile load test should be conducted upto 1.5 times the working load of conductor. For tensile load capacity of conductor concern specification should be referred. After Tensile load test Ending Clamp should be opened and checked for changes in the position of the inner, outer strands and the cone. Rubbing marks on the inner surface of the ending clamp body should be observed. There should be no rubbing of strands. For comparison of condition during assembly and after the tensile load test, help of camera, Blue-marking on cone face should be used.

(iii) Training record should be maintained in the training register available at depot.

4.0 Agency for Implementation: Railways Maintenance Organisation, Construction Organizations & Railway Electrification agencies for their staff and contractors.

5.0 Reference:Feedback from Railways, RE Projects.

****

Maintenance Instruction No. TI/MI/0052 Rev.0

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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SPECIAL MAINTENANCE INSTRUCTION
For
4-WHEELER TOWER CAR

(JUNE, 2017)

ISSUED BY:

TRACTION INSTALLATION DIRECTORATE
RESEARCH, DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR,
LUCKNOW - 226 011.

SPECIAL MAINTENANCE INSTRUCTION
for
4-WHEELER TOWER CAR

Amendment Number	Date of Amendment	Total pages including annexure	Amendment/ Revision
NEW		78	

	PREPARED BY	CHECKED BY	APPROVED BY
SIGNATURE			
DATE	29.06.2017	29.6.17	30.6.17
DESIGNATION	JE (D)/TI	Dy. Director(TI)-II	EDTI

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ISSUED TO .....
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SPECIAL MAINTENANCE INSTRUCTION
for
4-WHEELER TOWER CAR

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SPECIAL MAINTENANCE INSTRUCTION FOR
4-WHEELER TOWER CARS

1.0 Objective: For upkeep of tower wagons and all time availability of Tower Cars in working conditions.

2.0 Back Ground: Tower Cars are used for maintenance and attending to break downs of overhead equipment (OHE) for quick restoration of power supply to OHE. This Special Maintenance Instruction (SMI) has been prepared to maintain Tower Cars so that its availability can be ensured all the time.

Following maintenance instructions are to be followed for maintenance of various items of Tower Cars.

3.0 Monthly Schedule (With engine stopped).

3.1 Contactor and relays:
(i) Inspect visually.
(ii) Manually operate contactor to check operation.
(iii) Check interlock and contactors.
(iv) Check operations and contactors.
(v) Clean the interlock of contactor & relays.

3.2 Resistor & blocking diode: Check values and function of all resistors and diode and record it.

3.3 High and low voltage circuit: Check ground record insulation resistance of power circuit

3.4 Batteries:
(i) Clean dirt or any oil on top of battery.
(ii) Keep all terminal tight, clean and apply vaseline petroleum jelly.
(iii) Ensure that vent plugs are clean.
(iv) Check specific gravity of electrolyte
(v) Top up the distilled water as per the requirement i.e. twice in summer season and once in winter season in a month based on the float guide indicator.

3.5 Traction Motor: (i) Brush off loose dust or dirt before removing commutator cover.

(ii) Clean the commutator veering. Remove any copper beads from the commutator surface with fine caborandum cloth.
(iii) Deposit from dirt or greasy hands should be removed from solvent.
(iv) Examine the brush gear and clean the insulation of the brush arm.
(v) Check that the brush ring sits correctly on the carbons and that the springs are in good condition.
(vi) Check carbon brushes for wear. Fit new brushes in place of worn out carbon brusher or any one which are unlikely to last until the next inspection. See data for minimum length and brush grade.
(vii) Check carbon brushes for freedom in the brush holder and if striking cleans both the brush and inside of the brush holder.
(viii) Do not shake the carbon, as solvent will eventually ooze out affecting the commutator and causing the brush to jam in the brush holder. If the brush appears to be excessively slack in the brush holder, check the brush size and discard the brush holder as the case may be.
(ix) Top up suspension bearing lubrication oil and cardium compound of traction motors, gearbox.

3.5 Traction Alternator: (i) Brush off loose dust or dirt before removing cover.
(ii) Check tightness of connections.
(iii) Check for any loose hardware especially on the rotating rectifier assembly.

4.0 Three Monthly Schedule (with engine stopped)
4.1 Repeat all checks followed in monthly check.
4.2 Contactor and relays: (i) Inspect visually.
(ii) Manually operate contactor to check operation.
(iii) Check interlock and contactors.
(iv) Check contactors contact tips for pitting.

4.3 Resistor and blocking diode: Check values and function of all resistors and diode.

4.4 High and low voltage: Check for ground , record insulation circuits Resistance of power circuit and control circuit.

4.5 Batteries:

(i) Clean dirt or any oil on top of battery.
(ii) Keep all terminals tight clean and apply Vaseline petroleum jelly.
(iii) Ensure that vent plugs are clean.
(iv) Check specific gravity of electrolyte.
(v) Check the specific gravity & cell to cell voltage of each Cell of battery. If specific gravity is found below the requirement limit, maintain it to its required value.
(vi) D.M. water as per requirement and float guide indicator.

4.6 Traction Motor: Repeat the monthly service with following additional schedules.

(i) Blow out machine using clean dry compressed air. Take particular care to direct air under the commutator in order to remove dirt lodged in the armature core ducts.
(ii) Check tightness of all brush gear bolts.
(iii) Check tightness of bolts securing axle caps and gear case
(iv) Check air inlet bellows for cracking, tearing or collapsing.
(v) Check for the leakage from the gear case and suspension bearings Ensure the lids of the axle suspension bearing oil wells fit correctly.
(vi) Check all external leads for chaffing.
(vii) Measure insulation resistance, it should not be less than one mega ohm.

4.7 Traction Alternator: Monthly Service plus.

(i) Wipe off loose dirt on the outside surface of the alternator with a clean filter free cloth.
(ii) Remove stubborn accumulation of dirt using xylene
(iii) Clean all ventilating parts with filtered and compressed air at pressure of 1.75 to 2.8 kg/cm^2.
(iv) Clean inside of alternator using dry compressed air of a pressure of 1.75 to 2.8kg/cm^2.

4.8 Cable Connections: Check for loosening adjoins on terminal board & Equipments. Check for insulation damage also.

5.0 HALF YEARLY SCHEDULE (WITH ENGINE STOPPED)

Master controller	Clean and inspect contact, fingers. Check mechanical Interlock
Control equipments shunts.	Check condition and flexibility; replace worn frayed broken or corroded braided shunt.
Control equipments	Check terminal connectors and tighten if required.
Control Equipment	(i) Clean contactors (ii) Replace contact tips if worn or pitted.

Safety devices (i) Cooling water temperature switch (ii) Engine over speed switch	 (i) Remove and check on test bench and adjust if required. (ii) Remove and check on test bench and adjust if required.
Engine RUN/STOP switch	Check and clean contact
Battery	Remove boxes from tower wagon. Clean and repaint.
Load Ammeters	Check calibration
Traction Motor suspension bearing	(i) Change oil. (ii) Change wick lubricator if damaged. (iii) Check bearing cap bolts for tightness. (iv) Check bearing cap bolts for tightness. (v) Check wear on motor suspension and nose suspension. (vi) Check suspension bearing suspension.
Traction Motor	Repeat three monthly service including following additional schedules:- (i) Clean the grease escape drain from P.E. outer bearing cap and P.E. end shield. (ii) Clean all pinion and gear wheels check for tooth wear. (iii) Clean lubricant from each gear case to ensure that it is not cracked and the seals are in good condition. (iv) Replace felt seals if necessary.

6.0 MAINTENANCE OF TRACTION MOTOR

Overhaul: An overhaul is required after three to five years service. Following schedules are to be ensured:

(i) Remove as much dirt as possible particularly around the commutator covers the axle-cap filler pipes and the armature bearing caps.

(ii) Check the lateral and diametrical clearances of the axle suspension bearings; fit new bearings if the existing bearings are worn beyond the limits recommended (see data as given in the manual).

(iii) Remove the motor from the bogie and using the oil-injection equipment, remove the pinion.

(iv) Before dismantling the motor, give it a light run at 1500-2000 rev/min to check that the bearings are not noisy and that the vibration is not excessive.

(v) Dismantle the motor (see under dismantling & reassembling). Clean the armature thoroughly, also the interior of the frame. Bake each at 90^{o}C to remove moisture. (See Workshop Manual). After drying, check the insulation resistance while the machine is still hot. This should be at least one Meg. Ohm, if it is, apply a high voltage test. (See under HIGH VOLTAGE TESTS). Apply a commutator bar to bar comparison test to check for open or short circuited coils.

(vi) Remove and clean the brush holders. Examine each brush holder for brush clearance, for brush spring pressure, for damaged insulators, for spring-hub wear, for loose or defective support pin insulator and burnt spots. Recondition as necessary. Fit new brushes if necessary.

(vii) Check the wear plates on the nose suspension for wear, check also axle ways and the axle caps for wear, distortion and cracks. Examine all cables, fit a new cable in place of any that is chafed or otherwise damaged.

(viii) If the field coils and the connections are tight, dry and are in good condition, repaint the whole of the interior with silicone gray finishing paint.

(ix) If field coils have to be removed, recondition them individually, and on reassembly, refill the counter bores around the top pole studs with Tar Compound, class IV (Supplied by M/s Shalimar India) to exclude moisture.

(x) Inspect all other motor components for wear, distortion or for any other defects. Fit new bearings if necessary.

(xi) Inspect the shaft for damage to threads, bearing and whether pinion fits and ensure that the shaft is straight. Further inspect the armature for loose bands, solder throwing or other defects. Recondition the armature as necessary.

(xii) Treat the reconditioned or repaired armature with solventless

polyester (GE 702 or equivalent) insulating varnish. (For procedure, see Workshop Manual). The number of such treatments will depend upon the condition of the armature, but normally, twice will be sufficient.

7.0 OVERHAUL DURING IOH/POH

During the overhaul the pantograph must be removed from the Tower Wagon.

Bearings: After dismantling, check all ball bearings for wear of cage ball etc. and replace if necessary

Mechanical parts: The upper and lower articulation tubes must be dismantled and repaired if bent. The middle articulation shaft triangular bracket and equalizer arm etc. should be checked thoroughly for damages.

Throttle valve: Dismantle and over haul throttle valve.

Self starter: Self starter motor for Mark-II, Mark-III tower wagon to be overhauled in every IOH/POH & replaced in second POH.

Alternator: Engine driven alternator to be overhauled in every IOH/POH and replaced in second POH.

Painting: Scratch the old paint. Clean the surface and apply paint.

8.0 MAINTENANCE OF RECTIFIER

Except for blower, the rectifier unit as such is a static equipment with no moving parts, hence little maintenance is required. However, regular inspection is necessary if trouble free operation is required.

(i) The unit must be periodically cleaned with air blast. For inspection the front door can be opened easily by opening the locks and doors can be kept aside according to convenience.
(ii) Checkup various contacts and terminal connections in the initial stage of operation and later once in six months.

9.0 MAINTENANCE OF ENGINE:

Daily check **A-Check**

S.N.	Maintenance steps	Remarks
1	Check previous days engine log book	Correct as required.
2	Drain Water and sedimentation from fuel filter through drain cock.	Before starting the engine.
3	Check engine oil level and top up if necessary	Must be slightly less than or equal to 'H' mark on dip stick when engine is stopped and has stood for 20 minutes or more (must be measured after all oil is drained back into oil pan)
4	Check for fuel, oil, water and exhaust leaks	Correct if leaking.
5	Fill radiator/surge tank with treated water (Chromate concentration 3500 PPM)	Radiator cap must be firmly tightened back into the radiator/surge tank neck. Engine must not be operated without the aeration and overhauling of the coolant check, engine radiator water level.
6	Check air cleaner, oil level and change oil, if required(if oil bath type) clean dust pan	Use clean engine oil
7	Check airline connection for leaks	Correct as required.
8	Remove and clean air compressor breather, if equipped.	Fill with clean oil upto the mark.
9	Drain air receiver tank at the beginning of every day and close the drain cock.	-
10	Clean crank case breather.	Discard paper type element if clogged.
11	Check oil level in hydraulic governor, if provided.	Check for leaks. Use engine oil for topping up (as shown in fig 3.1)
12	Start the engine and note the oil	If there is a change in oil

	pressure both at idling and maximum speed.	pressure from that recorded in the log book on earlier occasion then stop engine and check through trouble shooting technique the cause for oil pressure change and correct if necessary.
13	Record oil pressure	Refere operation and maintenance manual for lube oil pressure limits
14	Fill fuel tank at the end of the day	Use clean fuel and a strainer. Also clean the cap and surrounding area before opening the filler cap. Fill fuel at the end of the day allowing diesel to settle. Drain sediment from fuel filter water separator bowl.

3.2 Check Every 300 Hrs or 6 Months whichever is earlier **B -Check**

S.N.	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of 'A' check	--
2.	Change engine oil.	When lub oil is examined through lub oil analysis in a laboratory, oil change period may be extended. In such cases, refer to your service representative.
3.	Fit new lubricating oil full flow filter element.	Inspect the changed filter element and check for metal particles and oil sludging/oxidation.

S.N.	Maintenance Steps	Remarks
4.	Remove, clean and inspect dry type air cleaner element. Remove and clean dustpan. Inspect element for holes and tears. Check gaskets and 'O' rings for damage.	Blow out dust with compressed air in the opposite direction of the normal air flow. If very dirty, wash in solution of warm water. (48.9°C-60°C) and non sludging detergent. Allow it to dry first then use compressed air. Replace if washed two times. Caution: Excess air pressure will damage paper. Air nozzle must be kept at least 8" from the element. Must not be used if even one pin hole exists. Discard element if punctured and also change gasket along with element.
5.	Clean oil bath air cleaner tray screen.	-----
6.	Change lubricating oil by-pass filter element and gasket if provided.	Record oil pressure
7.	Clean float tank and/or main fuel tank breather.	-----
8.	Check coolant PH value/concentration of DCA/chromate concentration (3500 PPM).	Change corrosion resistor element if PH calue is below normal range 8.5 – 10.5. Check chromate concentration at 3500 PPM.
9.	Check magnesium plate in assembly corrosion resistor. Change water filter element.	Check magnesium plate for pitting or being eaten away. Change if more than 50% of area is lost. Use DCA service element or chromate element bags AR 95679 if concentration is low.
10.	Change fuel filter element washer and 'O' ring on mounting bolt.	Clean shell fuel filter. Change element when restriction exceeds vacuum 20.32cm of mercury.
11.	Check oil in aneroid control, If equipped.	Use same oil as used in oil pan.

S.N.	Maintenance Steps	Remarks
12.	Check and adjust belts. New belts will stretch within one hour of use. They must be readjusted.	Tighten belt tension (use ST – 1293)
13.	Tighten foundation bolts and flexible coupling bolts of engine and alternator.	-----
14.	Check all air cleaner connections for cracks-chafing etc. Tighten all air intake connections.	Correct as required.
15.	Check fan hub and drive.	Use special tool no. ST 845 or ST 893 for tightening the fan hub nut.
16.	Clean/change air compressor breather element.	Change element for naturally aspirated engine. Clean screen for turbo engine.
17.	Check throttle linkage.	-----

EVERY 1500 HOURS OR 1 YEAR WHICH EVER IS EARLIER **C - Check**

1	Repeat all maintenance steps of Checks `A' & 'B'	
2	Check thermostat operation	It should start opening
3	Check fan hub and drive	Check mounting bolts & bearing end play
4	Check impeller water pump for play	Correct if necessary
5	Check for turbocharger oil leaks	Correct as required
6	Tighten turbocharger mounting nuts	Tighten to the specified torque. Do not tighten when engine is hot condition.

7	Check inlet air restriction	Check after cleaning dry type air cleaner element. If restriction is in excess of 25" water, a new element must be fitted.
8	Clean oil bath air cleaner	Remove complete assembly and clean inclusive of fixed screens.
9	Clean and tighten all electrical connections.	-
10	Check generator brushes and commutators	Replace and clean as required
11	Clean entire engine	High pressure and soap water mixture preferred after spraying engine with cleanser taking care of protecting electrical system.
12	Tighten all mounting bolts and nuts	Tighten as required. Over tightening may result in distortion or damage.
13	Clean aneroid air breather. If provided	Replace breather if necessary.
14	Check engine blowby.	Reading in excess of recommended limits. Corrective action must be taken through analysis with the help of trouble shooting chart.
15	Clean radiator	Blow air through the radiator core in opposite direction to the normal flow of air, if working under dusty/dirty condition.(Reserve flushing operation)
16	Check air compressure	Check shaft and clearance.
17	Adjust injectors and valves	Clean fuel inlet connection screens. Final adjustments must be carried out with engine hot and with correct torque as specified (refer O & M manual)
18	Change hydraulic governor oil/ aneroid oil	Use engine lubricating oil
19	Check vibration damper	If steam is not available, then use clean soap water solution as outlined in 'C' checks it.
20	Fuel & lube oil filters	Replace fuel & lube oil filter elements with sealing rings and clean the filter housing.

EVERY 6000 HOURS OR 3 YEARS WHICHEVER IS EARLIER. **D-Check**

SN	Maintenance Steps	Remarks
1	Repeat all maintenance steps of check A, B & C	
2	Check exhaust and inlet manifold and nuts.	
3	Tighten all mounting bolts and nuts.	
4	Clean Turbocharger diffuser and impeller and check end float.	
5	Check turbo charger bearing clearances	Only end float on semi floating bearing if in excess of limits, replace it.
6	Check crank shaft end float	If in excess of recommended limits, corrective action is indicated
7	Clean injector inlet screens	Must be done only if performance deterioration is evident. Some of the indications for performance deterioration are. 1. Black smoke 2. Change in fuel manifold pressure 3. Loss of power 4. Malfunction of aneroid. 5. Clean and calibrate all injector. 6. Check fuel pump calibration. 7. Replace aneroid bellows & calibrate.
8	Replace fuel pump filter screen and magnet.	
9	Steam clean engine.	If steam is not available, then use clean soap water.

10.0 MAINTENANCE OF TRANSMISSION

(i)	Maintenance steps: Check the transmission oil level and top up, if necessary. It must be equal to H mark on the dip stick. When engine is stopped and has stood for 20 minutes or more (must be measured after oil, get back into the transmission housing)
(ii)	Clean the transmission and check the transmission oil leakage. Rectify the same if leakage observed.
(iii)	The oil should be changed every 1000 hours of operation or sooner, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odour. The filter screen in the sump should be removed and cleaned with mineral sprits at each oil change.
(iv)	The filter element should be replaced at each oil change and at 200-hour intervals between oil changes. The filter shells should be cleaned. New gaskets and seal rings must be used when replacing filter elements. After installation, check the filter for oil leakage while the vehicle engine is running.

11.0 MAINTENANCE OF AXLE DRIVE

1	Three years or (approx 3,00,000 kms which ever is earlier.	Remove the final drives from the car & disassemble the gears, shaft & sub-assembly. Inspect the gears and bearing. The defective components must be replaced before re – assembly.

12.0 MAINTENANCE OF LIFTING AND SWIVELLING PLATFORM.

1	Replace suction strainer.	Yearly
2	Replace return line filter element.	Yearly
3	Drain oil tank, clean it and change oil.	Yearly
4	Replace seals of hydraulic cylinder	Two yearly
5	Replace guiding pads between telescopic structures.	Two yearly
6	Major over haul	At 72 months Replacing guide pads between telescopic structures and replacing seals of

		hydraulic cylinder constitute a part of major over haul.

13.0 Requirement of spares for maintenance during various schedules.

The items of maintenance spares required to be stocked along-with the list of must change items in respect of carriage, diesel engine, transmission system including traction motor spares are enclosed as annexure-V.

14.0 4-wheeler tower Cars shall have twin beam head light and LED type flasher light. Earlier tower wagons, which are not provided with twin beam headlight & LED type flasher light, shall be provided with twin beam headlight & LED type flasher light during major overhaul with modification in the shell.

15.0 OVERHAUL DURING IOH/POH

(i)	During the overhaul the pantograph must be removed from the Tower car.
(ii)	All the electrical equipments like traction motor to be overhauled as per the guidelines explained in the proceeding para.
(iii)	After dismantling, check all ball bearings for wear of cage ball etc. and replace, if any.
(iv)	The upper and lower articulation tubes must be dismantled and repaired, if bent. The middle articulation shaft triangular bracket and equalizer arm etc. should be checked thoroughly for damage.
(v)	Dismantle and overhaul throttle valve
(vi)	All mechanical parts, brake equipments, transmission system etc. to be thoroughly checked and accordingly carryout all repair /replacement for safety and smooth functioning as suggested in this document/Maintenance Manual of the equipment/ supplier.
(vii)	Scratch the old paint. Clean the surface and apply paint as per colour scheme.

TRANSMISSION

16 The transmission and control equipment were supplied by two firms viz. M/s Kirloskar Pneumatic Co. Ltd., Pune and M/s Venkateswara transmission private Ltd. (VENTRA) Hyderabad. Hydraulic transmission offered by M/S KPC is of their own design and that of M/s Ventra is of Hindustan Motors. However five numbers 4 wheeler tower wagons were provided with Voith transmission system.

A common power pack is used for both the two designs. A Kirloskar Cummins Ltd. model N-743-L naturally aspirated diesel engine developing 210 horsepower at 2100 rpm has been used. The transmission of both powers from diesel engine to wheels is by means of hydrodynamic system incorporating torque converter and gears.

The final power transmission in both designs is through cardan shaft and axle drives. In the KPC design the transmission output is directly connected to the axle drive on the rear axle by means of a long cardan shaft using axle drives of two different overall gear ratios. This transmission also incorporates reversing arrangements with the use of plate clutch unit.

In the VENTRA design the transmission output is connected to the axle drive through an intermediate gearbox of a differential gear unit and a hydrodynamic torque converter incorporating speed change provision. The final drive from diesel engine is through a slip- clutch assembly properly aligned with in the engine flywheel housing.

16.1 MAINTENANCE OF VOITH HYDRAULIC TRANSMISSION.

16.2 Maintenance Schedules

Maintenance interval	Work to be performed
20,000 km	Check oil level
300,000 km	Oil change, inspection of control parts, replacement of filter, replacement of disposable filter.
900,000 km	Major overhaul

16.3 Maintenance after 20,000 km

Check the oil level.

16.4 Maintenance after 300,000 km

a) Oil change

Under normal operating conditions, the oil filling lasts for a distance of approx. 300,000km . This period can be extended if

the oil sample is still within the tolerance of the specification for new oil.

For changing the oil, drain it from valve while it is at operating temperature and drain the oil cooler too. If oil of a different approved brand is to be filled in, flush the transmission and cooling system with half the quantity of the new oil needed for a complete fill.

b) Replace all filters. For this purpose, drain off the oil first, then remove the filters, take off the caps and remove filter elements.

c) Check control parts such as governor, standstill detector valve, operating cylinder, and main control valve for proper operation, leakage and wear.

16.5 Major Overhaul

A major over haul of the transmission is recommended after approx. 900,000 km of operation, depending on operating conditions and duty. During this over haul, the transmission is stripped as far as necessary. Bearing labyrinth rings, shaft seats etc. are inspected and damaged parts are replaced.

17.0 MAINTENANCE OF HINDUSTAN MOTOR HYDRAULIC TRANSMISSION

17.1 Control Linkage

Check the transmission shift control linkage and the directional linkage to ensure that the linkages are free and that the selector levers are properly positioned. The Shift levers should engage in all shift tower positions freely. Inspect the linkages for binding, wear, cracks, breaks or defective cotter pins.

17.2 Cold Oil Level Check

The cold check (engine not running) is made to determine if there is sufficient oil to safely start the engine - especially if the vehicle has been idle. The oil level should be at or near the full-level check plug. Some transmissions have one plug, others have two plugs, an ADD and a FULL plug.

17.3 Hot Level Check

Oil level must be checked with the engine running at 1000 rpm, transmission in neutral and with the transmission at normal operating temperature (82.3°C - 93.4°C). The upper check plug (if there are two

plugs) indicates the full oil level while the lower plug is the add level. The oil must be maintained at the FULL level. If there is only one check plug, the oil level must be maintained at this level. Add oil if necessary to bring the level to the FULL mark.

17.4 Oil, Filter Change

The oil should be changed every 1000 hours of operation or sooner, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odor. The filter screen in the sump should be removed and cleaned with mineral spirits at each oil change.

The filter elements should be replaced at each oil change and at 200 hour intervals between oil changes. The filter shells should be cleaned. New gaskets and seal rings must be used when replacing filter elements. After installation, check the filter for oil leakage while the vehicle engine is running.

17.5 Keeping oil clean

It is absolutely necessary that the oil put in the transmission be clean. Oil must be handled in clean containers, filler etc., to prevent foreign material from entering the system.

17.6 Filling of Transmission Oil

At temperature above -23.3°C, pour hydraulic transmission fluid type C-2 into filler opening. At temperature below -23.3°C, an auxiliary preheat is required to raise the temperature in the sump. Use only C-2 fluids from approved manufacturers.

17.7 Care of Breather

The breather should be kept clean at all times. It should be checked and cleaned regularly and as frequently as necessary, depending upon the operating conditions. A badly corroded or plugged breather restricts proper breathing, causing oil leaks.

17.8 Control Linkage Adjustment

Manual shift linkage must be adjusted so that the operator's control is positioned to exactly match the detent position of the selector valve on the transmission. Adjust the linkage so that it can be freely connected

without moving either the valve or the operator's control. Then operate the range selector lever, the directional selector lever and the output disconnect (if applicable) through each position. Make minor adjustments, if necessary, to insure that each of the selector levers seats in each position of the operator's control. Then inspect the control linkage for binding wear or breaks.

17.9 TROUBLE SHOOTING OF HM HYDRAULIC TRANSMISSION

Causes	Remedy
A. LOW CLUTCH APPLY PRESSURE	
1. Low oil level	Add oil to correct level
2. Clogged oil strainer	Clean strainer
3. Clogged oil filter	Replace filter element
4. Inching control adjustment not fully retracted	Check, adjust linkage
5. Air leak at intake side of oil pump	Check pump mounting bolts.
6. External oil leakage	Tighten bolts or replace gaskets
7. Brake hydraulic (or air) pressure applying clutch cutoff valve	Check brake residual pressure (brakes released); check brakes for full release.
8. Internal failure	Overhaul transmission, or repair subassembly
B. OVERHEATING	
1. High oil	Restore proper oil level
2. Clutch failed	Rebuild transmission
Causes	Remedy
3. Vehicle overloaded	Reduce load
4. Low clutch apply pressure	Refer to A.
5. Engine water overheated	Correct engine overheating
6. Cooler oil water line kinked or clogged	Clean or replace line
C. AERATED (foaming) OIL	
1. Incorrect type oil used	Change oil; use proper type
2. High oil level	Restore proper oil level
3. Low oil level	Restore proper oil level

4. Air entering suction side of oil pump	Check oil pump bolts and gasket
5. Air entering at clutch cutoff valve (air actuated)	Check plug seal and seal ring of valve.
D. VEHICLE WILL NOT TRAVEL	
1. Low clutch apply pressure	Refer at A
2. Selector linkage broken or disconnected	Repair or connect linkage
3. Internal mechanical failure	Overhaul transmission
E. VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED	
1. Selector linkage out of adjustment	Adjust linkage
2. Clutch failed (won't release)	Overhaul transmission
Causes	Remedy
F. VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED	
1. Low clutch apply pressure	Refer to A
2. Low converter out pressure	Refer to A
3. Engine malfunction	Check engine; refer to engine service manual
4. Aerated oil	Refer to C
G. CLUTCH CUT-OFF VALVE INEFFECTIVE	
1. Valve or plug sticking	Rebuild control valve body assembly
2. Brake apply hydraulic pressure incorrect	Check pressure at control valve (min-max limit - 9.15 kg/cm2 -140.7 kg/cm2)
3. Brake apply air pressure not reaching air cylinder	Check air cylinder (15.85 kg force required to stroke valve)
4. Plunger sticking in air cylinder	Check operation of air cylinder

5. Air entering at valve (air actuated)	Check operation of air cylinder (seals)

18.0 MAINTENANCE OF VENTRA DROP GEAR BOX

General

Ventra drop gearbox is a single stage gearbox, all the bearing and gears are adequately rated to give a longer life. This gearbox transmits the power from converter/ transmission to the rear axle drive gearbox through cardan shaft of adequate design.

Description

The input flange is key mounted on the input pinion shaft, which runs on the spherical roller bearings. The input pinion is meshed without put gear, which is key mounted on the output shaft. The output flange is key mounted on output shaft. The output shaft runs on spherical roller bearings. The gears and bearing are lubricated through pipe by means of a Hypo pump mounted on the output shaft. Oil seals are provided at input and output end to prevent the oil oozing through the end covers

18.1 Maintenance

1. Daily oil level to be checked through the level plug /indicator, if necessary, top up the oil.

2. Daily check the oil leakage through input, out put oil seals, through the end cover s and through housing joints etc. if so, rectify the oil leakage by changing the new oil seals or by tightening the respective bolts and nuts.

3. Once in a week take out the magnetic drain plug from the gear boxes and check for any wear out particles or debris, if heavier particles found, the gear box has to be opened and checked.

4. For the new gears, first oil changing period is one month Then once in three months, the specified oil to be changed

   Note: Before changing the equivalent oil, clean the gearbox with kerosene or diesel. Then pour the equivalent oil and drain out 1/2 to 1 litre of the same oil through the drain plug. Then put the oil little above the level plug / indicator

5. Breather must be cleaned thoroughly once in three months.

18.2 Ventra Axle Drive Maintenance Schedule

The final drive to the tower wagon is affected by the axle mounted right angle drive gear box. The input and intermediate shaft run spherical roller bearing. The axle also run on spherical roller bearing the gear box housings have been provided with oil pockets and gears and bearings get abundant lubrication. The bottom housing serves as the oil sump. Level, drain plug and inspection door have been provided for regular maintenance.

1. Daily oil level to be checked through the level plug and if necessary top up with the same oil (please refer oil chart for quantity/grade).

2. Check for oil leakage through oil seals and housing joints. Seal are to be replaces or housings are to be tightened according to the prescribed tightened torque, if necessary.

3. Once in a fortnightly take out the magnetic drain plug from the gear box and check for any wear particles or debris; if heavier particles are found the gear box has to be inspected by opening the cover at the top.

Note for Change of Oil

For a new gear box, first oil change shall be done after one month. During changing, clean the gear box with kerosene or diesel after draining out the sump. Pour the recommended/equivalent oil and drain out 1/2 to 1 litre oil again. Close the drain. Fill the sump with specified quality.

Periodicity for change of oil - every three months.

18.3 Maintenance of KPC HYDRAULIC transmission

18.3.1 Maintenance

18.3.2 Hydraulic system

a. The oil capacity of transmission is 20 litres.

b. Oil level should be checked daily through the oil level gauge in transmission. Oil level should be checked at idling engine speed, it should be between high & low marks.

c. Oil must be changed after 1000 Hrs. of operation.
d. Drain valve is provided for draining the oil without loss. Connect hose to the drain valve and then open the valve.
e. Fill the oil in transmission through breather cap hole. Run the engine and check the oil level. Replace the breather cap or alternatively, remove plug provided on cover top & fill oil. Refit plug after oil filling.
f. Replace filter element as per recommendations. Remove the filter cover and replace filter element. Use new gasket, if necessary, for the filter cover.
g. Suction strainer: Unscrew plug on top of strainer housing for strainer removal. Clean strainer throughly by flushing in clean diesel oil. All foreign particles must be removed from the strainer before refitting it. Ensure air tightness after replacing plug on housing strainer. Thread sealing compound may be used to avoid leakage of air in to the circuit.
h. Remove the breather assembly every 1000 Hrs. of operation. Flush the oil breather assembly.

18.3.3 Inspection - Daily

a. Check oil level. Add if necessary.
b. Check all pipelines, end connections for leakages. Replace damaged parts to stop leakages.
c. Check all pressure/ temperature gauges for proper functioning. Replace damaged gauge immediately.
d. Check oil leakage from oil seal bolted joints. Replace damaged oil seals. Tighten loose bolts/ screw to stop leakages from joints.

18.3.4 Inspection – Weekly

a Check strainer and clean.
b Check filters element and clean if necessary.
c Check and tighten all bolted joints including mounting bolts.

18.3.5 Inspection After Each 1000hrs Of Operation

a Change oil in the sump and fill new recommended oil
b Clean selector valve.
c Check all gauges for their correctness.

18.3.6 Periodic Overhaul

A complete over haul of the transmission should be done simultaneously with overhauling of engine. The period is approximately 4000 Hrs of operation or 18 month whichever is earlier.

19.0 TROUBLE SHOOTING OF KPC HYDRAULIC TRANSMISSION

Symptom	Cause	Remedy
Over heating	a. Insufficient heat exchanger capacity. b. Insufficient cooling water flow. c. Clutch slipping. d. Oil level too high. e. Improper oil. f. Clutch plates warped	a) Install heat exchanger of sufficient capacity. b) Check pipe lines and heat exchanger for clogging. Check correctness of pipe size used. c) Low clutch oil pressure (see low oil pressure). d) Correct oil level. e) Use only recommended oils. f) Replace clutch plates.
Low oil pressure	a) Clogged strainer. b) Stuck pressure regulation piston in selector valve assembly. c) Broken piston rings in clutches. d) Damaged or worn oil pump assly. e) Clogged or plugged orifice plate in selector valve assembly. f) Low oil level. g) Foamed oil.	a) Remove & clean strainer . b) Remove selector valve assembly and clean piston. c) Disassemble clutches and replace piston rings. d) Remove oil pump. Replace damaged /worn assly. e) Remove orifice plate and clean f) Add. oil to maintain proper oil level. g) Check for air leak in suction line.
No oil pressure	a) Faulty pressure gauge b) Low oil level or empty sump . c) Fully clogged oil strainer. d) Damaged oil pump.	a) Replace pressure gauge . b) Check gaskets, seals for leakage. Replace parts causing leakage. Maintain correct oil level. c) Remove & clean it. d) Replace oil pump.
Poor performance	a) Low oil pressure. b) Improper oil. c) Clutch slipping	a) Add oil to maintain oil level. b) Use recommended oil . c) Disassemble clutch assemblies.check clutch plates and replace worn-out or damaged plates.

Excessive Noise	a) Air leak in suction line of the sump. b) Bearing failure	a) Check and tighten all joints. Replace damaged end fittings/hoses /pipes. b) Disassemble transmission. Replace damaged bearings.
Neutral	a) clutch plates warped.	a) Replace clutch plates.

20.0 KPC Axle Drive Maintenance Schedule

1. Periodic maintenance

Daily - Check oil level daily. It should be at the upper mark. Refill the oil, if the level has dropped below the minimum mark. Be sure to use the same oil brand.

Check the bolts and screws and re-tighten if necessary. Inspect the torque reaction rod assembly and its mounting to base frame.

2. Every 375,000 Kms

Subject all parts to an intermediate inspection. Check the bearing pattern on the bevel gear drive. Check the taper roller bearings for proper axial clearances.

3. Every 750,000 Kms.

Subject all components to a major inspection and replace if necessary.

4. Oil Change

After a new axle drive has been in use for 50 Hrs., the oil must be changed. Further oil change must be made after every 6000 Hours of operation.

Remove the oil drain plug to drain the oil from the drive. If excessive metal particle are detected on the magnetic plug or in the oil, it shows that some components have rubbed each other. Open the axle drive and inspect, Remove the plunger type pump and clean pump strainer.

Clean the housing from oil sludge. Replace the drain plug. Fill with new filtered oil through the filler neck.

5. Axial clearance check, Tapered Roller Bearings:

Proceed in accordance with the guidelines and instructions. The bearing clearance must be maintained.

6. Check of Bearing Pattern, Bevel Gear Drive:

To enable this inspection the axle drive must be opened. Lightly coat three or four teeth on bevel pinion with blue coloring. Rotate the driven gear by hand. Check the bearing pattern on the contact surfaces. The bearing pattern should be centered on the working surface or pointing a little toward the minor diameter. If the bearing pattern falls short of this requirement, readjust.

BRAKE SYSTEM

21.0 Air Pressure System

21.1 Introduction

Air pressure system in the Tower car mark III carry out the following operations -

i) Operation of the brake cylinders

ii) Control system

iii) Signal Horns

iv) Parking brake

When the power pack of tower car works, the entire air pressure system is charged by the integrated diesel engine air compressor. The main reservoir pressure is kept between 7 to 8 kg/cm2 with the help of governor, time relay auto drain valve (fitted with main reservoir) and unloader. There is one another Safety valve set at 9.5 kg/cm2 which can save the air pressure system in the worst case, when the usual safety valve (unloader and auto drain valve with time relay) fails.

Duplex pressure gauges have been provided in both the Driver's cabins which will show the M.R. and B.P. of the air pressure system. Two nos. gauges have been also provided in the Driver's cabin to show the Brake cylinder pressure when brake is applied. Another two nos. gauge have been provided for control system (one in each Driver's.'s cabin) One no. of pressure gauge has been provided on control box which will show the actual pressure receiving by the control system. There is one air pressure oiler fitted with service pipe line to control box to facilitate the lubrication of pneumatic valves and equipment fitted in control board.

Condemned water from the system can be removed by means of drainage valve provided in air supply tanks. There are 4 nos. of brake cylinders (one for each wheel) to facilitate perfect brake on the tread of wheels from both sides.

There are two spring brake actuators provided specially for parking brake. It can park the Tower car when there is no air in the system. In the normal running condition due to air pressure, brakes are in the released condition.

It will function as emergency brakes when the air pressure drops below the spring break hold off pressure, the spring pushes the piston and the push rod out to apply the brakes.

21.2 Important valves and their functions.

21.2.1 C3W distributor valve

The C3W distributor valve consists of the following major parts.

i) Main valve
ii) Quiere service valve
iii) Inshot valve
iv) Cut off valve
v) Double release valve
vi) Auxiliary reservoir check valve
vii) Freight to passenger change over device or lock.
viii) Application and release chokes

21.2.2 Operation

The compressed air from brake pipe charges into (CR) control reservoir of the C3W valve and auxiliary reservoir (AR) through cut off valves. When the BP pressure is reduced by the Driver's brake valve due to differential pressure across the main valve diaphragm, the hollow stem lefts and allow AR pressure into B.C (brake cylinder) through inshot valve. The B.C pressure also acts on top of the upper diaphragm bringing the main diaphragm assembly down wards and finally to cap position. In this position B.C pressure is held against permissible leaks. Every time B.P. pressure is reduced in steps this phenomenon repeats.

The quick service valve helps in quick propagation of B.P (Brake pressure) reduction through the length of the train also. When the B.P. (Brake pipe pressure) is increased by Driver's brake valve, the hollow stem of main valve is brought to normal position by neutralizing the pressure differential across the main valve diaphragm and the B.C. pressure is released through the hollow stem to the atmosphere. As in the application, the upper diaphragm balance against upward force and comes to the lap position. Every time B.P. pressure is increased in steps, this phenomenon repeats.

There is on lever provided in C3W valve, by pulling it, the brakes can be released manually. The passenger freight change over device helps to achieve required brake application and release timings depending on the type of service either freight on passenger.

22 Spring brake actuator

Function

To produce braking forces at the wheel for parking brake

Operation.

In the normal running condition the chamber air is pressurized and the piston compresses the spring and the brakes are in released condition.

23 Spring brake application (Parking brake):-

When the air pressure in the Chamber is depleted, the spring pushes the piston and thereby the push rod out and applies the brakes through the slack adjuster.

24 Emergency brake:-

When the system air pressure drops below the spring brake hold off pressure, the spring pushes the piston and the push rod out to apply the brakes through the slack adjuster.

Mechanical Release:-

To release the brake temporarily for towing the vehicle, the wind off nut is unscrewed after loosening the lock nut, thus retracting the push rod.

Brake Cylinder:-

In tower car 4 nos. of brake cylinders have been used which have been fitted at rear end and front end. One brake cylinder works on each wheel.

When C3W valve BC lines operates, the air pressure rush into the cylinder and compress the spring and ultimately push out the piston and apply the brake on wheels treads from both sides with the help of mechanical levers and brakes shoes. If the driver release the brake with the help of auto brake valve A9,the pressure is released by C3W valve as well as through shut off vent type.

25 Auto Brake Valve (A-9 Automatic Valve):-

It is valve by which drivers can apply the brake to the tower car as well as release the brake to run the vehicle (Tower car)

Description

The A-9 Automatic Brake Valve is a compact self-lapping, pressure maintaining brake valve which is capable of graduating in

application or release of tower wagon brakes. The A-9 Automatic Brake valve has five positions: Release, minimum Reduction, Full service, over - reduction and emergency. The full service application position is preceded by a zone in which brake pipe air is supplied or exhausted in proportion to brake valve handle movement through this zone, thus providing the graduation of an automatic application or release of the tower wagon brakes.

The A-9 Automatic Brake Valve consists of a self-lapping regulating portion, which supplies or exhausts the brake pipe pressure and a vent valve which is actuated only when the brake valve handle is placed in Emergency position for the purpose of venting brake pipe pressure at an emergency rate.

26 Double check valve

Function

To charge central line in a selected manner from two independent sources.

Operation

When a pressure differential exists between the two end ports, the higher air pressure forces the check valve over to seal against its seat on the low-pressure side. This closes the passage between the low pressure port and the common port in the body. Air then flows from the high-pressure port through the common port to the device under control.

27 A1 Check valve

Check valves are used in pneumatic brake system to allow - compressed air to flow in one direction only. The A1 check valve is metal seated check valve and is used in compressor delivery line. When compressed air flows in the right direction, the valve of the check valve lifts by the upward air force acting underneath the valve and allows air to pass through the outlet connection. In case of reverse flow, the valve is pressed on its seat tightly due to air pressure acting on top face of the valve.

28 Safety Valve

The J1 safety valve is installed vertically in the main reservoir system, vents pressure at a pre determine setting to atmosphere in order to prevent excessive main reservoir pressure build up.

29 Automatic Drain Valve

The automatic drain valve automatically discharges precipitated moisture from a reservoir with each operating cycle of the control device.

30 J air filter

The J-air filter function to assist in preventing the passage of dirt and moisture which may be mixed with the air flowing from the main reservoir into the air brake equipment.

31 MAINTENANACE OF THE VALVES

Cleaning, Inspecting and Repairing

- With the brake valve completely disassembled, all parts must be cleaned and inspected.
- All the parts (excepting rubber parts) must be washed in a suitable solvent that will dissolve oil or grease and permit all the parts to be thoroughly cleaned without abrasion. The exterior of the body must be thoroughly cleaned by means of a cloth or rag saturated with a suitable solvent.
- All Gasket, Diaphragms, and "O" rings must be replaced.
- All Packing rings should be replaced.
- Clean all springs using a wire brush and suitable solvent and inspect for pitted marks distortion, or permanent set. Replace where necessary.
- Replace all parts that are cracked, broken, worn excessively, damaged or in such a condition as would result in unsatisfactory operation.
- The spring may be wire brushed to assist in the removal of rust and scale. After cleaning, blow all metal parts with a low pressure jet of clean and dry air.
- Promptly blow the parts dry with low pressure jet of clean and dry air.
- Discard the filter unit and replace with a new one.
- Inspect all other parts. Reject and replace any part that is cracked, cut damaged, worn excessively or is in such a condition that would result in unsatisfactorily operation.
- The spring must be replaced if it is rusted, distorted or has taken a permanent set.
- Frequency of overhauling of valves is to be decided by depots depending upon the utilization of tower wagon. However overhauling is to be carried out at least once in year.

NOTE : All the gauges and meters are to be calibrated once a year.

MAINTANANCE GUIDELINES AND SCHEDULE (CARRIAGE PART) OF 4 -WHEELER TOWER CAR

1.0 BODY REPAIRS

(i) Inspection and repair of body members are done after the Tower Car body is lifted off the wheels and axles are placed on trestles.

(ii) All furnishing and other components from coach shell, which are stripped, are to be sent to the respective sections for maintenance.

(iii) For major repairing work all the equipments (under slung, onboard and roof mounted) shall be removed from the Tower Car.

2.0 INSPECTION OF UNDERFRAME

(i) The underframe members should be thoroughly inspected for locating cracked/bent/corroded members. Corrosion is indicated by flaking of paint of metal, pitting and scale formation. Components like sole bar and trough floor which are not visible from both sides should be examined by tapping with a spiked hammer , Proper illumination will be required to carry out the check. A component will require repair / replacement if it has lost more than 20% of its thickness.

(ii) The underframe and shell members are categorized as vulnerable and not so vulnerable areas for corrosion.

(iii) Particular attention should be paid to the vulnerable members and locations listed below: -

- Sole bar, body pillars, and trough floor.
- Sole bars, body pillars above lifting pads.
- Sole bars and pillars behind the door pockets.
- Sole bars and pillars at the door corners.
- Head Stock
- Sole bars and pillar.

(iv) Procedure for inspection of underframe members for corrosion attention is laid down in RDSO technical pamphlet No C-7602.

2.1 SOLE BAR, BODY PILLAR

(i) Examine visually supplemented by tapping with a spiked hammer sole bars, body pillars in the bays under after removing the accumulated dirt and cleaning the surface.

(ii) If incidence of corrosion is noticed in the bottom half of the sole bar, the trough floor should be cut to a width of 300 mm and requisite

length for examination of inside top half.

(iii) If heavy corrosion is noticed, the sidewall should be cut to a height of 500mm from the bottom of covering sufficient length and all the exposed parts, after scraping and cleaning should be examined to determine the extent of corrosion.

2.2 SOLE BAR AND PILLAR ABOVE THE LIFTING PADS

(i) Examine the above members in the same manner as described in clause 2.1 above.

(ii) If signs of corrosion are noticed, the sidewall sheet above the lifting pads should be cut to a height of 500mm. above and to a length of half meter, on either side of lifting pads. Scrape the structural members, clean and examine minutely to ascertain the extent of corrosion.

2.3 SOLE BAR AND PILLAR AT THE DOOR CORNERS

Examine the above locations visually. If corrosion is noticed, cut to a width of half meter from the door corner. Remove accumulated dust. Structural members should be thoroughly scraped, cleaned and examined to assess the extent of corrosion.

2.4 SOLE BAR & BODY PILLAR AT LOCATIONS OTHER THAN DESCRIBED ABOVE

(i) Examine visible portion of sole bar through the end from above of the underframe.

(ii) Remove the accumulated dust and scrape structural members to the extent possible. If corrosion is noticed, sidewall sheet in the area of corrosion should be cut to a height of 450mm from the bottom of covering for sufficient length for thorough examination.

2.5 HEAD STOCK

(i) Examine visually inner headstock, outer headstock, stiffening immediately behind the buffers and the junction of the sole bar at the headstock for incidence of corrosion.

(ii) Examine carefully the base of buffer assembly as corrosion has been primarily noticed at this location.

(iii) Examine carefully the buffer base of headstock by chalk test or sound test for cracks and dents. Buffers fixing holes should not be elongated and no minor cracks to be allowed. Replace headstock if the wear is more than 4 mm i.e. when the thickness is below 4mm.

2.6 TROUGH FLOOR

(i) Examine the trough floor in the bays adjoining the wash basin and from below for signs of corrosion, supplemented by tapping with a spiked hammer.

(ii) If signs of corrosion are noticed in the above examination, the part should be thoroughly cleaned by scraping and an intensive inspection should be carried out to detect the extent of corrosion in the trough floor.

2.7 CORROSION REPAIRS TO UNDERFRAME MEMBERS

(i) Corrosion repairs shall be carried out as per instruction laid down in RDSO technical pamphlet nos. C-7602

(ii) It is essential to use corrosion resistant steel sheets for corrosion repairs of tower cars. Welding electrodes and paints should be of the prescribed quality conforming to the relevant IS/IRS specifications.

- Corrosion resistant steel sheet for trough floor, pillars, sidewall and roof should conform to IRS M-41.
- Electrode: IRS class A3/B2 of approved brands.
- Paints: Red oxide zinc chromate primer – IS 2074-92. Black synthetic enamel paint to IS:8662.

(iii) Where the corrosion noticed is of a very minor nature and has just started, there is no need to renew the parts. In those areas, the paint and the rust should be thoroughly cleaned to reach the bare metal and the surface treated with two coats of red oxide zinc chromate primer to IS:2074-92 to a DFT of 50 microns followed by two coats of black synthetic enamel paint to IS:8662 to a DFT of 40 microns

(iv) Where the corrosion repairs are carried out on the underframe or its paint coat is damaged, the underframe should be painted with two coats of red oxide zinc chromate primer to IS:2074-92 to a DFT of 50 microns followed by two coats of black synthetic enamel paint to IS:8662 to a DFT of 40 microns.

(v) For carrying out corrosion repairs to underframe members, the Tower Car body should be lifted off the Wheels & axles and kept on trestles. For repairs to sidewall and end wall, no lifting is required.

2.8 Head stock

For replacement of headstock, the following parts need to be stripped first:

- Side buffers
- Compreg board and Aluminum chequered sheet flooring
- End partition and electrical wiring
- Draw gear assembly
- End portion of BP/FP

Before the corroded portion is cut off, the auxiliary headstock and the two sole bar ends should be firmly supported on trestles. The corroded headstock is then replaced as per annexure-v of RDSO technical pamphlet No. C-7602. Only corrosion resistant steel (IRS M-41 or IS:2062 Fe 410 Cu WC) should be used for head stock repairs.

2.9 SOLE BAR

For carrying out repairs to sole bar, it is necessary to strip first the interior fittings, laminate paneling and window frames. Before cutting off the corroded portion of sole bar, both the adjacent ends should be supported on trestles. The new sole bar piece should be welded from outside and inside. To facilitate welding from inside, the Tower Car body should be lifted and kept on trestles.

2.10 CORROSION REPAIR OF SOLE BAR

Repairs to sole bar for replacement of corroded portions at the locations mentioned below should be carried out as per Annexure-II of RDSO technical pamphlet No. C-7602

2.11 SIDE WALL MEMBERS

For repairs to side wall sheets, the interior fittings, laminate paneling and window frames should be stripped first. Corrosion repair of side wall sheets and body pillars should be done as per annexure-III of RDSO technical pamphlet No. C-7602.

2.12 TROUGH FLOOR

For replacement of trough floor, first Compreg board and Aluminum chequered sheet flooring needs to be stripped. Corrosion repairs to trough floor should be done as per the annexure-IV of RDSO technical pamphlet No. C-7602.

2.13 ROOF

a) Roof repairs

Tower car, roof should be checked for corrosion. Special attention should be paid at location where gutter mouldings are

welded and ventilators bolted. Corroded roof should be repaired according to the instructions given in annexure VII of RDSO technical pamphlet no. C-7602.

b) TRA type roof ventilators repairs

(i) Examine the roof ventilator for damage or corrosion or leakage. If no corrosion is observed then seal the joints and crevices with waterproof sealing agent as per IS/IRS Specification. Ventilators found beyond repairs should be replaced as per RDSO technical pamphlet no. C-7602, Annexure-VII.

(ii) After repairs and refitting, ventilators should be tested for water leakage at their base joints at the time roof testing.

c) Roof testing

Tower car after POH repairs should be tested under water spray for roof leakage before they are finally turned out from the workshop. For this purpose, a fixture designed to simulate monsoon conditions should be provided in the workshop.

2.14 REPAIRS TO DOOR HANDLES

Examine the door handle for breakage, damages. If the fixing bolts are loose or missing, tighten the bolts. Replace the door handles, which are found beyond repairs.

2.15 REPAIRS OF BODY SIDE DOOR

The body side doors shall be repaired as per annexure VIII of RDSO technical pamphlet no. C-7602

2.16 REPAIRS TO DOOR PIVOTS

Examine the door pivots for corrosion, breakage or wear by cutting the bottom portion of outer panel. Cut the corroded portion of the door pillar (Z molding) and weld new piece joining the door pivot pin. If the female socket is worn or damaged beyond repairs then replace it. Replace the bush provided in the socket.

2.17 REPAIRS TO PARTITION WALL PILLAR/MOUNTING PLATE

Examine pillar/mounting plate for corrosion or breakage, etc. at bottom ends. If found corroded, repair the same as per RDSO technical pamphlet no. C-7602

2.18 REPAIRS TO DRAW AND BUFFING GEAR SUPPORT STRUCTURE

(i) Examine the draw gear support structure for corrosion, breakage, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or gusset plate with new support angle.

(ii) Similarly examine the buffing gear support structure for corrosion, breakage, etc. if the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or stiffeners.

(iii) Examine the body bolster for corrosion, breakage, wear, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakage or wear are beyond repair, replace the body bolster. Check the area surrounding centre pivot pin mounting holes for cracks.

2.19 WATER TANK SUPPORT STRUCTURE

Examine the water tank support structure for corrosion, breakage, wear, etc. if the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded angle with new angle of suitable size as per the requirement. Replace the rubber/wooden packing if perished or damaged.

2.20 REPAIRS TO THE FLOOR CHANNEL

Examine the floor channel for corrosion, breakage, wear, etc. by cutting open the Compreg board and Aluminum chequered sheet flooring where the corrosion is suspected. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded channels with new channel of suitable size as per the requirement.

2.21 GENERAL

(i) All repairs of cracks should be carried out by gouging and welding by suitable electrodes.

(ii) CAUTION: No electric welding on the Tower Car should be carried out without proper earthing from near the portion being welded. And in no case the earthing through Axle box/wheels and rails shall be permitted. In the absence of such earthing, the return current passes through axle roller bearings causing pitting of rollers and bearing failure in

service.

(iii) Distorted and bent parts should be heated and straightened.

(iv) The parts used for repairs should be given proper surface treatment and applied with protective paint. Relatively thick sections such as sole bars, cross bearers, etc. should preferably be grit blasted and immediately thereafter given a protective coat of red oxide zinc chromate primer paint.

(v) Welder's Qualification: Welders deputed to carry out welding work on coaches and coach components should be only those tested and certified as adequately skilled for welding work on coaches and coach components.

2.22 LIST OF TOOLS AND PLANTS

Lifting shop	Corrosion repair shop
1. EOT cranes	1. EOT cranes
2. Trestles for Tower Car body	2. Trestles for Tower Car body
3. Inspection torches	3. Gas cutting plants
4. Spiked hammers	4. Multi-operator welding plants
5. Ball peen hammers	5. CO_2 welding plant
6. Goggles for inspection staff	6. Electrical angle grinders
7. Measuring tape	7. Pneumatic hand grinders
8. Measuring scale	8. Component painting equipment
9. Safe guard for safety of heads of inspecting staff.	9. Phosphating plant

2.23 Examination and repair practice in maintenance depot shall be as per Annexure – IV.

Annexure -II

SUSPENSION, WHEEL & AXLES

1.0 BRIEF DESCRIPTION OF SUSPENSION

Suspension arrangement for 4-W Tower car (Except Mark-III) consists of helical springs working in parallel with hydraulic shock absorbers. Axles with their self-aligning spherical roller bearings mounted inside cast steel axle boxes are guided by axle guide assemblies.

Following are leading particulars of the 4-Wheeler Tower car:-

Particulars	4-Wheeler Tower car				
	BEML/PHOOLTAS/ VENTRA		BHEL	JAMALPUR	
				Mark-III	Mark-IV
Rigid Wheel Base	6100 mm	6100 mm	6100 mm	6100 mm	6100 mm
Diameter of wheel on Tread.	915 mm.	915 mm.	952 mm	952 mm	915 mm.
Axle Load	16 t	16 t	16 t	16 t	16 t

2.0 FEATURES WHICH CONTRIBUTES TO IMPROVED RIDING COMFORTS (Except Mark III)

Axles mounted on self-aligning spherical/cylindrical roller bearings, with helical springs working in parallel with shock absorbers of specified characteristics have all contributed to superior riding comforts. It is therefore, essential to ensure that these features are well maintained in service so as to obtain the desired performance throughout the life of the 4W-Tower Car.

Riding comfort offered by the 4W-Tower car depends exclusively on above design features and unless they are properly maintained and attended during periodical maintenance schedules & overhauls, riding deteriorates leading to subsequent heavier and costly maintenance.

3.0 OVERHAULING (Except Mark III)

TOWER Car suspensions are designed for good riding comforts with the help of self aligning spherical roller bearings, hydraulic shock absorber, helical springs for suspensions. Proper handling and maintenance of these will result in longer life and satisfactory service performance.

Tower Car requires to be given thorough periodical over haul (POH). The intermediate overhaul (IOH) as per the details given in Annexure-IV. While carrying out the overhauls instructions as given in the following paragraphs should be strictly followed.

3.1 LIFTING THE BODY OFF THE SUSPENSION (For all OHE Car)

Tower car body can be lifted off the suspension by either:

(i) Two electric cranes of minimum 10t capacity each with suitably designed swings and cradles, or

(ii) Four Hydraulic/electrical lifting jacks of 10t capacity each simultaneously operated by single control switch. The 4-W Tower Car should not be lifted from any other point but from lifting pads.

Note: Under no circumstances a lifting jack or sling should be applied on at any other location except on lifting pads in the workshops.

(iii) Cranes or jacks used for lifting should be operated uniformly and simultaneously without jerks, before lifting the 4-W Tower car, following components should be disconnected.

(a) Propeller shaft (For Diesel Hydraulic) coupling connecting axle drive
(b) Standstill detector connected on axle drive
(c) Speedometer cable connection on axle drive
(d) Disengage all axle box safety straps
(e) Torque arm assembly connecting axle drive and underframe
(f) Shock absorbers connecting axle box and underframe
(g) Brake tie members and brake block hanger bracket
(h) Safety chain link connection axle drive with underframe
(i) Motor connections (For Diesel Electric Tower Car)

Note: Before finally lifting 4-Wheeler Tower car body, the axle drive should be supported by steel/wooden blocks of requisite thickness, so as to avoid the axle drive from overturning in case of hydraulic transmission.

Tower Car should never be lifted from one end only as the axle guides and lower spring seats are likely to suffer damage and dents may occur on body panel. The 4-Wheeler Tower car may be lifted by means of a crane or screw jacks as mentioned above till all the 8 guide

bushes disengage from the lower springs seats and wheels are rolled out.

3.2 ATTENTION TO SUSPENSION COIL COMPONENTS (Except Mark III)

Following attention should be paid to 4-W Tower car suspension components during POH before assembling them.

(i) After through cleaning check for any possible cracks, particularly at places where axle guide flanges and safety strap bracket are welded. Circlip groove should also be checked for damages. Normally squareness and alignment of axle guide does not require checking. If biased wheel flange wear or wear in the rear cover of the roller bearing axle box have been observed, the squareness of guides and their alignment should be checked thoroughly with the help of alignment gauges. In the event of misalignment of axle guides or damaged guides, which require replacement, following procedure may be adopted.

(a) Whenever a axle guide is damaged it is to be replaced.

(b) Where the measurements of guides shows a deviation from the dimension given in fig.1 (Applicable for BEML 4 Wheeler Tower Car only .For other make of tower cars their Trammeling Drawing can be obtained from their respective manufacturer). The concerned pair of guides should be cut and re-welded in position. Guide should always be cut in pairs, as the adjacent guide distance has to be maintained. In case of BEML it is 630 ± 1 mm .

(c) While cutting out guides, care should be taken that only weld metal is cut and guide flange or underframe is not damaged.

(d) Guides which are cutout, need not be scrapped but the flange periphery should be built up by welding wherever spoiled or pitted by gas cutting and ground to shape, care should be taken not to damage the circlip groove of the guide cap.

(e) For re-welding of axle guide:-

- Locate new guide with the aid of setting gauges with reference to other guides. Two gauges, one giving the longitudinal and other diagonal location in relation to other guides are sufficient to locate it. However, a third gauge be used as a counter-check. Tack weld the guide to underframe.
- Remove the gauge and complete the welding.
- Allow the frame to cool off.
- Check the dimension of the guide in relation to others with

the aid of master gauges.

- Check also the height of the guide in relation to other guides with a straight edge.
- Use low hydrogen electrodes of approved brand for welding (Electrodes under IRS Class A3/A4 may be used).
- Important dimensions to be checked after rectification.
- The crown clearance between the rubber pad and the axle box shall be as per following table.

BEML	VENTRA	BHEL	PHOOLTAS	JAMALPUR	
				Mark-III	Mark-IV
125 +0/-5mm.	130 +0/-5mm	50 +0/-5mm	92 ± 5mm	NA	110 +0/-5mm

The rubber pad is to be adjusted every time the timber packing are inserted between the lower spring seat and the lower rubber washer to compensate tyre wear, so as to obtain the prescribed clearance between axle box crown and the rubber pad.

3.3 WHEELS AND AXLES (For all Tower Cars)

(i) The leading dimensions of powered wheels and axles set should be checked as per respective drawings of different manufacturers as mentioned in Annexure III These wheels are clearly marked with their axle capacity and should not be interchanged with other wheels under any circumstances

(ii) The wheel profile should be checked to RDSO SK. No.91146 Alt.3 profile Fig. 2 If the profile is found worn out, it should be re turned.

(iii) Variation in the tread diameter of the wheel on the same axle should not exceed 0.5mm. Large variation in wheel diameter will lead to biased flange wear. The variation in wheel diameter between one pair of wheels and the other should not exceed 13mm.

(iv) Wheel gauge should be within the tolerance of +/-1mm.

(v) Under no circumstances, wheels, which have reached the condemning, limit, as indicated by grooves on the wheel rim/tyre should be used.

(vi) In case any wheel is de-wheeled and repressed on, the pressing on pressure and the wheel gauge tolerance shown in as per respective drawings of different manufacturers as mentioned in Annexure III should be strictly adhered to and a record of wheel pressing on pressure maintained.

(vii) Weld reclamation of Axle should never be done.

3.4 ROLLER BEARINGS (For all 4 W Tower Cars)

Axle boxes are fitted with roller bearing as per Drawing mentioned in Annexure III.

(a) LUBRICATION OF ROLLER BEARINGS

The quantity of grease required to be filled in axle box during renewal is given below:
SKF bearing – 2 kg
FAG bearing – 1.5 kg

The list of approved brands of grease is given below:-

Supplier	Type of bearing	
	SKF	FAG
IOCL	Servogem 3	Servogem 3
HPCL	-	Lithon 3
BPCL	-	Polypak 3

Different types of grease should not be mixed together.

(b) INSPECTION OF ROLLER BEARING (For all 4 W Tower Cars)

(i) Thoroughly clean the exterior of axle box and then remove the front cover from the body casting.

(ii) Examine the grease, if it is discoloured fully, bearing should be dismounted and thoroughly inspected. If the grease is in good condition, bearing need not be dismounted, but be washed and cleaned in position with petrol or white spirit.

(iii) When dismounted, scoop out all accessible grease by the hand and by using a rubber scraper take out all grease. Wash the bearing with spirit or petrol.
Ensure that tracks, rollers and cages of bearing are free from damage. Measure the bearing clearance using a feeler, if the roller and tracks are not pitted or flaked and cage is not worn, In case of Spherical roller Bearing check that rollers do not fall out when the outer ring is swiveled at an angle, bearing is in good condition. The following bearing clearances for new as well as in service self-aligned spherical roller bearing for BG Tower Cars may be followed:-

Bearing Make	Radial Clearance in un-mounted condition (mm)		Radial Clearance in mounted condition (mm)	
	New Bearings	In service bearings	New Bearings	In service bearings
FAG/NORMA	0.145 - 0.190	0.270 Max.	0.080 - 0.160	0.220 Max
NEI/NBC	0.145 ~ 0.190	0.295 Max.	0.080 ~ 0.160	0.245 Max

(c) DISMANTLING

Roller bearing can be dismounted as described below:

(i) Straighten the folded tabs of the triangular locking plate, unscrew the hexagon and screws holding the securing cup. Remove the securing cup. Then push the injector adapter ring on the journal against the bearing and clamp it firmly against the bearing inner ring. Connect the oil injection pump capable of developing a minimum pressure of 740kg/sq.cm to the adaptor ring and pump in thick cylinder oil, so that a film of oil is formed between the bearing and the axle journal. Remove the adapter ring as soon as the oil firm is formed. Fit the withdrawal tool over the bearing outer ring, then push the locking ring forward, so that the claws of the sleeve engage the inside face of the bearing outer ring. Due to oil film between the journal and inner ring the bearing can be easily dismounted by turning the withdrawal screw.

(ii) After removing the bearing, remove the rear cover and the sealing ring.

(iii) Wash and examine the bearing and other components.

(d) FELT SEALING RING

The felt sealing ring should be examined and if found damaged, replace it. However, it is advisable that every alternate POH, the felt ring is renewed.

(e) MOUNTING OF ROLLER BEARING AND AXLE BOX

(i) Soak felt ring in cylinder oil to IS:1589-60 Type-I Gr-3 heated to 40^{o}C - 50 ^{o}C for 30 minutes and fit in the groove in rear cover.

(ii) Clean and examine journal and ensure that threaded holes for locking screw are perfect.

(iii) The collar may be shrunk fitted on axle journal after heating the collar in a neutral oil bath or by an Induction heater, with the help of a mounting sleeve. Make sure that the collar firmly butts against

journal shoulder.

(iv) Fit the rear cover with four bolts alongwith rubber 'O' ring and felt sealing ring in position. Fill in the 'V' grooves and the cavity in the rear cover upto the face of the ring with approved brand of grease.

(v) Heat the roller bearing in a hot oil bath or an Induction heater and slide it over the journal carefully with the help of a mounting tool. Push the bearing forward till it firmly butts against the ring. The stamped face of the bearing should be kept outwards while fitting the bearing so that the stamping can be seen during inspection. After the bearing cools off, pack the bearing with grease.

(vi) Assemble the required securing cup and lock plate with hexagon screw The securing screw is locked by bending over the tabs provided in the locking plate against flat of bolt heads.

(vii) Liberally, smear inside of axle box with grease and fit it over the bearing. Put the required front cover with sealing rings and tighten up bolts and lock the nuts with split pins.

(viii) Check if the axle box can be rotated freely by hand.

The working space for mounting and dismounting of roller bearing must be absolutely clean and the table on which roller bearings are cleaned must be free from iron filings, dust, etc. Kerosene oil may be used for cleaning the roller bearing and journals. The cleaning bath should be changed every time to keep it free from dust and foreign matter. Steel trays with lids should be used for cleaning roller bearing.

3.5 AXLE BOX HOUSING

Roller bearings are housed in accurately machined cast steel axle boxes. The axle boxes are also provided with cast iron Front cover and light alloy back covers secured by four bolts. Axle boxes and covers should be thoroughly cleaned and checked for cracks particularly at the bolt holes of the covers, which have shown proneness to failures. The bolts should be examined for worn threads, straightness etc. before reuse and should be well tightened and locked by spring washers and split pins to ensure that the covers and the axle box housing form a water-tight assembly and protect bearing from dust and moisture.

3.6 AXLE BOX SPRINGS (Except Mark –III)

Axle box springs are as per respective drawings of different manufacturers as mentioned in Annexure III manufactured as per RDSO spec. WD-01-HLS-Latest Revision/Amendment. It is necessary to check

these springs for cracks and measure their free height to ensure that they meet the design requirements.

All the springs shall be grouped in categories and used on bogies as per instructions detailed in RDSO technical pamphlet no.C-8419 (latest revision/amendment).

Top and bottom faces of these springs should be ground parallel if necessary as both ends bear against flat surfaces and the inclination in vertical axis corrected to fall within the tolerances specified on their respective drawings

3.7 LOWER SPRING SEAT (Except Mark –III)

Lower spring seat on axle box wing in which guide bush moves up and down does not normally wear in service. If the surface is worn more than 0.4mm in diameter or if the surface is scored or other wise damaged, the lower spring seat should be replaced. The lower spring seats should be carefully checked for cracks before reuse. During POH clean the inner surface of lower spring seat and smear all-round the honed face with Axle box roller bearing grease.

3.8 AXLE GUIDE ASSEMBLIES (Except Mark –III)

Axle box set guides are accurately machined and welded to the underframe to ensure that the wheel set are guided in parallel, these guides are fitted with bushes at the lower end to guide the wheel set both in lateral and longitudinal direction.

Following components which form the axle guide assembly should be thoroughly examined and renewed as indicated:

1.	Guide	Circlip groove is damaged.
2.	Upper spring	Damaged, dented or seat or protective tube cracked
3.	Dust shield	Distorted or broken spring or otherwise defective
4.	Dust shield	Examine at every POH change if required
5.	Guide ring	Cracked broken or worn
6.	Circlip	Replace if bent or worn-out
7.	Guide bush	Worn out more than 1.2mm in diameter
8.	Lower rubber	Distorted or damaged
9.	Upper rubber	Distorted or damaged washer

In case of the total diametric clearance is more than 1.6mm between the guide and the lower spring seat based on maximum bore diameter

and minimum bush diameter the component worn out should be replaced.

l) SHOCK ABSORBERS (Except Mark –III)

Hydraulic shock absorbers are set to offer resistance as per following table. Shock absorbers are fitted to work in parallel with axle springs. These shock absorbers normally give trouble-free service and require no attention in between two POHs

BEML	VENTRA	BHEL	PHOOLTAS	JAMALPUR	
				Mark-III	Mark-IV
250 kg / 10cm/sec	275 Kg/ 10cm/sec	475 kg /10cm/sec	250 kg /10cm/sec	NA	250kg/10cm/sec

However, a shock absorber, which is found either leaking or physically damaged, should be renewed. As the resistance of these shock absorbers is likely to deteriorate in service, it is necessary to attend to them. The shock absorbers can be got overhauled from their respective manufacturers, tested and renewed as and when required.

3.10 ACTION TO BE TAKEN BEFORE REASSEMBLING THE SUSPENSION (Except Mark III)

After attending to the various components as detailed above the suspension may be reassembled taking into consideration the following aspects.

(i) The two wheel and axle sets selected for the 4-Wheeler Tower car should not have variation of more than 13mm on tread diameter
(ii) The two pairs of axle box springs selected for each axle should not vary in their tare height by more than +/-3 mm and their load deflection characteristics should be as per RDSO specification WD-01-HLS (Latest revision/Amendment).
(iii) Packing rings of requisite thickness to be selected for use on lower spring seat for taking up the wheel wear.
(iv) Top and bottom rubber pads on the axle box spring should not be used again if they are not in good condition.

3.11 SEQUENCE OF REASSEMBLING THE SUSPENSION (Except Mark –III)

(i) Assemble the roller bearing and axle boxes and ensure that the bearing is effectively secured.
(ii) Smear the honed surface of lower spring seat with roller bearing grease. Place the lower rubber washer on axle box wing and insert the helical spring on the lower springs seats with rubber ring and compensating ring. Wooden packing to be added if required to compensate for wheel wear.
(iii) Insert upper rubber washer, top spring seat, dust shield spring, dust shield, guide ring and guide bush on the axle box guide and lock the bush in the position with circlip.
(iv) Lower the 4-W Tower car body on the wheel and axle sets taking care to ensure that all the 8 guide bushes engage lower spring seat and the body is set evenly on the 4 axle boxes.
(v) Assemble propeller shaft coupling connecting with axle drive.
(vi) Assemble torque arm connecting axle drive with underframe.
(vii) Connect speedometer cable and standstill detector.
(viii) Engage all axle box straps.
(ix) Shock absorbers connecting axle box and underframe to be bolted.
(x) Connect brake tie members and brake block hanger bracket with pins.
(xi) Touch up the paint on the suspension with one coat of anti-corrosive black paint.
(xii) Connect TM cable in case of Diesel Electric Tower Cars.

4.0 RUNNING CLEARANCES (Except Mark –III)

After assembling suspension and lowering 4-W Tower car body, the clearances between the 3.2) above & to be maintained accordingly. Suitable packing shall be used to maintain dimension when wooden packing is given on axle box to compensate for wheel wear.

5.0 ATTENTION REQUIRED FOR SUSPENSIONS ON OPEN LINES AT DEPOTS.

(i) Lifting the body off the suspension, instruction contained in para 3.1 above should be strictly adhered to while lifting the body off the suspension.
(ii) Sick lines should not try to weld a damaged axle box guide or replace the same. The 4-Wheeler Tower car should be sent to workshops for welding the guide and checking the alignment of guides.

(iii) The instructions contained in Conference Rules, Part IV for the examination of wheel profile, axle should be strictly adhered to. Wheel sets showing biased flange wear, i.e. one flange wearing faster than the other should be with drawn from service and sent to shops for examination and rectification. 4-W Tower car have been provided with 16 tonnes wheel and axle sets, which are marked clearly on the wheels. It is important that these wheels are not mixed up with the 13 tonnes axle wheel assembly, which is used on other stocks.

Note: Max. permissible flat on wheels of these coaches should be limited to 50mm.

(iv) Roller bearing should not be attended to in sicklines. All that would be necessary in service is to feel the axle boxes at train examining stations for any tendencies on their part to get overheated. If any axle box shows a tendency to run hot, the 4-Wheeler Tower car should be sent to shops for attention.

(v) Four bolts securing the rear and front cover of the axle box shall be examined to ensure correct assembly with spring washer and split pins.

(vi) Whenever a spring is to be replaced, it should be ensured that the variation in the height of the spring with respect to the other springs forming the suspension already on the 4-W Tower car should not be more than 6 mm. Difference upto 6mm should be made by insertion of suitable steel packing.

(vii) For this purpose, it is necessary that the sicklines should have an imprest of axle box springs duly tested and certified to conform to the instructions contained in para 3.10).

(viii) If hydraulic shock absorbers used on suspension show any sign oil leakage or other damages, the same should be replaced with shock absorber completely overhauled. For this purpose, tl sicklines should maintain 'imprest' for use as unit chan assemblies. Leaking shock absorbers should be sent to tl workshop for overhauling. The shock absorbers should be check to ensure that the bolts securing it are properly tight and locked.

(ix) The brake blocks should be replaced when worn out to a thickness of 20mm For BEML.

(x) Straps for the axle boxes, should be checked for proper securing arrangement and for adequate running clearances.

(xi) If hard wooden packing are required to be used on lower spring seats for taking up the wheel wear, the packing of proper thickness should be used.

(xii) Under no circumstances wheels, which have reached the condemning limit, indicated by the grooves on the wheel

rims/tyres should be used.

(xiii) Tower car should not be allowed to run in service with a broken axle guide or broken spring. 4-W Tower car should be immediately sent to shops for replacing the broken axle guides or broken springs.

6.0 MAINTENANCE OF GUIDE LINES FOR SUSPENSION OF 4 WHEELER TOWER CAR (Mark III)

(a) As Mark III Tower Car is fitted with laminated bearing spring unlike other tower cars. Therefore, the inspection and maintenance of the suspension system should be done as per following procedure.

S.No.	Description of item	Inspection criteria
1	Shackle	Visually examine the shackle, check the dimension for inner gap 357x62, wear limit is 1 mm for both sides.
2	Horn cheek	Visually examine the horn cheek. Check the horn gap (285mm). The wear limit of rubbing surface is 1mm.
3	Shackle pin	Visually examine the shackle pin, check the dia. of pin (Ø 35mm), wear limit is 0.5mm.
4	Suspension arrangement	The axle box housing clearance from axle guard horn is 10mm at either sides and lateral clearance is 20mm (either side)

b. LEAF SPRING REPAIR

Following procedure should be adopted for leaf spring repair of Mark - III Tower car.

(i) Physically examine whether any spring plate/buckle and spring clip are broken. The springs are tested by scragging.
(ii) Check camber and free camber whether it is within limits or not.
(iii) If any plate spring clip and buckle is found broken the same is to be replaced.
(iv) If Camber and free camber are not within limits it is to corrected.
(v) The spring is debuckled and is checked by scragging. Then spring is to be buckled. After clipping the spring is to be riveted.
(vi) Load test is to be done.
(vii) The Free camber is 146 +6 mm.

7.0 BRAKE GEAR

(i) Maximum radial clearance of 1mm between the brake gear pins and bushes is permitted. If the clearance is more, the worn out part should be replaced and the standard clearance maintained

(ii) Brake block should be replaced when they wear out to the specified thickness. For BEML the thickness is of 20mm.

(iii) An adjusting palm pull rod with holes at regular intervals is provided in the brake rigging to take up slack in the rigging due to wheel wear. Adjustment should be done by relocating the pin in different holes on the palm pull rod.

8.0 WIND SCREEN WIPER

(i) Windscreen wipers should be checked for its operation only on the wet windscreen. If wiping is not proper the wiper blade has to be replaced.

(ii) The wiper arm and blade assembly shall be to RDSO Specification No, C-K306 (Latest revision).

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Annexure III

LIST OF THE REFERENCE DRAWINGS

Following are the lists of the drawing for 4-wheeler tower Car manufactured by different vendors.

1 Drawing no. of M/s BEML's 4 Wheeler Tower Car.

SN	Description	Drawing no.
(i)	Powered wheel and axle	BEML drg. No.907-81009
(ii)	Non-powered wheel and axle	BEML drg. No.907-81010
(iii)	Axle box springs	BEML drg. No. 907-81105
(iv)	Guide	907-81002
(v)	Upper spring	907-81007
(vi)	Dust shield	903-81110
(vii)	Dust shield	411-81114
(viii)	Guide ring	903-81156
(ix)	Circlip	411-81160
(x)	Guide bush	411-81161
(xi)	Lower rubber	903-81139-P.2
(xii)	Upper rubber	903-81140
(xiii)	Bearing	SKF no.22328C/C3
(xiv)	Felt	ICF/M/D/SPEC-001

2 Drawing no. of M/s Phooltas Harsco Rail Solution Wheeler Tower Car.

SN	Description	Drawing no.
(i)	Power pack Arrangement	OHE-4 0200/00 Rev 02
(ii)	Axle Drive Gear Box	OHE-4 01 03/00 Rev.01
(iii)	Torque Arm Assembly	OHE-4 02-05/00 Rev.01
(iv)	Layout of Tower Car	OHE-4 00 02/00 Rev.02
(v)	Axle (Powered)	OHE-4 01 00/02 Rev.01
(vi)	Axle (Non Powered)	OHE-4 01 00/01 Rev. 0
(vii)	Helical Coil Spring	OHE-4 03 01/00 Rev.0
(viii)	Brake Rigging Diagram	OHE-4 07 00/00 Rev.0
(ix)	Wheel & Axle	OHE-4 01 01/00 Rev.0
(x)	Suspension Arrangement	OHE-4 03 00/00 Rev.01
(xi)	Axle Box Guide Arrangement	OHE-4 04 00/00 Rev.01

3.0 Drawing no. of M/s Ventra Locomotives Ltd., 4 Wheeler Tower Car

SN	Description	Drawing no.
(i)	Axle box assembly drawing no.	ABS 0076
(ii)	Suspension cum axle box guide arrangement	SGM 0090
(iii)	Lower spring seat and Guide	SGP 0532 & 0533
(iv)	Coil spring	SGP 0482
(v)	Brake rigging arrangement	BGM 0132
(vi)	Wheel and axles Powered	WAS 0103
(vii)	Non-powered	WAS 0104

4.0 Drawing no. of Jamalpur Workshop's 4-Wheeler Tower Car Mark III

SN	Description	Drawing no.
(i)	Suspension arrangement	SKETCH –89068
(ii)	Wheel and axle	JMP drg. No. OHE/M3/RG-02
(iii)	Axle box bearing	No.4000/22 (item 9)
(iv)	Axle box Arrangement	4000/22,4000/23,4000/24
(v)	Laminated bearing spring	SKETCH-89069

5.0 Drawing no. of Jamalpur Workshop's 4-Wheeler OHE Car Mark-IV

SN	Description	Drawing no.
(i)	Details of running gear arrangement	K1016
(ii)	Running gear arrangement	RDSO/SK-K0042
(iii)	Helical spring	SK-K1016 (item 1)
(iv)	Lower rubber washer	EMU/M-0-1-008
(v)	Guide bush	ICF/SK-0-1-182 (item 2)
(vi)	Circlip	ICF/SK-0-1-182 (item 3)
(vii)	Dust shield	T-0-1-619
(viii)	Dust shield spring	T-0-1-667
(ix)	Upper rubber washer	EMU-0-1-005
(x)	Wheel and axle set powered	SK-K1017 (item 1&2)
(xi)	Wheel and axle set non-powered	SK-K1017 (item 1&3)

6.0 Drawing no. of BHEL's 4 Wheeler Tower Car

SN	Description	Drawing no.
(i)	Wheel and axle	1 720 11 03 000
(ii)	Wheel Ø 952	EMU/M-0-1-027
(iii)	Cartridge bearing	0 718 88 01 000
(iv)	Axle box guide arrangement	1 72016 03 001
(v)	Roller bearing	1 720 16 03 002
(vi)	Lower rubber washer	EMU/M-0-1-008
(vii)	Guide bush	EMU/M-0-1-023
(viii)	Helical spring	2 720 15 03 001
(ix)	Dust shield	3 720 16 03 002
(x)	Dust shield spring	T-0-1-012
(xi)	Guide ring	T-0-1-640
(xii)	Rubber packing ring	T-0-1-632
(xiii)	Circlip	115x4N IS: 3075-86 Part-I

Annexure-IV

FORMAT FOR SCHEDULE OF STANDARD EXAMINATION OF 4-WHEELER OHE CAR

(Daily Check)

4-WHEELER Tower CAR: Cumulative km.:

Date :

No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
1.0	4 WHEELER TOWER CAR			
1.1	Drain condensate from automatic drain valves of brake system.			
1.2	Drain the moisture manually on daily basis.			
1.3	Check the leakage of air pressure, if any, rectify the same.			
1.4	Check the brake application and relieving before leaving the depot.			
1.5	Check the working of horns during starting.			
1.6	Check the oil level of axle drive, if found less, add upto maximum mark.			
1.7	Check the Transmission oil level in the oil tank , if found less, add upto maximum mark.			
1.8	Ensure correct level of radiator water, lube oil in ADGB & fuel in tanks			

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Car body, Under frame, Brake Rigging etc.)

Weekly Schedule

4-WHEELER Tower Car No. Cumulative km.:

Date :

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	4 WHEELER TOWER CAR			
1.1	Repeat all Daily checks			
2.0	Car Body			
2.1	Car body should be washed both from outside and inside.			
3.0	Shell			
3.1	Visually check body panels/ walls for damages.			
3.2	Visually inspect window bars for damage/missing.			
3.3	Examine body side doors for proper working/damages.			
3.4	Inspect door handles for damages/missing.			
4.0	Under frame			
4.1	Check condition of head stock/sole bar/cross members.			
4.2	Inspect brake hanger brackets for damages.			
4.3	Inspect safety brackets for brake hanger pins.			
5.0	Suspension			
5.1	Examine rubber stopper/stop screw of axle box crown for damage/ missing/ looseness.			
5.2	Inspect axle box safety straps/loops for damage/breakage/missing.			
5.3	Visually examine axle box springs for breakage/damage.			

5.4	Visually examine dashpot oil filling special screw for deficiency.			
5.5	Check oil leakages in dashpot through defective seals/vent screws.			
5.6	Visually examine axle box clearance.			
5.7	Examine vertical shock absorbers for damages.			
6.0	*Brake rigging*			
6.1	Check brake-rigging arrangement for any defects/deficiencies.			
6.2	Examine brake beams breakages/ damages.			
6.3	Check and attend brake beam safety wire ropes/safety straps.			
6.4	Check and attend brake shoe head and key and replace if necessary.			
6.5	Check and replace worn brake blocks.			
6.6	Visually inspect brake hangers, brake gear pins and cotters/split pins and replace if necessary.			
6.7	Visually inspect damaged/ missing brake gear bushes and replace if necessary.			
6.8	Examine lever hanger pins.			
7.0	*Draw gear*			
7.1	Check and replace damaged/ missing split pins/cotter/ rivets.			
7.2	Examine draw hook, draw bars and rubber pads for damages.			
7.3	Check conditions of the screw coupling and its components and replace if required.			
7.4	Check condition of draw beam and locating pins on it.			
7.5	Examine visually draft key locking pins.			
8.0	*Buffing gear*			

8.1	Visually examine buffer plungers for damage/drooping/stroke length.			
8.2	Examine buffer mounting bolts and attend if necessary.			
8.3	Examine visually buffer casing for cracks/damages.			
9.0	*Running gear*			
9.1	Examine visually axle box for grease oozing out, warm axle box if any.			
9.2	Visually examine wheel tyre profile and thickness of tyre and check with tyre profile gauge if they appear to be near condemning limit.			
9.3	Visually inspect axle box covers.			
9.4	Inspect wheel tread for shattered rim, spread rim, shelled tread, thermal cracks, heat checks.			
9.5	Check the oil level of axle drive, if found less, add upto maximum mark.			
10.0	Seats			
10.1	Examine the holding/securing brackets for seats and attend if necessary.			
10.2	Examine and repair damaged upholstery cushions			
10.4	Seats and frames should be cleaned.			
10.5	Cushion should be cleaned with duster. Oil or head stain and dirty spots if any should be cleaned with mild soap solutions and wipe dry.			
11.0	Doors			
11.1	Examine doors for proper functioning and securing with hinge pivots. Doors should not graze with floor or doorsill			

	plates.			
11.2	Examine door locks, latches firmly secured with correct sized screws and properly/ smoothly engaging in their slot. The tongue of gravity type latch should be in proper alignment with its slot plate.			
11.3	Visually examine window shutters for smooth working and proper locking.			
12.0	Windows			
12.1	Check window-balancing mechanism for proper functioning.			
12.2	Examine window safety catches for proper engagement in their slots.			
12.3	Window bars should be provided and fixed in prescribed manner and replaced if damaged.			
13.0	Interior fittings			
13.1	Examine laminated panels and mouldings for damage/cracks.			
13.2	Examine tower bolts of backrests for proper working.			
13.3	Examine ventilation grills for damages.			
14.0	Wash Basin fittings			
14.1	Examine push cock for proper function			
14.2	Check and attend leakage in pipe, pipe fittings.			
14.3	Clean drain grills and drain holes of wash basin if found chocked			
14.4	Check and replace damaged/ missing mirrors / shelves / soap dishes			

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR
(Car body, Under frame, Brake Rigging etc.)

MONTHLY SCHEDULE

4-Wheeler Tower Car No. Cumulative km.:

Date :

S No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	Repeat all items of Weekly Schedule			
2.1	*Suspension*			
2.1.1	Add specified grade of oil in dashpot.			
3.0	*Brake System*			
3.1	Externally clean the brake system pneumatic pipes and check for leakages. If required tighten the end fittings. Check the mounting fasteners of Air reservoir/ Distributor valve/ relay valve magnet valve and other brake system equipments			
3.2	Check and attend brake block adjuster.			
3.3	Examine and attend brake levers.			
3.4	Examine and attend brake hanger lever brackets.			

SCHEDULE OF STANDARD EXAMINATION OF4 WHEELER TOWER CAR
(Coach body, Under frame, Brake Rigging etc.)

QUARTERLY SCHEDULE

4 WHEELER TOWER Car No. Cumulative km.:

Date :

S No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	Repeat all items of Monthly Schedule			
2.0	Intensive cleaning of Tower Car			
3.0	Under frame			
3.1	Examine trough floor and other under frame members from underneath for corrosion.			
4.0	*Secondary Suspension*			
4.1	Check Axle Box Crown clearance.			

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR
(Coach body, Under frame, Brake Rigging etc.)
Six Monthly Schedule

4-WHEELER TOWER Car no. Cumulative km.:

Date :

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	Repeat all items of Quarterly Schedule			
2.0	Shell			
2.1	Thoroughly clean and remove dust, rust accumulated at underframe and pillars with coir brush and compressed air.			
2.2	Examine for corrosion of sole bar and other under frame members with torch light or inspection lamp.			
2.3	Touch up damaged paint both inside and outside.			
2.4	Check roof ventilator for damages.			
3.0	Suspension			
3.1	Check and attend axle guide assembly if necessary.			
3.1.1	Check axle box clearance with gauge.			
4.0	*Draw gear*			
4.1	Ensure that wear on screw coupling shackle pins, trunion pins, shackle/link holes and draw hook holes should not exceed 3mm.			
4.2	Ensure that wear at any section on draw hook should not exceed 10mm.			
5.0	*Buffing gear*			
5.1	Ensure the length is within 584-635mm.			

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
5.2	Inspect buffer plunger false plate for wear and profile.			
6.0	*Running gear*			
6.1	Check with wheel distance gauge for loose or tight wheel.			
7.0	Flooring			
7.1	Inspect and attend damaged/cracked flooring.			
7.2	Examine and attend opened joints.			
7.3	Examine Drain holes in trough floor for accumulation of water due to clogging if noticed. Inspect affected area for corrosion.			

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Underframe, Brake rigging etc.)

Yearly Schedule

4 WHEELER TOWER Car no.

Cumulative km.:

Date :

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	Repeat all items of Six-monthly Schedule			
2.0	Thorough flushing of water tanks			
3.0	Overhaul all brake equipments, except brake cylinder.			
4.0	Replace rubber kits during yearly repairing of pneumatic valves.			
5.0	Ultrasonic Testing of wheel set.			

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Under frame, Brake rigging etc.)

Twenty Four Months

3 WHEELER TOWER Car no.

Cumulative km.:

Date :

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	Repeat all items of Yearly Schedule			
2.1	Run out the Wheels/Axles and attend all the items as mentioned in Annexure-II			

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Under frame, Brake rigging etc.)

Thirty six Months

4 WHEELER TOWER Car no.

Cumulative km.:

Date :

No.	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.0	Repeat all items of yearly Schedule			
2.0	Brake			
2.1	Overhaul the safety switch.			
2.2	Clean the chokes, exhaust plugs, mesh filters in the distributor valves and check proper functioning of all sub-assemblies.			
2.3	Overhaul the drivers brake valve. Replace all the rubber items, clean filters.			
2.4	Check for proper functioning of relay valves and replace the damaged/ worn out items.			
2.5	Replace rubber-sealing washer of air brake hose coupling.			
2.6	Check all the hose assemblies of brake system for damage or over ageing replace if required.			
2.7	Remove the brake cylinder and over haul 100% rubber parts replacement.			
2.8	Overhaul all valve magnets, speed cylinders, direction cylinders and gear cylinders by replacing 100% rubber parts.			

SCHEDULE OF STANDARD EXAMINATION OF4 WHEELER TOWER CAR

(Coach body, Under frame, Brake rigging etc.)

Periodical Overhaul (seventy two months)

5 WHEELER TOWER Car no.

Cumulative km.:

Date:

SN	Details of work to be carried out	Condition/ Action	Sign.	Remarks
1.	The following sequence of work should be generally followed during POH of Tower Car			
2.	Verification of deficiencies.			
3.	Pre-inspection and Lifting of Tower Car body			
4.	Stripping			
5.	Body repair.			
6.	Fitting of Water Tank, Plumbing & Leakage testing			
7.	Repair of internal panels			
8.	Fitment of shutters			
9.	Fitment of doors			
10.	Fitment of seats			
11.	Repair, maintenance & fitment of screw coupling.			
12.	Painting and finishing			
13.	Repair and maintenance of Axle Box Guide Arrangement as per Annexure II.			
14.	Repair and maintenance of brake system including overhauling of Distributor valve.			
15.	Repair and maintenance of rolling gear			
16	Lowering of Tower Car body on Wheels/ Axles.			
17.	Brake Testing			
18.	Testing of branch wiring			

SN	Details of work to be carried out	Condition/ Action	Sign.	Remarks
19.	Testing of electrical equipment			
20	Final Inspection & Dispatch			
21.	Maggering and continuity check of electrical equipment to be carried out. Same should also be tested on test bench.			

ANNEXURE-V

(A) Spares for Carriage

Must change items (with dash pot type of guide arrangement) during POH

SN	Description	Qty
1	Roller bearing grease	1.52 to 2.0 kg/ bearing when opened
2	Locking plat	4 nos (when opened)
3	Rubber sealing ring of axle front & rear cover	4 front, 4 rear (when opened)
4	Rubber packing arrangement	8 nos
5	Guide ring (Acetal)	8 nos
6	Guide bush (Acetal)	8 nos
7	Circlip for dash pot guide bush	8 nos
8	Dash pot oil	2 lts approx./dash pot
9	Brake gear bush (as a set)	All
10	Brake shoe key	8 nos
11	Shoe adjuster assembly & nut and bolt with split pin	8 nos
12	Brake beam bush collored	8 nos
13	All bulb type cotters	All when opened
14	Sealing washer for air vent screw	8 nos
15	Rubber stopper and crown bolt	4 nos
16	Air brake house pipes	2 nos
17	Dirt collector filters	All
18	Felt sealing ring (for axle box)	4 nos
19	Wiper blades	4 nos
20	Lower and upper rubber washers (IRSR-64/98)	8 lower & 8 upper

Spares to be kept in the inventory at POH shop/shed.

SN	Description	Qty
1	Shock absorbers	2 nos
2	Suspension springs	2 nos
3	Brake blocks	16 nos
4	Brake head shoe key	4 nos
5	Brake gear pins & bushes	1 complete set for 1-tower car
6	Brake beams	2 nos
7	Felt sealing rings	4 nos

8	Locking plats	4 nos
9	Wipers arm and blade assembly & wiper motor	2 assemblies
10	Horns	2 nos
11	Upper & lower spring seat	2 nos each
12	Flexible hose connection for brake cylinder	4 nos
13	Air brake hose assembly	2 nos
14	Roller bearing grease	5 kg approx.
15	Rubber sealing rings of axle box front and rear cover	4 nos
16	Rubber packing rings	8 nos
17	Guide ring (Acetal)	4 nos
18	Guide bush (Acetal)	4 nos
19	Circlip for dash pot guide bush	4 nos
20	Dash pot oil	50 lt approx.
21	Shoe adjuster assembly	4 nos
22	Split pins & cottors	Sufficient
23	Sealing washers for air vent screw	8 nos
24	Rubber stopper and crown bolts	4 nos
25	Dirt collector filters	1 no. each
26	Buffer bolts	8 nos
27	Glass wind screen	2 nos
28	Suspension safety straps	4 nos
29	Brake beam safety strap/loop	4 nos
30	Glass shutters with equalizing device	2 assemblies
31	Louver shutters	2 assemblies
32	Air brake hose pipe assembly	2 nos
33	Isolating and cut off cocks	1 no. of each type
34	Fans	2 nos
35	Brake cylinders (with its spares like piston packing ring, dust excluders etc)	2 nos
36	Brake gear levers	1 complete set for a Tower car
37	Lower & upper rubber washer (IRSR-64/98)	4 lower & 4 upper
38	Driving axle alongwith axle drive with torque arm for each type of tower Car.	1No
39	Non-driving axle for each type of tower Car.	1No
40	Valve Magnet –for speed gear and direction.	04 Nos
41	A-9 Valve, distributor valve, C3W valve, C2W relay valve	1 each

(B) Transmission System

Must change parts for transmission for CRT-5633 (Avtec)

S N	PART NO	DESCRIPTION	Qty
Mandatory Changes			
1	80000561	Element (every 250 hours	2
2	Transmission Oil	C4 SAE 30 Transmission Oil (Every 1000 r hours)	App 55 Litres
Overhaul Parts list (App 8000 Hours)			
1	6884505	SEAL & GASKET KIT	1
2	9409058	BOLT	12
3	23041915	BEARING ROLLER	2
4	6838403	EXT SNAP RING	1
5	6774184	INT SNAP RING	1
6	6703059	RING,EXT SNAP	1
7	6774708	NUT LOCK	1
8	6758485	WASHER THRUST	1
9	6773088	CUP	24
10	6770302	Roller needle	12
11	6769276	Spring	12
12	6770574	Roller needle	12
13	6774710	Plate Stator backing	1
14	6770578	Retainer	2
15	23047054	Sleeve Converter ground	1
16	23048010	Bearing	1
17	6769319	Snap ring	1
18	23048012	Bearing	1
19	6882657	Hose Assy	1
20	23047967	Bearing	1
21	6753304	Snap ring	1
22	6750025	Snap ring	1
23	6768469	Thrust Washer	1
24	23047964	Bearing	1
25	6756042	Belleville Spring	1
26	6756041	Snap Ring	1
27	6884212	Washer Thrust	1
28	6880157	Hose lube feed	1
29	23045626	Tube Jumper	1
30	6754835	Snap ring	1
31	6769721	Ring Compression	1
32	23018736	Hub	1
33	23047970	Bearing	2
34	6756338	Spacer	1

35	6753487	Snap ring	1
36	23041450	Bearing	1
37	8892840	Snap ring	1
38	23018418	Pump Assy	1
39	6776451	Screen Assy	1

Recommended spares for each transmission CRT 5633 transmission for 2 years.

SN	Description	Qty
1.	FILTER ELEMENT	10
2.	SEAL AND GASKET KIT	2
3.	GASKET	5
4.	GASKET	5
5.	HOSE ASSEMBLY	2
6.	Ring external snap	1
7.	Turbine	1
8.	Nut. Lock	1
9.	Washer Thurst	1
10.	Race	1
11.	Stator	1
12.	Cup	24
13.	Roller, Needle	12
14.	Spring, Needle Roller	12
15.	Roller, Stator Freewheel	12
16.	Plate, Stator Backing	1
17.	Bolt	12
18.	Strip, Locking	6
19.	Pump, Torque TC 580	1
20.	Bearing, Ball	1
21.	Gear, Accessory Drive Inp.	1
22.	Washer	36
23.	Bolt	36
24.	Ground Sleeve	1
25.	Bolt	5

(C) Engine:

Must change items for engine NTA-855 of Cummins India Ltd, Pune

SN	Parts	Qty
1.	SHELL,MAIN BEARING	1
2.	RING,LINER SEAL	6
3.	LINER,CYLINDER	6

4.	SEAL,OIL	1
5.	SEAL,OIL	1
6.	PICKUP,MAGNETIC	1
7.	PISTON & CONN ROD	6
8.	VALVE,SOLENDID	1
9.	SEAL,O RING	1
10.	RING,RETAINING	1
11.	VIBRATION DAMPER	1
12.	GASKET,CAM FOL HOUSING	3
13.	GASKET,CAM FOL HOUSING	3
14.	GASKET,CAM FOL HOUSING	3
15.	ROD,PUSH	12
16.	ROD,PUSH	6
17.	CAP,FILLER	1
18.	THERMOSTAT	1
19.	COOLER LUB OIL	1
20.	NOZZLE,PISTON COOLING	6
21.	BREATHER,CRANKCASE	1
22.	MANIFOLD,EXHAUST	1
23.	MANIFOLD,EXHAUST	1
24.	MANIFOLD,EXHAUST	1
25.	MTG EXHAUST MANIFOLD	1
26.	SHIELD,HEAT	1
27.	HOSE OIL SUPPY	1
28.	INTERCOOLER AIR	1
29.	V-BELT	1
30.	PICKUP MAGNETIC	1
31.	FILTER,LUB OIL	1
32.	FILTER,FUEL	1
33.	FILTER,OIL BYPASS	1
34.	HOSE,FLEXIBLE	1
35.	HOSE,FLEXIBLE	1
36.	BUSHING	1
37.	CLIP	3
38.	BLANKET,TURBOCHARGER HEAT	1
39.	CONTROL,SAFETY	1
40.	SWITCH,PRESSURE	1
41.	BUSHING	1
42.	SWITCH,PRESSURE	1
43.	HOSE,FLEXIBLE	1
44.	SENSOR,TEMPERATURE	2
45.	SENSOR,PRESSURE	1

46.	V-BELT, RIBBED	2
47.	SWITCH,OVERSPEED	1
48.	HOSE,FLEXIBLE	2
49.	HOSE,FLEXIBLE	1
50.	HOSE,FLEXIBLE	1
51.	HOSE,FLEXIBLE	1
52.	HOSE,FLEXIBLE	2
53.	KIT,VENT HOSES	1
54.	INHIBITOR,CORROSION	1
55.	SWITCH,RELAY	6
56.	THERMATIC,VALVE	1
57.	KIT, WASHER SEALING	1
58.	KIT, WASHER SEALING	1
59.	CLAMP,TUBE	12
60.	CLAMP,TUBE	3
61.	CLAMP,TUBE	2
62.	SCREW,HEXAGON HEAD CAP	24
63.	WASHER,LOCK	56
64.	SCREW,HEXAGON HEAD CAP	24
65.	SCREW,HEXAGON HEAD CAP	16
66.	SCREW,HEXAGON HEAD CAP	32
67.	SCREW,HEXAGON HEAD CAP	32
68.	WASHER,LOCK	80
69.	HOSE,FLEXIBLE	2
70.	SCREW,HEXAGON HEAD CAP	8
71.	WASHER,LOCK	8
72.	SCREW,HEXAGON HEAD CAP	4
73.	WASHER,LOCK	4
74.	SCREW,HEXAGON HEAD CAP	4
75.	WASHER,LOCK	40
76.	SEAL,O RING	14
77.	SEAL,O RING	10
78.	SEAL,O RING	16
79.	SEAL,O RING	6
80.	WASHER,LOCK	40
81.	INDICATOR,RESTRICTION	1
82.	HOSE,ELBOW	1
83.	CLAMP,T BOLT	1
84.	HOSE,ELBOW	7
85.	HOSE,ELBOW	1
86.	CLAMP,T BOLT	13
87.	CLAMP,T BOLT	6

88.	CLAMP,T BOLT	2
89.	HOSE,HUMP	1

Recommended spare of engine for six months

SN	Description	Qty
1.	Seal oil Acc Drive	1
2.	Oil seal	1
3.	Heat shield cover	1
4.	Valve solenoid	1
5.	Switch pressure	1
6.	Switch temperature	1
7.	Thermostat	1
8.	Gauge oil level	1
9.	Cap filter	1
10.	Hose oil supply	1
11.	Clip	2
12.	Switch magnetic	1
13.	Switch pressure	1
14.	Wiring harness	2
15.	Hose assembly	1
16.	Sender	2
17.	Transducer pressure	2
18.	Hose flexible	1
19.	Probe	1
20.	Ammeter	1
21.	Gauge water	1
22.	Gauge lub. Oil	2
23.	LO pressure gauge	2
24.	Techno meter	1
25.	Gauge Lub. Oil	1
26.	Gauge water	1
27.	Hose flexible	2
28.	Hose assy	1
29.	Hose assy.	1
30.	Elbow	12
31.	Hose assy.	1
32.	Vaccum indicator	1
33.	Elbow	1
34.	Hose Air Cleaner	2
35.	Elbow Hose	1
36.	Clamp T.bolt	1
37.	Clamp T.bolt	2
38.	Hose hump	2
39.	Clamp T.bolt	2
40.	Hose Elbow	2
41.	Clamp T.bolt	4
42.	Clamp T.bolt	1
43.	Kit Hyd.Filter & hoses	1
44.	Ket Hyd. Hoses	1

45.	B Check ket (AR3238018)	10
46.	Assy. Rotor screen	2
47.	Gasket Rkr Hsg	3
48.	O Ring Injector body	6
49.	O Ring Injector body	12
50.	Gasket breather cover	4
51.	Element inner	3
52.	Element outer	3
53.	Belt WTR Pump	1
54.	Belt alt. Fan (178473)	1
55.	Coil assy.(3054610)	1
56.	Total	

Requirement of oil and lubricant for tower Car.

SN	Description	Qty
1	Lube oil	3 Litrs
2	Hydraulic drive for radiator	54 Litrs
3	Transmission CRT-5633 (V)	40 Litrs
4	Axle drive gear box	25 Ltrs
5	Axle box	2 Kg.
6	Cardan shaft	100 gms
7	Brake rigging	As required

(D) Recommended spares for 3-years normal maintenance for Traction Motor

SN	Description	Qty
1	Axle BRG lubricator assembly	4
2	Half wiper of felt ASSY.COM	4
3	Brush holder complete (RH)	6
4	Brush holder complete (LH)	6
5	Cable bush PE side	4
6	Cable bush PE side CE side	4
7	Bellows	2
8	Rubber sandwitch unit	2
9	Carbon brush	64
10	Control gear equipment 72V	01
11	Magnet valve complete with coil	01
12	Contact for EP contactor	01
13	ARC box for EP contactor	01
14	Fixed contactor for master controller	09

(E) Recommended spares for 3-years normal maintenance for lighting circuit

1	Twin beam Sealed assembly	01
2	Lamp holder for cab and hood light	05
3	Push button with element	02
4	Hood light switches	10
5	Head light switch	01
6	LED type flasher lamps	01
7	LED type marker lamps	01

(F) Recommended spares for 3-years normal maintenance of traction alternator

SN	DESCRIPTION	PART NO	UNIT
1	Wound stator frame	T9501	1 No
2	Wound main rotor	T9502	1 No
3	Wound exciter armature	T9503	1No
4	Wound exciter field	T9504	1No
5	Machined shaft with keys	T9505	1No
6	Aluminum fan	T9506	1No
7	Coupling hub	T9507	1No
8	Balancing disc	T9508	1No
9	Diode disc assembly	T9509	1No
10	Rotating diode 130A, 1600V (F)	T9510	3Nos
11	Rotating diode 130 A, 1600V (R)	T9511	3Nos
12	MOV (250V/14)	T9512	1No
13	NDE bracket	T9513	1No
14	DE bracket	T9514	1No
15	Bearing hub	T9515	1No
16	Outer bearing cap	T9516	1No
17	Inner bearing cap	T9517	1No
18	Stationary ring (grease)	T9518	1No
19	Mobile ring (grease)	T9519	1No
20	CGS plate	T9520	2No
21	Side cover with filter	T9521	2No
22	Top cover with filter	T9522	1No
23	Front cover	T9523	1No
24	Rear cover	T9524	1No
25	NDE cover	T9525	1No
26	DE cover with grid	T9526	1No
27	Tinned copper busbar (N)	T9527	1No
28	Tinned copper busbar (U)	T9528	1No
29	Tinned copper busbar (V)	T9529	1No
30	Tinned copper busbar (W)	T9530	1No
31	Deep groove ball bearing (6317/C3)	T9531	1No
32	Molded Insulator (10/36)	T9532	17No
33	Supporting clamp	T9533	2No
34	Flex plate 1.2mm Thick (SAE 0)	T9534	6No

***

Government of India, Ministry of Railways
Research Designs & Standards Organisation, Manak Nagar, Lucknow – 226011

MAINTENANCE INSTRUCTION No. TI/MI/0053

1. **TITLE:** Pre and Post Monsoon Precautions for Traction Installation.

2. **APPLICATION:** Traction Installation.

3. **OBJECTIVE**: Objective is to minimize the damages due to monsoon hazards (e.g. Severe Rains/floods, Heavy wind/cyclone, lightening etc.) to Traction Installation. This SMI does not include and does not supersede specific instruction issued by zonal Railways regarding pre monsoon precautions.

4. **MAINTENANCE INSTRUCTIONS FOR PRE & POST MONSOON CHECKS:** Following should be ensured.

4.1. (i) **Monsoon Periods:** CEE/Zonal Railway, shall define the monsoon period (months of a year) for different sections of a zonal railway and issue to divisions. Divisions, in-turn, shall issue the same to subordinate offices. Monsoon periods may be different for different section of a Zonal railway depending upon geography and this should be taken care.

(ii) **Pre monsoon period:** Based on (i) above, CEE/Zonal Railway shall define duration of Pre-monsoon period in which all pre-monsoon activities should be completed. Pre-monsoon Period may vary from one month to 3 month depending upon nature of activity/works to be carried out.

(iii) **Bad weather warning and preventive action:** System of receiving the bad-weather warnings to TPC from Metrological Center shall be established. Controller with the assistance of TPC shall take preventive measures.

4.2 Pre monsoon activities:

A. PSI Installations

(i) Silica gel & Breather: Silica gel of breathers of Power transformers, Auxiliary Transformers is 100% replaced by specified quality silica gel. Silica gel breather should be maintained healthy by ensuring good condition of gasket, transparent cover, oil in the cup.

(ii) Door Gaskets & Cable Entry: Gaskets of doors of CB, BM, Marshaling box of transformer, Isolator key boxes, control panel etc should be ensured to be available and without damage. Cables should be taken through cable glands and redundant cable entry holes should be closed.

(iii) Oil level: It shall be ensured that oil level of power transformer, Auxiliary Transformers, PTs, CTs and other oil filled equipment is correct and it should not require any filing during monsoon period. Correct oil level will ensure reliability of the equipment.

(iv) AT drop Out Fuse: AT drop out Fuse replacement (100%) should be planned in pre monsoon period to ensure its mechanical and electrical strength in monsoon period. Released Fuse elements may be checked for its reusability at the depot by the Supervisor-incharge.

(v) **Heaters:** Heaters provided in CB, BM, C & R Panel, Marshalling Box of transformer etc should be ensured for proper working.

(vi) **Switching Stations :**

(a) Building roofs to be checked for leakage/seepage of rain water to avoid leakage on electrical equipment.

(b) Cleaning of cable trenches and water outlets to avoid water accumulation in substation/switching stations.

(c) Oil sump shall be made free from rain water

(d) Ensuring provision of all cables with cable gland and sealing of unused holes in cable tray, mechanism box, marshaling box etc.

(vii) **Transformer:** It must be ensured that transformer radiators, conservator tank, PRD are properly sealed to avoid ingress of moisture. The radiator corrosion should be attended. Bushing should be cleaned.

(viii) **Lightening and resultant surges Protection System:**

a. Ensure lightening arresters of all Traction Installations for its healthiness.

b. Ensure earths are properly connected to lightening Arrestors and its value should be within prescribed limits. Bolted Earth Connections should be properly tightened. Earth of LT and low voltage Equipments (Relays, Relay Panels, and Control Panel etc.) is equally important and should be checked for proper connections.

c. Ensure all surge protections of PSI, SCADA for their values within limit and their healthiness. Overaged should be planned for replacement.

d. Ensure all Arcing horns of PSI Equipments for their values within limit and defect rectified.

e. For Cables, which are provided with sheath and/or screen, it should be ensured that sheath/screen is terminated as per standard practice and guideline.

f. Leakage current meter reading connected in series with LA should be recorded and should be compared with previous reading. If sudden rise in leakage current is observed than LA should be thoroughly checked.

(ix) Bushing of CT, PT, LA, CB, BM & Transformer should be clean properly.

B. **OHE Installations:**

(i) **Bonds availability and tightening:** 100% bond connections shall be made available and re-tightened.

(ii) **Earth Pit Connections:** 100% Earth pit connection shall be re-tightened.

(iii) Buried rail Connections to and from earthing grid & track shall be checked.

(iv) **Guy Rod**: Guy Rods shall not be slack and 100% guy rods shall be retention by tightening U-bolts to prevent insulator breakage and other damages due to vibration and jerks during heavy winds.

(v) **Tower Wagons, Break-down Road vehicles, ART/SPART**: These shall be equipped with mandatory spares and T&P in good condition to meet emergency requirements. Materials shall have easy access. Generator sets, portable flood lights, lighting arrangements for breakdown vehicles shall be kept in good condition.

(vi) In the scheduled inspection just preceding the monsoon, special attention should be paid to the vulnerable points likely to permit ingress of moisture

resulting in reduction in dielectric strength of the equipments and rusting of parts.

(vii) Special Patrolling & Tower wagon Inspection: A special patrolling and Tower wagon inspection of all overhead lines should be done in pre and post monsoon period to identify defects/deficiencies which may cause failure during the coming monsoon season and afterwards. Following minimum checks shall be carried out and defects rectified.

(a) **Structures**: Locations of leaned structures; missing fasteners; damaged protective coatings like galvanizing or paints; shall be recorded and rectified.

(b) **Foundations**:

(i) Check the condition of embankments with respect to stability of mast. Signs of external damage; settled and washed out soil below normal ground level over foundations should be checked. Rectification with compact soil, sand bags, gravel etc. should be ensured for exposed foundations.

(ii) Ensure proper drainage of rain water surrounding the OHE foundation.

(iv) Muff of OHE mast which are cracked/broken or buried in soil, shall be rectified.

(v) Foundation of OHE structure should be in clean condition.

(c) **Insulators and Fittings**:

(i) One time cleaning of insulators in pollution zone is necessary to prevent excessive trippings and failures during initial monsoon rains. Cleaning of section insulators, 9-t insulators are also important.

(ii) Record of locations of damaged insulators, missing locking devices like nuts, washers and pin, burnt out fittings, deflected strings, damage to protective coatings, cracked insulators to be recorded and rectified.

(iii) Bird droppings, Bird nests, dense spider webs, kites with threads hanging on the insulator string shall be recorded and rectified.

(iv) Refer ACTM Vol II Part-I Para-20314 regarding Environmental Effect on OHE and Para 20325 regarding special checks and action should be incorporated on pre monsoon activity plan.

(d) **Cantilever**: Ensure free-movement by lifting contact wire. Insulator mast-attachment should be free to rotate. Apply lubricant if not free.

(e) **ATD**: Ensure free movement and correct X, Y values to avoid failures due to sudden change of Temperature and heavy winds. ATD Guy Rod shall be re-tensioned.

(f) **Overline structures**: Availability, condition and proper fixing of Protective screens and no water leakage on the OHE shall be ensured by Engineering department. Survey of unauthorized cable/pipes crossing through overline structure shall be carried out. Plugging of holes on ROB/FOB shall be carried out. TRD organization shall also advise engineering department. Checking of OHE on Girder Bridge for proper earthing.

(g) **Trees**:

i. Trimming of Shrubs and trees causing obstruction and Infringement shall be done by the authorized TrD staff and Supervisors. No part of, the tree shall be nearer than 4 m from the nearest live conductor. Any tree or

branches likely to fall on the live conductors should be cut or trimmed periodically to maintain the safety clearances.

ii. The cutting of the trees shall be done by the Engineering Department in the presence of authorized TrD staff to ensure safety and satisfactory completion of the work.

iii. Creepers on all portal structures & traction mast shall be removed.

(h) Non-railway Installations, which need to be periodically inspected by Traction distribution department e.g. Powerline crossings etc, should be got Inspected with the concern department/state government and deficiencies observed shall be made good through them. Refer ACTM Vol II Part-I Para 20331 regarding transmission line periodical inspection during pre and post monsoon period.

(i) Hoardings and Advertisement Boards in the vicinity of Railway Tracks or on Overline structures which may fall on track during rain/thunder storms shall be advised for removal to concern authority.

5. **MAINTENANCE OF RECORDS:**

a) Vulnerable location (leaning mast, poor foundations etc.) registers b) Bonding register c) Earth Register

d) PSI Equipment Maintenance Registers: make entry for replacing silica gel, arching horn gap, oil level drop out fuse etc

e) ATD Register: For free movement, Z-Y value, guide tube condition. Special entry shall be made for Guy Rod re-tensioning.

f) Tower Wagon/ Breakdown-Road vehicle/ART/SPART Spares and T&P register.

6. **AGENCY FOR IMPLEMENTATION:** All OHE & PSI depots on Indian Railways

7. **REFERNCE:**

(a) Railway Board letter No. 2008/Elect(G)/161/8/Punct. Dated 07.10.2011
(b) Railway Board letter No. 2008/Elect(G)/161/8/Pt. Dated 05.09.2012
(c) Railway Board letter No. 2017/13/CE-III/BR/Monsoon Dated 27.04.2017
(b) ACTM Volume II, Part I: para 20253, 10422, 20325(9), 20331.

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सत्यमेव जयते

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No. RDSO-TI0LKO(PSI)/28/2020-O/o PED/TI/RDSO Dated: As signed

To,

As per the mailing list attached

Sub: Revised Maintenance Instruction No. TI/MI/0054 Rev.1 for 25kV Vacuum Circuit Breaker and Interrupter of Indian Railways Traction System.

****

The existing Maintenance Instruction No. TI/MI/0054 has been revised and superseded by Maintenance Instruction No. TI/MI/0054 Rev.1 for 25kV Vacuum Circuit Breaker and Interrupter of Indian Railways Traction System

The copy of the revised Maintenance Instruction No. TI/MI/0054 Rev.1 for 25kV Vacuum Circuit Breaker and Interrupter of Indian Railways Traction System is attached herewith for kind information and necessary action, please.

This is issued with the approval of the Competent Authority (PED/TI).

Encl: As above

Digitally Signed by
Jitendra Kumar
Date: 23-07-2025 18:03:50
Reason: Approved

(Jitendra Kumar/ जितेंद्र कुमार)
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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय Ministry of Railways

निर्देश संख्या. टी आईएम/ आई /0054 रिवि. 1

MAINTENANCE INSTRUCTION No. TI/MI/0054 Rev.1

भारतीय रेलवे ट्रैक्शन सिस्टम के 25kV वैक्यूम सर्किट ब्रेकर और इंटरप्टर के रखरखाव के निर्देश

Maintenance instructions for 25kV Vacuum Circuit Breaker and Interrupter of Indian Railways Traction System

(July, 2025)

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक (कर्षण संस्थापन) Principal Executive Director (TI)	23/7/25
अनुशंसित Recommended by	कार्यकारी निदेशक (कर्षण संस्थापन) Executive Director (TI)	23/07/25

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	Prepared By	Checked By	Issued by
Signature & Date	23.7.25	23/07/25	23/7/25
Designation	SSE(Protection)/ TI	ADE/ TI-3	DIRECTOR/ TI-3

Amendment History

Revision Number	SMI NO	Total pages	Date of Issue	Reasons for Amendment/ Revision
0	TI/MI/0054	06	08.09.2017	-
1	TI/MI/0054 (Revision 1)	08	23.07.2025	The value of Insulation Resistance of M/S Megawins make VCB & VI is updated as per their manual.

1. Scope:

This Maintenance Instruction covers the procedure for maintenance of 25kV Vacuum Circuit Breakers and Interrupters used in the Indian Railway Traction System.

2. Background:

For proper upkeep & maintenance of the Circuit Breaker and Interrupter, the existing maintenance practices are based on the ACTM and different supplier manuals. Due to repeated failures of 25kV Vacuum Circuit Breaker and Interrupters, a meeting was held at RDSO, Lucknow on 20.09.2016 between RDSO, Zonal railways, and 25kV Circuit Breaker and Interrupter manufacturers. In the meeting, it was decided that RDSO shall prepare and issue a standard Maintenance Instruction for a 25kV Vacuum Circuit Breaker and Interrupter covering all aspects of Storage, Pre-commissioning, and maintenance.

3. References:

SN	Standard
1.	AC Traction Manual- Volume II, Part-I
2.	M/s ALIND Erection and Testing Manual for Vacuum Circuit Breaker and Interrupter.
3.	M/s. BHEL Erection and Testing Manual for Vacuum Circuit Breaker and Interrupter
4.	M/s. Megawin"s Instruction manual for Circuit Breaker.

4. Storage:

4.1 The Circuit Breaker/Interrupter shall be stored in packed/supplied condition only.

4.2 The packed case should be kept on raised ground to prevent accumulation of rainwater in the storage area and submergence of units and should be covered with waterproof tarpaulins.

4.3 If the Circuit Breaker/Interrupter has been supplied in fully assembled condition (ALIND Make) the same shall be stored in assembled vertical position only.

4.4 Special care shall be taken while handling the interrupting chamber and Support Insulator.

4.5 The manufacturer manual may also be followed for additional requirements.

4.6 Vacuum Circuit Breaker/Interrupter should not be stored for long periods.

5. Pre Commissioning Tests:

The following tests shall be carried out before commissioning (energisation) of the Vacuum Circuit Breaker/Interrupter.

5.1 Vacuum Integrity of vacuum bottle shall be carried out i.e. One-minute dry power frequency withstands voltage test at 55kV/76kV/95kV (as per supplier manual).

5.2 Ensure that the interrupting chamber, Support Insulator, as well as control Cubicle, are correctly aligned.

5.3 Insulation resistance measurement using a 2.5/5kV Megger between Lower Terminal & earth and Upper Terminal & Lower Terminal. The measured values shall be as per the supplier manual.

	M/s BHEL	M/s Alind	M/s Megawin
Between open terminals	10,000 Mega ohm	5,000 Mega ohm	300 Mega ohm
Between the lower terminal to Earth	10,000 Mega ohm	5,000 Mega ohm	300 Mega ohm

5.4 Measurement of Contact resistance between upper and lower terminal. The measured values shall be as per the supplier manual.

- M/s BHEL – Max. 80 micro-ohms
- M/s ALIND- Max. 50 micro-ohms
- M/s MEGAWIN- Max. 100 micro-ohms

5.5 The AC and DC connections should be made as per the approved drawing.

5.6 Measurement of spring charging time in seconds (for spring-type mechanism).

5.7 Perform Manual Operations before energisation.

5.8 Inspection of working of interlock.

5.9 Visual Observation of Porcelain Insulator for any crack /damage.

5.10 Earthing connections have been made properly.

5.11 Check silica gel granules should be blue in colour.

5.12 The door has been properly fixed, and the door gasket is placed properly so that no moisture/vermin ingress takes place.

5.13 No foreign materials (wire, tool, etc.) are left on or inside the equipment

5.14 No moisture should be available in the control cubicle.

5.15 Ensure that the heater is in healthy condition.

5.16 Ensure that the Capacitor Tripping Device (CTD) in the Circuit Breaker cubicle has been set at 85+/- 3V.

5.17 If stored for a longer period (for more than one year), moisture may ingress in the pole unit housing so it should be specially checked for any type of moisture ingress. BHEL make units come with prefilled nitrogen at 0.5kg pressure in the pole unit.

5.18 The manufacturer manual may also be followed for additional requirements (if any).

5.19 The Measurement of open/close timing, travel, dynamic contact resistance, etc. using a circuit breaker Analyser.

5.20 Check the function of anti-pumping in Circuit Breaker.

5.21 Corresponding Isolator Interlock Operation to be checked.

6. Tools required for maintenance:

In addition to normal maintenance tools, the following special tools may also be required for the maintenance of Vacuum Circuit Breaker and Interrupters.

6.1 Circuit Breaker/Interrupter Analyser for the measurement of Timing, Travel, and Contact Resistance. RDSO vide letter no. TI/PSI/DCRM/POLICY/12 dated 17.07.2012 has circulated a tentative specification to the railway for the equipment.

6.2 2.5 kV/5kV Insulation Tester.

6.3 Electronic Multimeter to measure coil resistance and auxiliary contact resistance.

6.4 High pot tester for Power frequency withstands Voltage Test (up to 95kV).

6.5 The manufacturer specified lubricants for lubrication.

7. Maintenance Schedule:

As Each Manufacturer has a different Operating Mechanism, some of the checkpoints given in the table, will be applicable for a particular make/type only. The manufacturer's manuals shall be followed for the detailed settings.

The maintenance schedule has been categorized into monthly, yearly, and six-yearly schedules detailed below.

7.1 Monthly Schedule:

The points to be checked in the monthly inspection are tabulated below:

SN	Items to be checked	Inspection/Testing	Action Required
1.	Porcelain Insulator	Visual Inspection for any Crack/Damage/Cleanliness	The surface should be cleaned after shutting down permission
2.	Control Box	Moisture/Rainwater Condensation	On the Heater if moisture is observed.
3.	Condition of open/ close indication	Observe Visually	If the indication is not found, then check and correct it
4.	Spring Charge Indication	Observe Visually	If the indication is not found, then check and correct it
5.	Counter Reading	To be noted	
6.	Top/Bottom Terminal	Check for overheating signs over terminals	Confirm it by thermal imaging/contactless

			thermometer and tighten the terminals, if found loose after taking shutdown.
7.	Colour of Silica Gel	Check the colour of the silica gel	Replace silica gel if the colour changes from deep blue to white/pink colour.
8.	Control Voltage	Control Voltage is at the required voltage	
9.	Unusual sound	Check for any unusual sound during Electrically & Manually operation.	

7.2 **Annual Inspection:**

All the monthly inspection points shall be applicable in the yearly inspection along with the points tabulated below:

SN	Items to be checked	Inspection/Testing	Action Required
1.	Moving and sliding Parts	Check for lubricant	Lubricate if required (only supplier-recommended lubricant)
2.	Contact wear indication	Check for contact wear mark on the steel stem of the pull rod in closed condition	If the wear mark is not seen, then the contact is worn off and requires Vacuum Bottle replacement.
3.	Speed Regulator	Inspection for free movement	
4.	Reduction gear	Oil Leakage/abnormal Sound	Replace the unit if an abnormal sound is observed.
5.	Travel and Wipe characteristics	Check the value of the wipe and travel are as per manufacturer	Correct as per supplier Instruction Manual
6.	Fasteners of Motor Limit Switch and Auxiliary Switches	Tightness of the fasteners and terminal screws, split pins/snap pins etc.	Tighten /locking to be done if found loose.
7.	Tightness of Hardware	Inspect for any looseness	Tight if found loose.
8.	Pole Part of VCB and VI	The Insulation Resistance measurement shall be measured by 2.5/ 5kV Megger. It shall be as per	If found less than the supplier specified investigate the

		OEM's specified value. • Between Open Terminals (BHEL-min 5000 MΩ) (ALIND-min 5000 MΩ) (Megawin-min 300 MΩ) • Between Lower Terminal and earth (BHEL- min 5000 MΩ) (ALIND-min 5000 MΩ) (Megawin-min 300 MΩ)	insulating rod and Porcelain.
9.	Operating Coil Resistance Measurement	Resistance is below the supplier's specified limits. (M/s. BHEL-43+/-5%)	Change the coil if not under limits
10.	Closing (at 85%) and tripping (at 70% of rated Voltage i.e. 110VDC) operation Check	If not operate	Change the coil
11.	Closing Time	Should be less than 150ms (VCB), Should be less than 120ms (VI) or As per the supplier's specification.	
12.	Tripping Time	Less than 80ms (VCB). Less than 90ms (VI).	
13.	Open/Close Operation	Operate 10 electrically and 10 manually operations	
14.	Contact resistance	The contact resistance of the main contacts shall be measured by Micro Ohm Meter and shall be as per OEM's specified value M/s Megawin-Max. 100 micro-ohm. M/s BHEL-Max. 80 micro-ohm M/s ALIND- Max. 50 micro-ohm.	
15.	Anti-pumping	The functioning of Anti-pumping to be checked.	
16.	CTD	The functioning of the Capacitor tripping device is to be checked.	
17.	Interlock	Checking the interlock with DPI	
18.	Door Gasket	The door Gasket should be checked and if necessary, replaced.	

7.3 **Six Yearly Inspection**:

The entire Monthly and yearly inspection points shall be applicable in the Six Yearly inspections along with the points tabulated below:

SN	Items to be checked	Inspection/Testing	Action Required
1.	Healthiness of Vacuum Bottle/power frequency test	Equipment shall withstand 55kV/76kV/95kV power frequency voltage (as specified by supplier) applied across its contacts in open condition.	Replace the bottle if not withstand.
2.	Slow opening and closing	After all the inspection slow opening and closing shall be done.	Observe normal operation.

सत्यमेव जयते

भारत सरकार, रेल मंत्रालय
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ई मेल/E-mail : dtiohed.rdso@gmail.com

संख्या/No. TI/OHE/ Thermo-vision Camera /2017 दिनांक/Dated, the 26th October, 2017

To,

The Principal Chief Electrical Engineer,

(i) Central Railway, Station Building, Mumbai CST – 400 001. (ii) Eastern Railway, Fairlie Place, Kolkata-700 001.
(iii) East Central Railway, Hajipur-844 101. (iv) East Coast Railway, Bhubaneshwar-751 023.
(v) Northern Railway, Baroda House, New Delhi - 110 001. (vi) North Central Railway, Allahabad-211 015.
(vii) North Eastern Railway, Gorakhpur-273 012. (viii) North Frontier Railway, Mailgaon - 781 011.
(ix) North Western Railway, Jaipur – 302 017. (x) Southern Railway, Park Town, Chennai- 600 003.
(xii South Central Railway, Railnilayam, Secunderabad-500371(xii) South Eastern Railway,Garden Reach, Kolkata-700 043.
(xiii) South East Central, Railway, Bilaspur-495 004. (xiv) South West Railway, DRM's Office, Hubli-580 028.
(xv) Western Railway, Churchgate, Mumbai-400 020. (xvi) West Central Railway, Jabalpur- 482 001.
(xvii) Central Organisation for Railway Electrification, Nawab Yusuf Road, Allahabad-211000.
(xviii) Konkan Railway, Belapur Bhavan, Navi Mumbai – 400614

Sub: Maintenance Instruction on "Identification of defects on traction installation using thermo vision camera and preventive action"

Ref: This office letter no. TI/OHE/Thermo-vision Camera/2017 dated 24.05.2017

Maintenance Instruction No. TI/MI/0055 titled "Identification of defects on traction installation using thermo vision camera and preventive action" is enclosed herewith for implementation.

This is issued with the approval of PED/TI, RDSO.

26/10/17
(नीरज कुमार वर्मा /Neeraj Kumar Verma)
निदेशक(ओएचई-डी)/Director(OHE-D)
[कृते महानिदेशक(कर्षण संस्थापन)/For Director General(TI)]

Encl: As above

Copy to:

1.The Secretary (Electrical)/Railway Board, Rail Bhavan, New Delhi- 110001 for information please.
2. The Executive Director, M/s Rail vikas nigam limited, First Floor, August Kranti Bhawan, Bhikaji Cama Place, R. K. Puram, New Delhi - 110066
3. General Manager (Electrical), M/s IRCON International Limited, C-4, District Centre, Saket, New Delhi, Delhi 110017
4. M/s Power Grid, Qutub Institutional Area, Katwaria, sarai, New Delhi-110016

Government of Indian, Ministry of Railways
Research Design & Standards Organisation, Manak Nagar, Lucknow – 226011.

MAINTENANCE INSTRUCTION FOR IDENTIFICATION OF DEFECTS ON TRACTION INSTALLATION USING THERMO VISION CAMERA AND PREVENTIVE ACTION.

1.0 **SCOPE**: This instruction stipulates the guidelines for prediction/identification of defects on Traction Installation Equipments using Thermo-vision Camera.

2.0 **APPLICATION**: All Traction Installations of OHE, PSI, RC, Stations etc.

3.0 **OBJECTIVE**: To predict/identify defects and to rectify the same by carrying out Preventive Maintenance before in-service failure of equipment.

4.0 **DETAILS OF SPECIAL MAINTENANCE INSTRUCTIONS**:

4.1 **Periodicity of Inspection:** Half-yearly or any other guideline issued by Railway Board and RDSO. However, PCEE may decide more intensive periodicity based on local condition of installations, load, pollution level etc.

4.2 **Recording of the Image:**

a) The image of the complete assembly should be taken and not of individual sub components since the analysis is based on relative temperature of sub-components and not on ambient temperature. For example: if a G Jumper needs to be analysed then complete G Jumper and PG clamps are to be recorded in one picture.
b) The focus of the image should be best possible for better analysis.
c) It is to be ensured that the images are to be saved sequentially in BMT/IS2 format or any other heat pictures format only and not as JPEG. Necessary settings should be made in the camera before starting the imaging.
d) Night time is the best to record the images as the temperature difference is clearly seen.
e) For bridging interrupters at SP and BM/Isolators in normally open condition, recording is to be done after closing the equipment. For standby AT at station/TSS, recording is to be done after connecting it to the load.
f) The checking should preferably be carried out when there is load in the concerned component.
g) Zonal Railways may standardize system of components for better identification.
h) One spare memory card and battery should be kept with Thermo vision camera while capturing the image in the sections.
i) Emissivity (ratio of the energy radiated from a material's surface to that radiated from a blackbody at the same temperature and wavelength and under the same viewing conditions) should be kept between 0.88 to 0.95.

4.3 **Maintenance of Records and Analysis for identifying defective components**:

a) Trained Supervisor/Technician will note the details (recommended format given below, however railway may adopt better format and recommend to RDSO) in a register as well as in computer excel sheet or other program suitable for filtering and analysis but uniformly in the zonal railway. The memory card of thermal image camera along with the register is used to compile data and scrutiny. The images should be stored in the computer/External memory so that these can be retrieved in future. The details should be filled without spelling mistakes for future filtering and analysis.

DEPOT	SECTION	SUB-SECTION	LOCATION	NAME OF SUBCOMPONENT & NUMBER	IMAGE NO	DATE OF IMAGING

MAX. TEMP OF SUB-COMPONENT	MIN. TEMP. OF SUB-COMPONENT	TEMP DIFFERENCE	PRIORITY OF RECTIFICATION	CAUSE OF DEFECT NOTED DURING PREVENTIVE MAINTENANCE	RECTIFICATION DONE

b) In each image the temperature of different similar sub components are to be marked using the marking tool in the camera software. Correct marking over the sub-component is to be ensured by hovering the mouse-pointer over the sub-component to get the maximum temperature.

c) After marking the points the temperatures are recorded and displayed in the image.

d) In the software it should be possible to change the image into different palettes by which the image could be analysed more accurately.

e) It is also possible to change the maximum and minimum temperature-range-scale to get the hot spot more clearly if the temperature difference is not substantial.

4.4 **RECTIFICATION:** After all the images have been analysed, following points are to be noted:

NOTE: Any defect identified during thermos-vision camera imaging at site, requiring immediate attention, should be reported to Depot-In charge, TPC, Officer-In charge and immediate rectification should be ensured.

a) The records, as per 4.3 above, should be filtered on the basis of temperature difference of 5 degrees and above.

b) A copy of the data made by the nominated Supervisor/Technician is also given to the TPC to note day to day progress.

c) Defective PG clamp, catenary wire and jumpers should be attended on priority.

d) Priority of rectification shall be based on temperature difference as below:

Variation of temperature Compare with adjacent/ nearby similar components	Duration for attending
a- > 20 °C b- 10°C-20°C c- 5°C-10°C d- <5°C	a. 24 hours b. 5 Days c. 10 Days d. Normal

e) Images of the rectified component should also be taken.

5.0 **Agency for Implementation**: Railways, Construction Organizations and Railway Electrification agencies (for Measurements defect identification during erection and commissioning).

6.0 **References**: Railways Feedback was taken for preparing the SMI.

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Government of India, Ministry of Railways
Research Designs & Standards Organisation, Manak Nagar, Lucknow – 226011

1. TITLE: Prevention from climbing of Monkey over Traction Installation structures.

2. OBJECTIVE: To minimize the failures of **Traction Installations (OHE, SP/SSP/FP/ TSS)** due to climbing of the monkey over High Voltage live structures **(Mast, Portal upright, Gantry Mast upright etc.)** causing Electrical and Mechanical failures resulting in traffic disruption, loss of material and man hours.

3. MAINTENANCE INSTRUCTIONS:

3.1 Following arrangements are suitable to prevent climbing of monkey over Traction Installations structures and should be provided.

3.1.1 Barbed wire frame Arrangement: Annexure-I- Latest revision of Drg. No. TI/SK/OHE /ANTIMON/RDSO/ 00001/08/0.

3.1.2 Cylindrical Arrangement:

3.1.2.1 Annexure-II-drawing. Galvanized Steel or Aluminum Cylindrical Drum.

3.1.2.2 Philosophy is to prevent Monkey from gripping structure while climbing.

3.2 Different type arrangements may also be provided within same Railway for comparison.

3.3 These arrangements shall not be provided on ATD locations.

3.4 Arrangement will be provided on identified Monkey Prone Locations/Sections approved by PCEE.

3.5 Provisions of Indian Railways Schedule of Dimensions 1676mm Gauge (BG) Revised 2004 with ACS shall not be violated.

4. MAINTENANCE OF RECORDS:

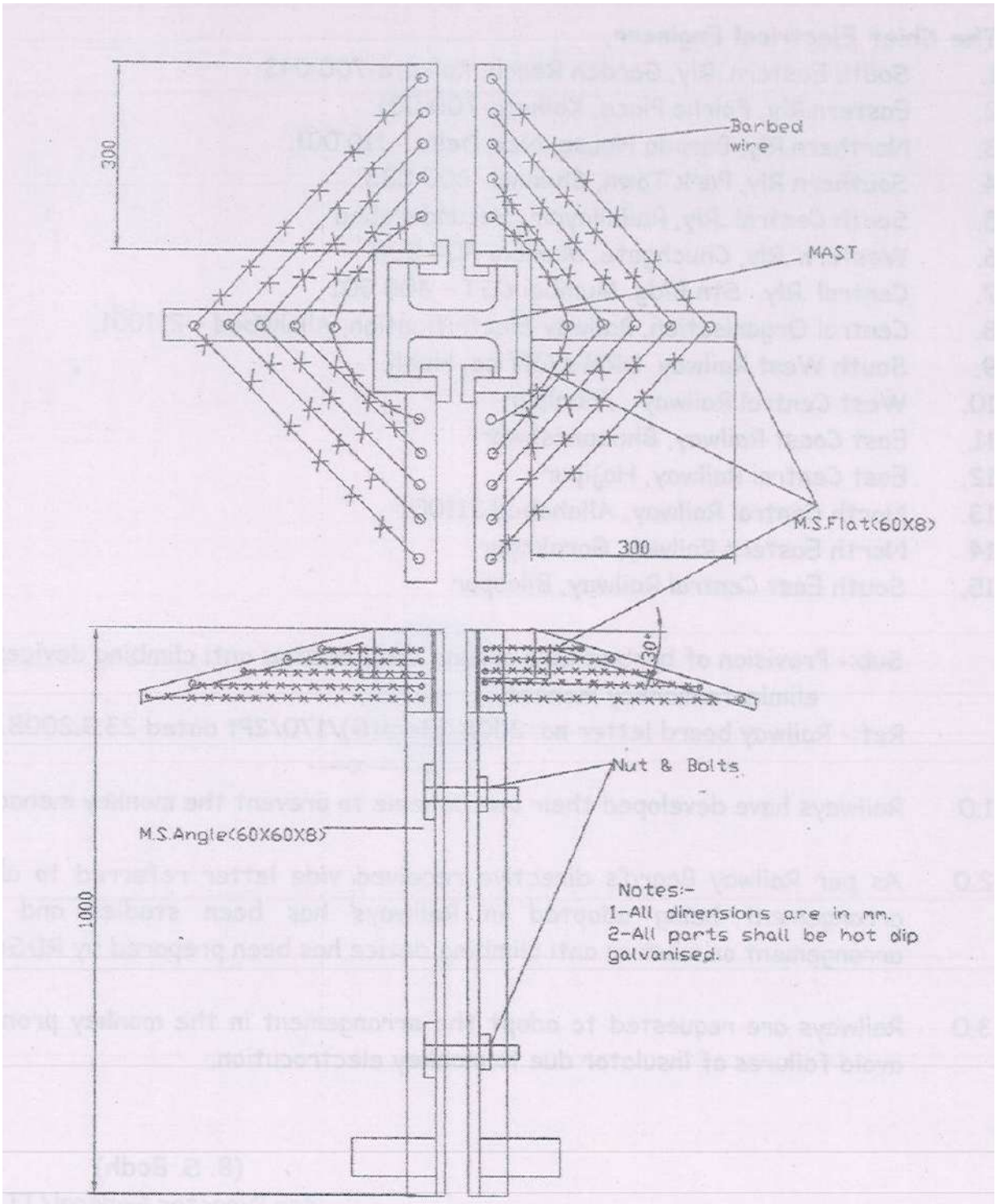
For failure analysis, record of locations & date of provision, shall be maintained in the OHE Depot.

5. AGENCY FOR IMPLEMENTATION: Railway TRD Maintenance organization.
Not to be implemented by Electrification agencies.

6. REFERNCES:

(a) Railway Board letter No.2007/Elect(G)/220/2 Pt-II dated 10.11.2017
(b) RDSO letter No. TI/OHE/GA/2017 dated 09.03.2018
(c) Railway Board letter No. 2000/EEM/220/1 dated 27.10.2020

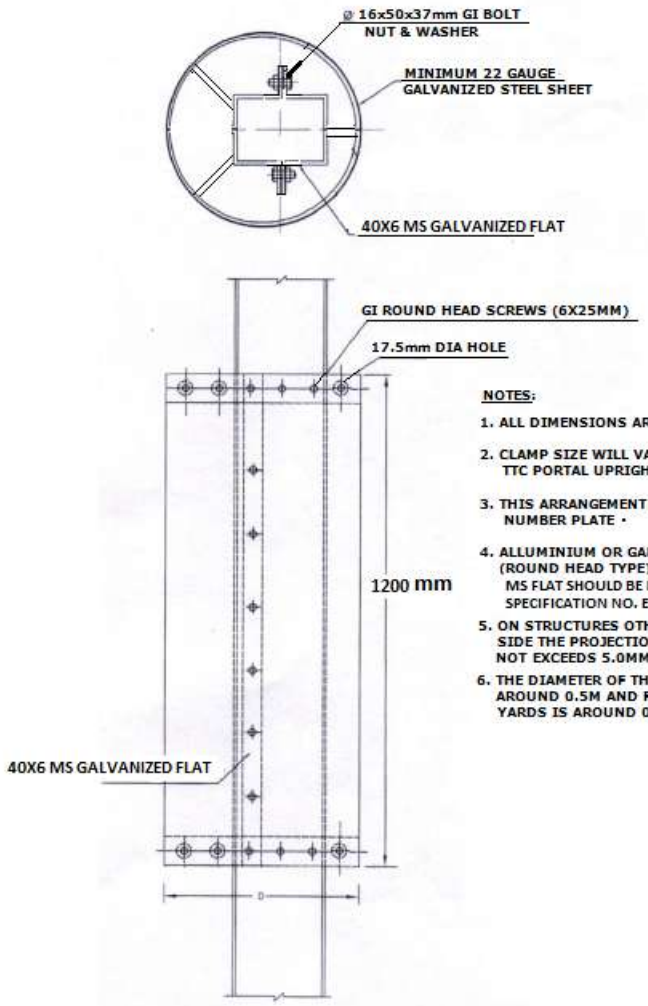
Annexure-I



DN	CK	AP	Anti Clumbing Arrangement
			Drawing No.
SE/TI			TI/SK/□HE/ANTIM□N/RDS□/00001/08/0

Annexure-II

MONKEY ANTI-CLIMBING DEVICE FABRICATION SKETCH



NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. CLAMP SIZE WILL VARY AS PER SIZE OF MAST & TTC PORTAL UPRIGHT.
3. THIS ARRANGEMENT SHALL BE FIXED ABOVE NUMBER PLATE.
4. ALLUMINIUM OR GALVANISED SHEET TO BE BOLTED (ROUND HEAD TYPE) WITH MS GALVANISED FLAT. MS FLAT SHOULD BE HOT DIP GALVANIZED AS PER SPECIFICATION NO. ETI/OHE/13(4/84).
5. ON STRUCTURES OTHER THAN PORTALS ON TRACK SIDE THE PROJECTION OF SHEET SURFACE SHOULD NOT EXCEEDS 5.0MM FROM THE FACE OF THE MAST.
6. THE DIAMETER OF THE DEVICE FOR MAST IS AROUND 0.5M AND FOR PORTAL STRUCTURES IN YARDS IS AROUND 0.9M.

For TTC mast

For BFB/RSJ mast

Internal Construction of the device

SPECIAL MAINTENANCE INSTRUCTIONFOR FINDING JOINT LOCATION AND FLAW IN THE JOINT OF JOINTED GROOVED COPPER CONTACT WIRE

1. **OBJECTIVE:** Condition monitoring of in–service "Jointed Grooved Copper Contact Wire".

2. **BACKGROUND:** In 25kV a.c. Traction System, failures of silver brazed joints of Jointed Grooved Copper Contact Wire (hereinafter referred as JGCC wire) are being reported due to opening of silver brazed joint. Opening of silver brazed joint may be due to poor manufacturing technique, effect of sliding of Electric loco pantograph, corrosion due to industrial pollution and vibration fatigue and other internal defects during manufacturing stage.

   Western Railway and Southern Railway have successfully done condition monitoring using ultrasonic scanning. Based on their experience and feedback from other railways following maintenance instructions are being issued.

3. **INSTRUCTIONS:** The most common technique for detection of cracks is ultrasonic scanning. Following are the equipment and operating guidelines for using on contact wire

   i. **Flaw detector:**
      a) It should be pulse echo type.
      b) It should be capable to carry out 100% scanning by accessing only bottom side of JGCC wire.
      c) Battery used shall be re-chargeable, plug-in type with approx. 8 hours continuous operation capacity per charge.

   ii. **Probe**:
      a) Angle beam probe of size 5 mm (diameter) should be used.
      b) Probe should have adjustable angle facility and frequency of 2.5MHz.
      c) Probe should have changeable wedge, which can be changed depending on the condition of JGCC wire.
      d) During scanning, angle of probe should be adjusted to 70^0,
      e) Test Range: 0-100 mm,
      f) Reference Sensitivity amplitude: 70 dB, Scanning amplitude: +6dB.

   iii. **Scanning:**
      a) Scanning should be done on the bottom part of JGCC wire.
      b) JGCC wire should be applied with Couplant (refer probe manual) before scanning.
      c) Speed of scanning shall be suitable enough for greater efficiency.

   iv. Maintenance:
      a) The identified flawed/suspected locations found shall be marked by clip with red paint. It should preferably be spliced simultaneously using separate staff without affecting continuity of scanning.
      b) The jointed contact wire tension length shall be replaced with contact wire made out of CCC rod at earliest opportunity on programmed basis in the "identified polluted areas" and those tension lengths where contact wire tension has been increased.
         In other areas, failure prone JGCC wire may be replaced in phased manner.
      c) Maintenance depot shall keep a record in register of the tension lengths of JGCC wire in following format:

Section	Line	JGCC wire Tension length Location		Date of scanning	Indication % of FSH respect to RSL, location			Splice provided	JGCC Wire Tension length replaced
		From	To		From	To	%	YES/ NO	YES/ NO

   v. **Periodicity of scanning:** Annual ultrasonic checking of balance JGCC wire. In addition, quarterly TW checking in identified high-polluted area.

4. Railways shall submit to RDSO the total length, no of tension lengths of JGCC wire in service, Replaced during last year.

5. REFERENCES:

1. Specification for hard drawn grooved contact wire(jointed/welded)-ETI/OHE/042(6/97)
2. SMI no. TI/MI/0037 for OHE contact wire and associated fittings.

676180/2021/O/o PED/TI/RDSO

Government of India

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Ministry of Railways

Research Design & Standards Organisation

Manak Nagar, Lucknow-226011

MAINTENANCE INSTRUCTION No. TI/MI/0058, Revision-1
Maintenance Instructions
For
SPECICAL MAINTENANCE INSTRUCTION (SMI) TO PREVENT CONTACT WIRE PARTING AT RRA LOCATION

	Prepared By	Checked By	Recommended By	Approved By
Signature	SSE/OHE(D)	JDTI-II	EDTI	PEDTI
Date	10.8.2021	10.8.2021		

Issued by

Traction Installation Directorate
Research Design & Standards Organisation
Manak Nagar Lucknow- 226011

SPECICAL MAINTENANCE INSTRUCTION (SMI) TO PREVENT CONTACT WIRE PARTING AT RRA LOCATION

1. Objective to Prevent contact wire parting at RRA location.

2. BACK GROUND: On 25 KV AC Traction System, there have been many failures of Contact Wire parting at RRA clamp due to non- availability of curvature on sides of RRA clamp.

3. FAILURE PROCESS

   a) Cantilever rotates (upto 550 mm depending upon tension length) front and back due to temperature variation.
   b) Non availability of curvature results in groove formation on contact wire & results in failure in tensile mode.
   c) Contact wire may part on either side of RRA clamp.

4. Maintenance Instruction:

   a) Special Drive should be launched to identify locations where RRA Clamp sides are not having curvature.
   b) Provide correct RRA clamp, i.e. RRA clamp having curvature on both sides.
   c) Check for cracks/damages of contact wire & replace contact wire piece during RRA clamp replacement or otherwise.
   d) Ensure stagger as per drawing (both Contact wire & Catenary wire have the same stagger).
   e) Provide correct RRA dropper length as per drawing. Dropper is in single piece.
   f) Ensure Proper gradient, relative gradient of contact wire.
   g) Ensure correct Raised Register Arm Tube (RRT) length as per drawing.
   h) The above points should also be checked during AOH & POH maintenance.
   i) Railway should ensure provision of RRA clamp (RI No.1371-3) made of SGCI as per RDSO drawing No. ETI/OHE/P/1370-1, Mod-H in each overlaps locations in place of RRA clamp made of MCI (Drawing No. ETI/OHE/P/1370-1, Mod-E).
   j) Inner diameter of RRA clamp should be measured before installation. The inner diameter should be equal to 13mm.

5. Provision of supporting contact wire:

a) It is advised that an additional piece of contact wire approximately 2m length may be provided across RRA clamp with 02 PG clamps on either side as a short term measure to avoid falling down of OHE in case of contact wire parting at RRA location. The both end of supporting contact wire should be bent in C shape to avoid slipping of PG. This arrangement should be provided at location where RRA clamps are not available as per drawing mentioned in para 4(i).

b) The arrangement for supporting contact wire across RRA clamp with 02 PG clamps on either side is shown in figure-1.

FIGURE-1

6. Note**:**

a) RRA clamp should be flexible (free) at RRA adjuster.

b) Raised register arm tube (25mm)(RI No. 2431) lengths are 0.3m,0.6m,0.8m,1.0m,1.2m,1.5m & 1.7m.

c) Raised Register Arm Dropper Assembly should as per drawing No. ETI/OHE/P/2470 Rev.-E.

7. REFERENCES:

a) ETI/OHE/P/1370-1 Rev. H(Raised Register Arm Clamp) , ETI/OHE/P/1370-1 Mod-E, (Raised Register Arm Clamp , MCI), ETI/OHE/P/2470 (Raised Register Arm Dropper Assembly), ETI/OHE/P/2471-1 Rev.-E (Dropper Clip (25) for Raised Register Arm), ETI/OHE/P/2472-1 Rev-B (Raised Register Arm Dropper), ETI/OHE/P/2480 (Raised Register Arm Dropper Assembly). (ETI/OHE/P/1041-2, Rev.-C contact wire parallel clamp).

b) RE/33/P/2431,Rev.-D (Raised Register Arm Tube 25), RE/33/P/2432 Rev.-E(Raised Register Arm Adjuster 25mm).

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फ़ैक्स/Fax : 91-0522-2465731
ईमेल/E-Mail:dtiohed.rdso24@gmail.com

File No: RDSO-TI0LKO(OHE)/33/2020 -Part(1) Date : As signed

To,
Principal Chief Electrical Engineer,
Address: As per attached list.

Sub.: Revised Maintenance Instruction No. TI/MI/0059-Rev.3 for Provision of Anti-bird disc & Packing saddle with Catenary Suspension clamp.

Ref. (i) This office letter No. RDSO-TI0LKO (OHE)/33/2020-Part (I) dtd. 06.11.2024.
(ii) SWR letter No. SWR/EL/T-601/RDSO/22(E-157939) dtd. 05.03.2025.

Vide reference (i) above; RDSO issued the Maintenance Instruction No. TI/MI/0059-Rev.2 regarding the provision of Anti-bird discs & Packing saddles (RI No. 1174), along with Catenary Suspension clamps (RI No. 1161) to all ZRs.

2. SBC division of SWR vide reference (ii) has reported certain observations on SMI No. TI/MI/0059-Rev.2 related to Fire Retardant grade of the Anti-bird discs material.

3. In Rev.2 of SMI, polycarbonate material flammability grade of 5VA as per UL-94 was given. Considering the observations, the flammability rating of polycarbonate material in Revised Maintenance Instruction No. TI/MI/0059-Rev.3 have been changed and as per revised SMI, Polycarbonate material of Flammability Rating V-2 or higher rating upto 5VA as per UL-94 can be used for Anti-bird disc manufacturing.

4. Copy of Revised Special Maintenance Instruction No. TI/MI/0059-Rev.3 for Provision of Anti-bird disc & Packing saddle (RI No. 1174) with Catenary Suspension clamp (RI No.1161) is enclosed herewith.

5. Type Tests & Acceptance Tests for Anti Bird Disc and Silicon-O Ring have been included in para 4.1(h) of SMI.

6. Prototype test may be done by RDSO on case-to-case basis as required by Zonal Railways. However, the Acceptance tests shall be done by Zonal Railway/Inspecting agency.

This is issued with the approval of competent authority.

21/3/25
(Gaurang Gupta)
Director/(TI-II)
[For Director General(TI)]

Encl: As above

Mailing List for letter No. RDSO-TI0LKO(OHE)/33/2020 -Part(1)

SN	Railways/ PSUs	Gov. Email ID	Gmail ID
1	PCEE/CR	cee@cr.railnet.gov.in	cedecrly@gmail.com, dyceetrdcrly@gmail.com
2	PCEE/ER	cee@er.railnet.gov.in	cedeerly@gmail.com
3	PCEE/ECR	cee@ecr.railnet.gov.in	dyceetrdhjp@gmail.com cedeecr@gmail.com
4	PCEE/ECoR	cee@ecor.railnet.gov.in	cedeecor@gmail.com, ceeecor@gmail.com
5	PCEE/NR	cee@nr.railnet.gov.in	nrtrdhq@gmail.com
6	PCEE/NCR	cee@ncr.railnet.gov.in	cedencrald@gmail.com
7	PCEE/NER	cee@ner.railnet.gov.in	nerhqtrd@gmail.com, ceenerly@gmail.com
8	PCEE/NFR	cee@nfr.railnet.gov.in	cedenfr@gmail.com dyceetrdnnfrmlg@gmail.com
9	PCEE/NWR	cee@nwr.railnet.gov.in	nwrhqtrd@gmail.com
10	PCEE/SR	cee@sr.railnet.gov.in	cedesr.2020@gmail.com
11	PCEE/SCR	cee@scr.railnet.gov.in	cedescr789@gmail.com, trdscr@gmail.com
12	PCEE/SER	cee@ser.railnet.gov.in	trdsergrc@gmail.com cedesergrc@gmail.com
13	PCEE/SECR	cee@secr.railnet.gov.in	cedesecr@gmail.com
14	PCEE/SWR	cee@swr.railnet.gov.in	swrtrdhq@gmail.com
15	PCEE/WR	cee@wr.railnet.gov.in	Dyceetrd2020@gmail.com
16	PCEE/WCR	cee@wcr.railnet.gov.in	cedewcrjbp@gmail.com dyceetrdwcr@gmail.com
17	CAO, CORE	cee@core.railnet.gov.in	ceempcore@gmail.com, dyceemp@gmail.com, dyceemp1@gmail.com, dyceemp2@gmail.com
18	PCEE/KRCL	cee@krcl.co.in	edbo.kr@krcl.co.in

सत्यमेव जयते

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय Ministry of Railways

निर्देश संख्या. टी आईएम/ आई /0059 रिवि. 3

MAINTENANCE INSTRUCTION No. TI/MI/0059
Rev.3

एंटी-बर्ड डिस्क और कैटेनरी सस्पेंशन क्लैंप (आरआई नंबर 1161) के साथ पैकिंग सैडल (आरआई नंबर 1174) के प्रावधान के लिए रखरखाव निर्देश

MAINTENANCE INSTRUCTIONS FOR PROVISION OF ANTI-BIRD DISC & PACKING SADDLE (RI NO. 1174) WITH CATENARY SUSPENSION CLAMP (RI NO.1161)

(March, 2025)

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक (कर्षण संस्थापन) Principal Executive Director (TI)	21.3.25
अनुशंसित Recommended by	कार्यकारी निदेशक (कर्षण संस्थापन) Executive Director (TI)	21/03/25

जारी कर्ता/ ISSUED BY:

कर्षण संस्थापन निदेशालय
TRACTION INSTALLATION DIRECTORATE,

अनुसंधान अभिकल्प और मानक संगठन
RESEARCH DESIGNS & STANDARDS ORGANISATION,

मानक नगर, लखनऊ- 226011
MANAK NAGAR, LUCKNOW-226011

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	Prepared By	Checked By	Issued by
Signature & Date	20.03.25	AMIT KUMAR Digitally signed by AMIT KUMAR Date: 2025.03.20 19:48:47 +05'30'	20/3/25
Designation	JE/ TI	ADE/ TI-2	DIRECTOR/ TI-2

Amendment History

Revision Number	SMI NO	Total pages	Date of Issue	Reasons for Amendment/ Revision
0	TI/MI/0059	05	20.01.2020	Railways were reporting flashing and breakage/parting of insulator due to bird fault.
1	TI/MI/0059 (Revision 1)	06	04.01.2024	Revised for correction in drawing Nos. of Anti Bird Disc and inclusion of tolerance on Anti Bird Disc.
2	TI/MI/0059 (Revision 2)	09	05.09.2024	Considering failure of Anti Bird Disc material reported by Zonal Railways, material of Anti Bird Disc has been revised from Acrylic to Polycarbonate.
3.	TI/MI/0059 (Revision 3)	10	21.03.25	FR rating of Anti-bird material changed from 5VA to V-2 or higher rating as per UL-94.

INDEX

PARA	DESCRIPTION	PAGE NO.
1.	TITLE	03
2.	BACKGROUND	03
3.	OBJECTIVE	03
4.	INSTRUCTIONS	04&05
5.	AGENCY FOR IMPLEMENTATION	05
6.	MAINTENANCE OF RECORDS	05
ANNEXURE- I	Photographs of Anti Bird Disc arrangement is attached	06&07
ANNEXURE- II	Catenary Suspension clamp, Drawing No. RE/33/P/1160 (Rev. K)	08
ANNEXURE- III (A)	Drawing of Anti bird disc, Drawing. No. TI/ DRG/OHE/ABD/RDSO/00000/19/0 Rev.2 (Sh.-1)	09
ANNEXURE- III (B)	Drawing of Anti bird disc, Drawing. No. TI/ DRG/OHE/ABD/RDSO/00000/19/0 Rev.2 (Sh.-2)	10

	Prepared By	Checked By	Issued by
Signature & Date	Prepared 20.03.25	AMIT KUMAR Digitally signed by AMIT KUMAR Date: 2025.03.20 19:50:29 +05'30'	20/3/25
Designation	JE/ TI	ADE/ TI-2	DIRECTOR/ TI-2

MAINTENANCE INSTRUCTION No. TI/MI/0059 Rev.3
Revised Maintenance Instruction for Provision of Anti-bird disc & Packing saddle (RI No. 1174) with Catenary Suspension clamp (RI No.1161)

1. TITLE:

(i) Provision of Anti-bird disc for prevention of bird fault in composite and porcelain insulator (Stay tube Insulator, Bracket tube insulator and 9 ton insulator).

(ii) Provision of Packing saddle (RI No. 1174) with Catenary Suspension clamp (RI No.1161) are given in modified drawing of suspension clamp (drawing No. RE/33/P/1160 Rev. K) to prevent Catenary Strand Melting/Parting.

2. BACKGROUND:

(i) Railways are reporting flashing and breakage/parting of Insulator, due to bird fault. In bird prone areas, insulator failure and in-turn traffic disruption may take place. This problem takes place due to perching of the bird on the insulator resulting into short circuit between live part and earth.

(ii) Zonal Railways are reporting melting/parting of Catenary strand inside the Catenary suspension clamp due to frequent tripping and passing of fault current through the poor connection of catenary and suspension clamp. During earth fault, the fault current passes from catenary wire to suspension clamp and further to the bracket/ stay tube.

3. OBJECTIVE:

(i) It is proposed to provide anti-bird disc on ST, BT & 9-ton Insulator at bird prone locations to prevent shorting of live part and earth by bird. This anti-bird disc will also act as deterrent for bird to perch on the insulator due to spikes provided on the outer periphery of the disc.

(ii) Provision of Packing saddle to reduce the concentrated force on Catenary wire below 'U' bolt to prevent melting/cutting of the Catenary strand inside the suspension clamp.

4. INSTRUCTIONS:

4.1 (a) Anti bird disc shall be provided on insulator end fitting of 25 kV side of composite and porcelain insulators (ST, BT & 9 ton) with suitable size of silicon O ring to avoid bird fault.

(b) If there is less space between first shed of Porcelain stay insulator and metal cap, Disc may be provided on Mast side. Zonal Railway should keep record of locations & monitor the efficacy of this arrangement on mast side and submit feedback to RDSO.

(c) The disc shall be provided on metal cap of composite insulator and in between first shed and metal cap with suitable size of silicon O ring in porcelain insulator.

(d) Silicon O rubber shall be made of High temperature Vulcanizing (HTV) type Silicon Rubber having Silicon polymer content by weight 30% minimum as per clause no. 4.2.16 of RDSO specification No. TI/SPC/OHE/INSCOM/1072, Rev.02 or latest.

(e) The details of Anti Bird Disc are available in the drawing of Anti bird disc Drg. No.TI/ DRG/OHE/ABD/RDSO/00000/19/0 Rev.2 (sh-1 & sh-2) attached as Annexure- III(A) & III(B). The Diameter (D) of Anti Bird Disc & Distance (L) may be finalized by the Zonal Railways as per the design of the Installed Insulators.

(f) Material of Anti Bird Disc should be Polycarbonate material as per:

i. The Clause no. 4.0, Table 1, Group 01, PC Class 2 of latest ASTM D3935-21

ii. Flammability rating of V-2 or higher as per UL-94, wherein, material are classified among fire rating HB (least flame retardant) to 5VA (highest flame retardant).

Following additional properties of Polycarbonate material are given in below Table.

1.	General Properties		
	Resilient, Easy to Handle, Impact resistant, good dimensional stability, good electrical insulation, UV Resistant, Fire retardant material, Good optical clarity, Chemical resistant		
2.	Dielectric Strength Minimum	ASTM D149	15kV/mm
3.	Flammability Rating	UL94	V-2 or higher rating
4.	Izod Impact Test	ASTM D 256	640J/m, min
5.	Specific Gravity	ASTM D792	1.19 – 1.22

(g) Each Anti Bird Disc shall be engraved the name of manufacturer/logo and year of manufacturing in size of 6 mm figures. The same shall not wiped out during the life of the Anti-bird disc. Photographs of Anti Bird Disc arrangement are attached as Annexure-I.

(h) The test protocol and inspection & certification should be as per details given below:

Test for Anti Bird Disc

Sr. No.	Test Description	Test Standard	Required Value	Type test	Acceptance test	Routine test
1	Visual Examination	SMI-0059 Rev-3	As per RDSO approved drawing	Yes	Yes	Yes
2	Dimension	SMI-0059 Rev-3	As per RDSO approved drawing	Yes	Yes	Yes
3	Specific Gravity	ASTM D 792	1.19 – 1.22	Yes	Yes	No
4	Tensile Yield Strength	ASTM D 638	55 MPa, minimum	Yes	No	No
5	Izod Impact Test	ASTM D 256	640J/m, minimum	Yes	No	No
6	Flammability Test	UL-94	V2 or Higher Rating	Yes	Yes	No
7	Dielectric Strength Test	ASTM D 149	15kV/mm	Yes	No	No

Test for Silicon-O Ring

Sr. No.	Test Description	Test Standard	Required Value	Type test	Acceptance test	Routine test
1	Visual Examination	SMI-0059 Rev-3	As per RDSO approved drg	Yes	Yes	Yes
2	Dimensions	SMI-0059 Rev-3	As per RDSO approved drg.	Yes	Yes	Yes
3	Specific Gravity	ASTM D 792	1.52 – 1.58	Yes	Yes	No
4	Silicone Content	ASTME 1131-2020	30%(Min)	Yes	Yes	No

(i) The lot size for Anti-bird disc and Silicon-O ring shall be 1000 Nos. (Maximum) for testing of minimum three samples per lot. Samples shall be selected randomly from the lot. Sampling size for verification of dimension shall be done as per IS: 2500-1.

(j) Manufacturer shall do dimension verification and visual examination as Routine Test on every sample of Anti-bird disc and Silicon-O ring. The manufacturer shall maintain the record of all tests i.e., Type/Acceptance/Routine tests.

(k) The type tests shall be carried out in accordance with the relevant procedure laid down in governing standard, from any Government lab/ NABL accredited laboratory having the relevant testing facility. Acceptance tests shall be carried out in-house through calibrated testing equipment only.

(l) Firm shall maintain the record of raw materials alongwith relevant Test Certificates. In case of use of inferior raw material/providing false information, necessary administrative action shall be taken against firm as per extant rules.

4.2 Zonal Railways should carry out Inspection and installation of prototype before placing bulk order for manufacturing.

4.3 Packing saddle (RI No. 1174) with Catenary Suspension clamp (RI No.1161) as given in modified drawing of suspension clamp (drawing no. RE/33/P/1160 Rev. K or latest attached as Annexure-II) should be provided at all locations.

5. AGENCY FOR IMPLEMENTATION:

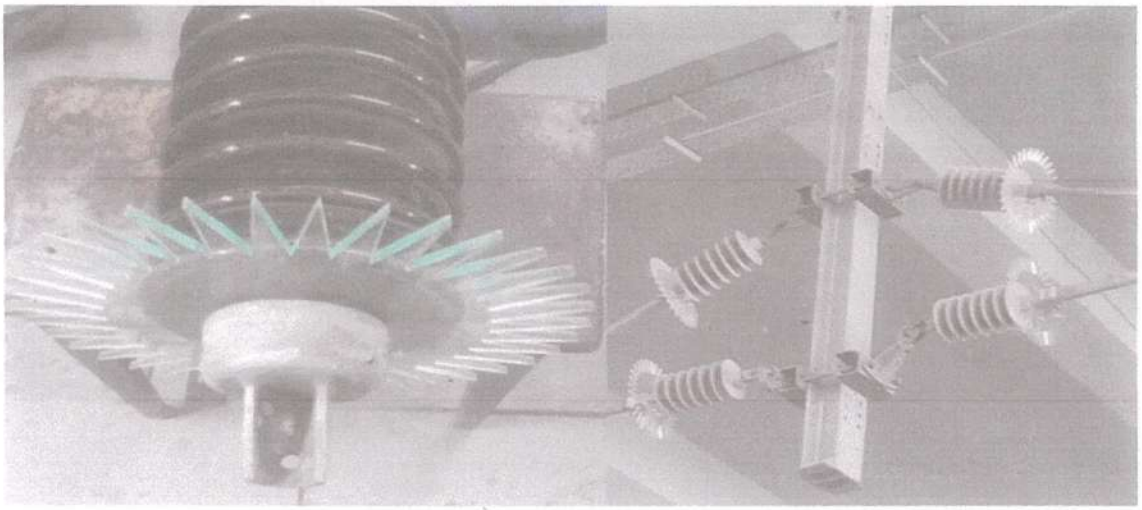
Anti-bird disc arrangements will be provided on identified Bird/tripping Prone Locations / Sections as approved by PCEE.

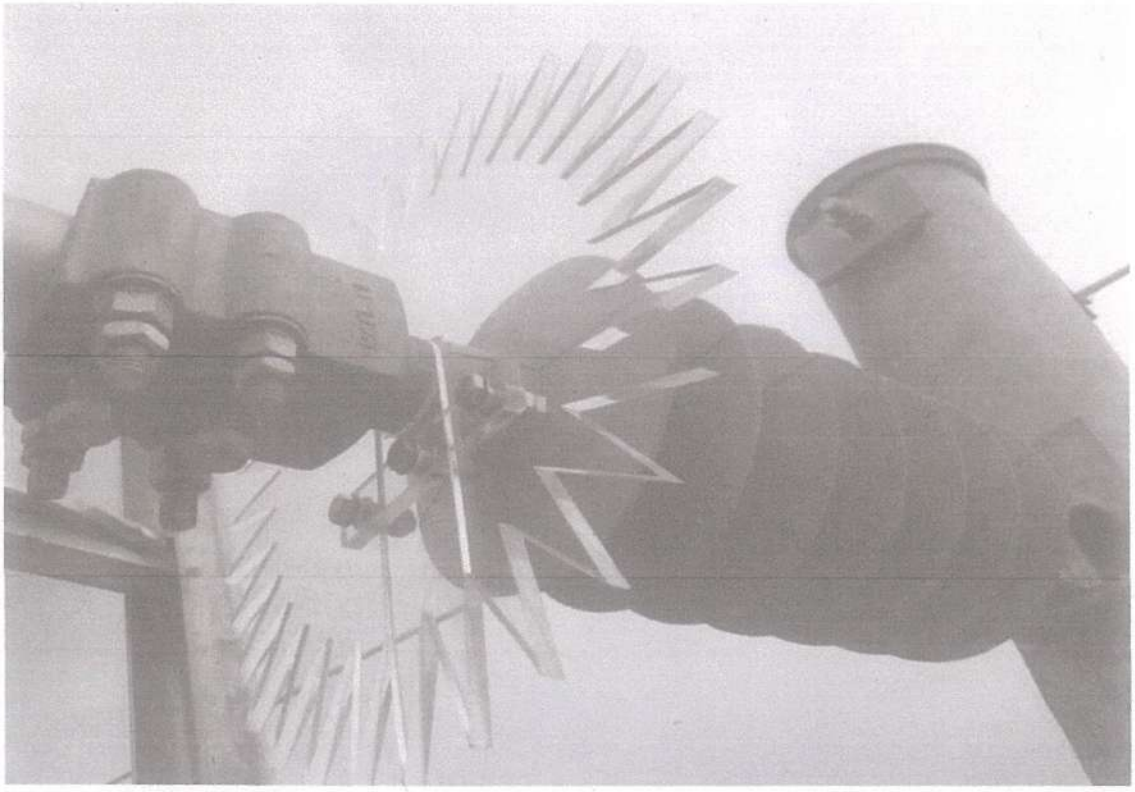
6. MAINTENANCE OF RECORDS:

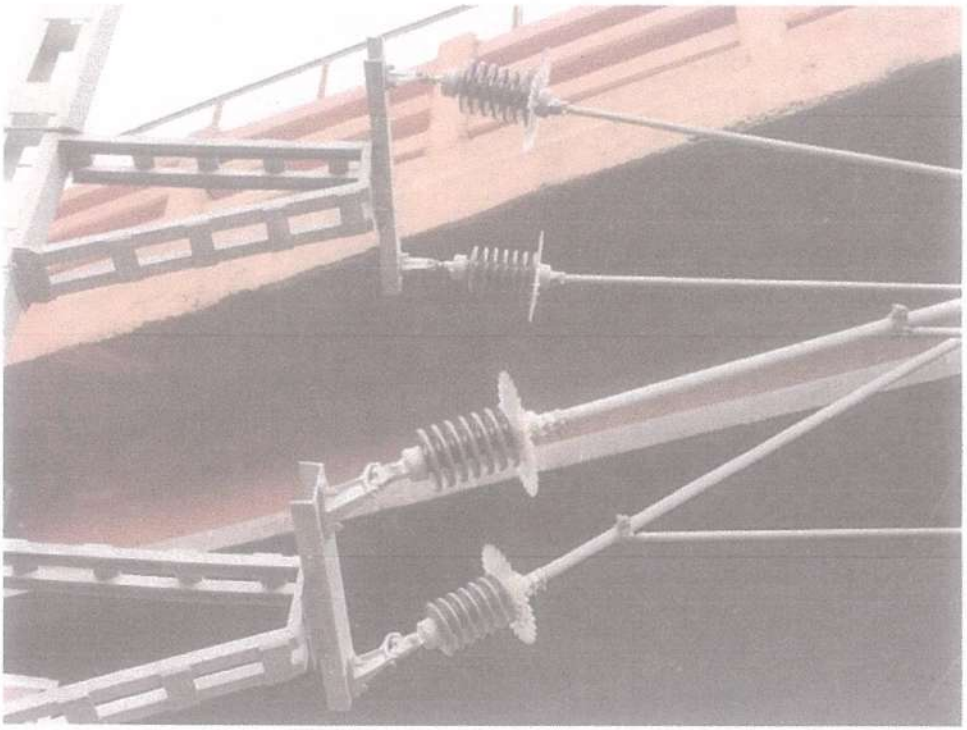
Railways are advised to keep record of the locations where Anti-bird disc arrangement and packing saddle have been provided to know the efficacy of the proposed system. It is also advised to send feedback on the same every six months regarding the effectiveness of the proposed system.

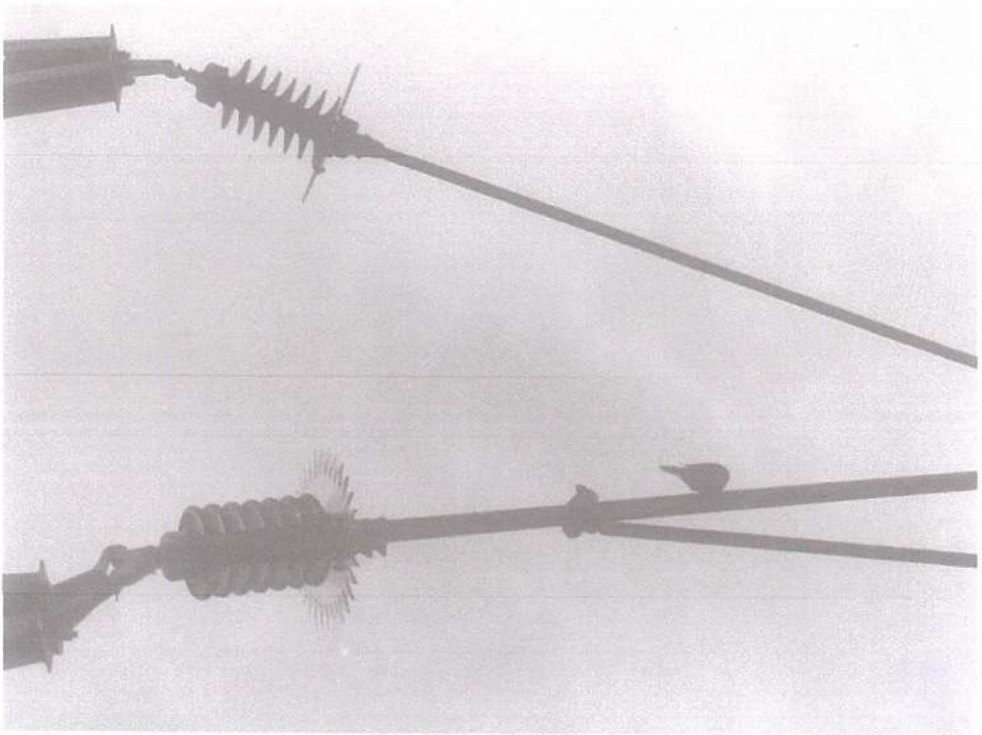
Annexure-I of TI/MI/0059 – Rev.3

Photographs of arrangements of Anti-Bird Disc and Insulator



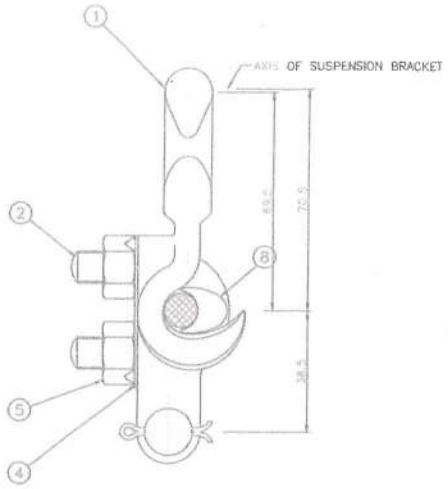


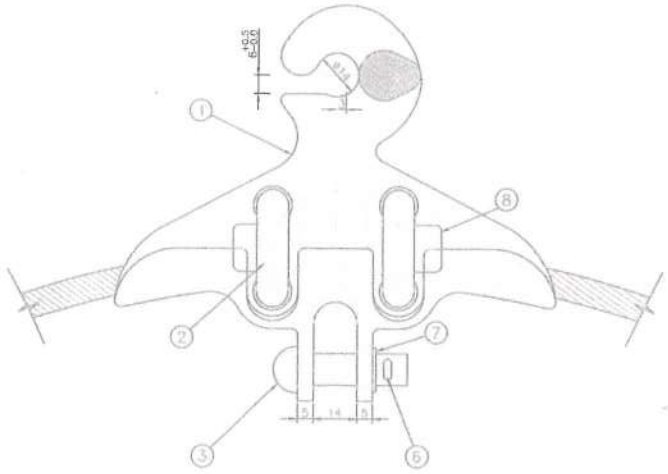


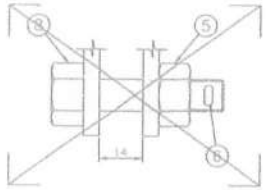


	Prepared By	Checked By	Issued by
Signature & Date	Pramod 20.03.25	AMIT KUMAR Digitally signed by AMIT KUMAR Date: 2025.03.20 19:53:41 +05'30'	
Designation	JE/ TI	ADE/ TI-2	DIRECTOR/ TI-2

SN 89







DELETED

REF. No.	DESCRIPTION	PART No.	MATERIAL	SPECIFICATION	Approx. WEIGHT (kg)	No.OFF	
1	SUSPENSION CLAMP BODY	1161	ALUMINIUM BRONZE	IS:3091		1	
2	'U' BOLT ø10mm	1162-S	STAINLESS STEEL	ETI/OHE/18		2	
3	PIN ø10mm/35mm	161-S	"	"		1	
4	SUSPENSION CLAMP LOCK PLATE	1163	ANNEALED COPPER	IS:1897		2	
5	NUT	10N	STAINLESS STEEL	ETI/OHE/18		4	
6	SPLIT PIN 2.5x20mm		ANNEALED COPPER	IS:549		1	
7	PUNCHED WASHER A12		PHOSPHOR BRONZE	ETI/OHE/18		1	
8	PACKING SADDLE	1174	HALF HARD COPPER	IS:1897		1	

NOTES:-

1. ALL DIMENSIONS IN mm.
2. TO BE USED FOR SUSPENSION OF:-
   CATENARY(65)(ø10.5mm).

SUSPENSION CLAMP

DEE/OHE RE Sd/- 1.2.66

AEE/OHE RE Sd/- 1.2.66

REF.:--

IDENTIFICATION No.:- 1160

DATE	MOD	NATURE OF MOD.	INITIAL
1.4.60	'J'	[illegible]	Sd/-
31.8.84	'H'	[illegible]	Sd/-
9.8.83	'G'	[illegible]	Sd/-
26.4.74	'F'	[illegible] CORRECTED	Sd/-
13.9.65	'E'	RETRACED	

RAILWAY ELECTRIFICATION

RE/33/P/1160 REV. K

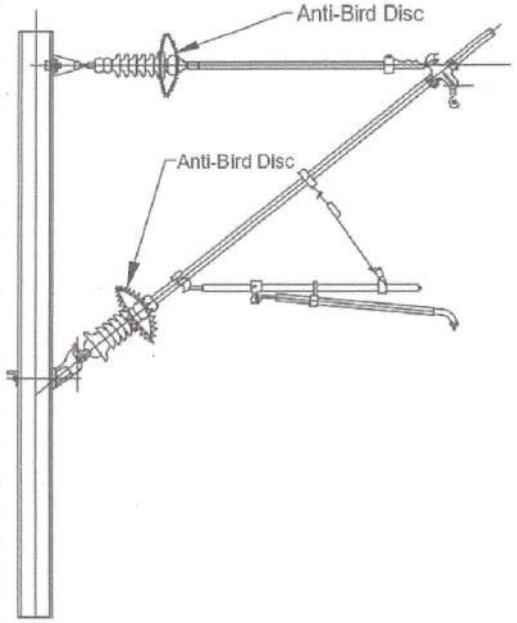
DR. DATE NAME

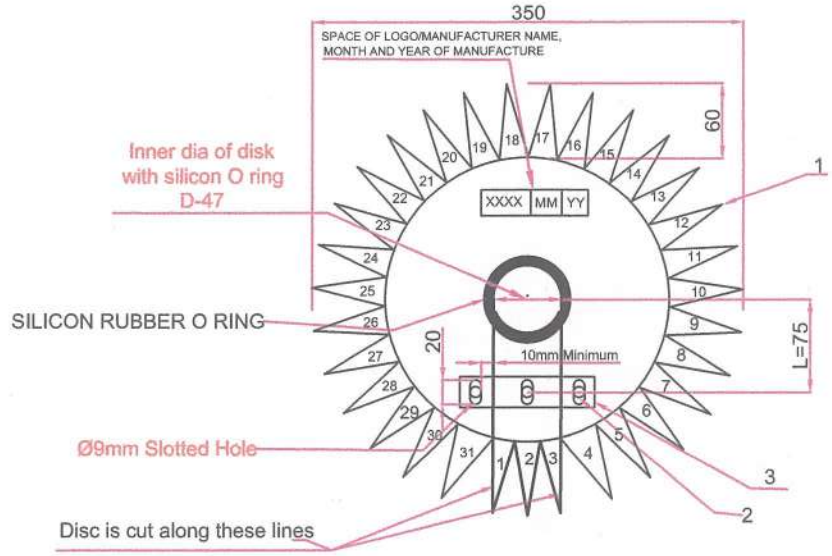
TC Sd/-

CK. 01 Sd/-

SCALE: - 1:1

IR

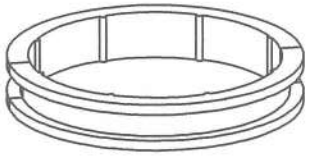




REF.	DESCRIPTION	MATERIAL SPECIFICATION	NO. OFF
1	ANTI-BIRD DISC	ASTM D3935-21	1
2	NUT/SS BOLT LENGTH 35mm	TI/SPC/OHE/FASTNERS/0120 A4-50 OR SUPERIOR GRADE	3/3
3	ANTI-BIRD DISC PLATE	ASTM D3935-21	1
4	SPRING WASHER	TI/SPC/OHE/FASTNERS/0120	3/3
5	SILICON O RING	TI/SPC/OHE/INSCOM/1072	1

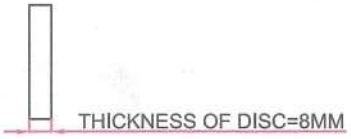
NOTE-

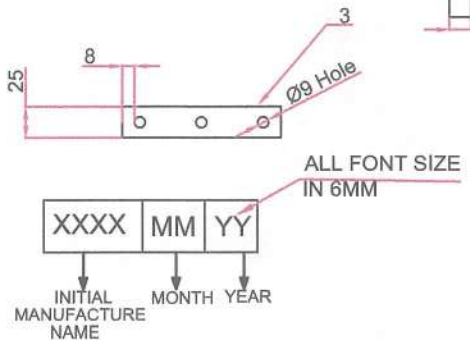
1. ALL THE DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. TOLERANCE OF ±1.0mm IS PERMISSIBLE ON ALL DIMENSIONS UNLESS OTHERWISE SHOWN.
3. THE MATERIAL SHALL BE OF POLYCORBONATE OF GROUP 01 OF CLASS 2 AS PER ASTM D 3935-21 OF FIRE RETARDANT RATING UL 94-V2 OR HIGHER
4. ALL THE FASTENERS SHALL BE OF STAINLESS STEEL AND SHALL CONFORM TO GRADE A4-50 OR SUPERIOR GRADE
5. THE TOLERANCE ON DISK THICKNESS SHOULD BE ±5%.
6. DIAMETER (D) OF ANTI BIRD DISC AND DISTANCE (L) MAY BE FINALIZED BY THE ZONE RAILWAYS AS PER DESIGN OF THE INSTALLED INSULATOR.



SILICON RUBBER O RING

Thickness of O Ring - (4±1) mm





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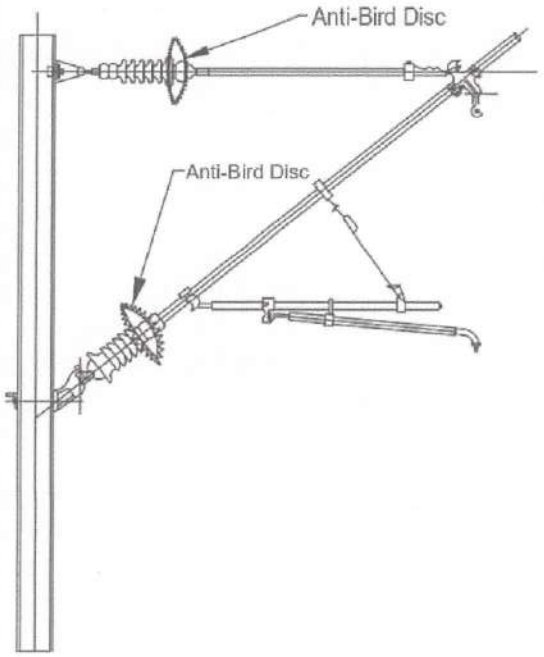
ANTI - BIRD DISC (FOR COMPOSITE ST , BT , 9 - TON INSULATORS)

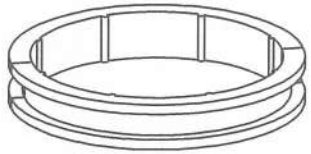
DTI-2

-SD-
Bhardwaj Chaudhary
20.01.20

REF.:-TI/DRG/OHE/ABD/RDSO/00000/19/0

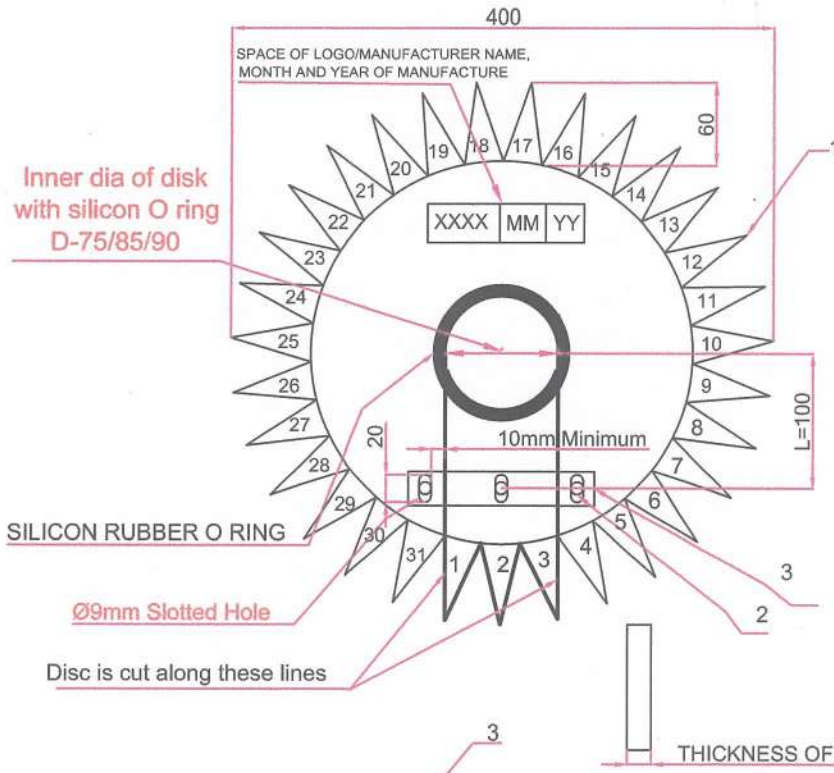
DATE	MOD	NATUREOF MODE	INTIAL		SIGNATURE	NAME	R. D. S. O.
03-2025	Rev.2	1. FR rating of Anti bird material changed from 5VA to V2 or higher		DR	Approved		TI/DRG/OHE/ABD/RDSO/00000/19/0
				CK	AMIT KUMA		Rev.2 Sh
05-11-2024	Rev.1	1. Material of Anti Bird Disc changed. 2. Notes modified. 3. 3 Spikes Removable 4. Oval Shape Hole Only On Disk	SD JD TI-2	DR			SCALE NTS
				CK			SUB SCALE :- 1/2

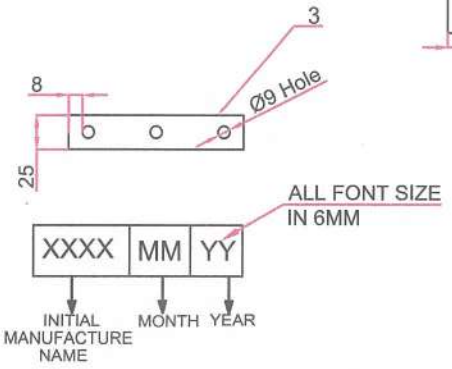


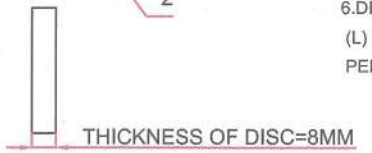


SILICON RUBBER O RING

Thickness of O Ring - (4±1) mm







REF.	DESCRIPTION	MATERIAL SPECIFICATION	NO. OFF
1	ANTI-BIRD DISC	ASTM D3935-21	1
2	NUT/SS BOLT LENGTH 35mm	TI/SPC/OHE/FASTNERS/0120 A4-50 OR SUPERIOR GRADE	3/3
3	ANTI-BIRD DISC PLATE	ASTM D3935-21	1
4	SPRING WASHER	TI/SPC/OHE/FASTNERS/0120	3/3
5	SILICON O RING	TI/SPC/OHE/INSCOM/1072	1

NOTE-

1. ALL THE DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. TOLERANCE OF ±1.0mm IS PERMISSIBLE ON ALL DIMENSIONS UNLESS OTHERWISE SHOWN.
3. THE MATERIAL SHALL BE OF POLYCORBONATE OF GROUP 01 OF CLASS 2 AS PER ASTM D 3935-21 OF FIRE RETARDANT RATING UL 94-V2 OR HIGHER
4. ALL THE FASTENERS SHALL BE OF STAINLESS STEEL AND SHALL CONFORM TO GRADE A4-50 OR SUPERIOR GRADE
5. THE TOLERANCE ON DISK THICKNESS SHOULD BE ±5%.
6. DIAMETER (D) OF ANTI BIRD DISC AND DISTANCE (L) MAY BE FINALIZED BY THE ZONE RAILWAYS AS PER DESIGN OF THE INSTALLED INSULATOR.

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ANTI - BIRD DISC (FOR PORCELAIN ST , BT , 9 - TON INSULATORS)	DTI-2	-SD- Bhardwaj Chaudhary 20.01.20	
'REF.:-TI/DRG/OHE/ABD/RDSO/00000/19/0		R. D. S. O.	

DATE	MOD	NATUREOF MODE	INITIAL		SIGNATURE	NAME
20-03-2025	Rev.2	1. FR rating of Anti bird material changed from 5VA to V2 or higher		DR	Pramod	
				CK		
05-11-2024	Rev.1	1. Material of Anti Bird Disc changed. 2. Notes modified. 3. 3 Spikes Removable 4. Oval Shape Hole Only On Disk	SD JD TI-2	DR		
				CK		

TI/DRG/OHE/ABD/RDSO/00000/19/0 Rev.2 Sh

SCALE NTS

SUB SCALE -

2/2

GOVERNMENT OF INDIA

Ministry of Railways

MAINTENANCE MANUAL

FOR

TRACTION DISTRIBUTION EQUIPMENT

(OHE, PSI & SCADA)

FOR 160 KMPH TRAIN OPERATION

Document No. TI/MI/0060

Issued by:

Traction Installation Directorate,

RESEARCH DESIGNS & STANDARDS ORGANISATION,

MANAK NAGAR,

LUCKNOW – 226 011.

(For official use only)

November, 2022

TITLE: MAINTENANCE MANUAL FOR TRACTION DISTRIBUTION EQUIPMENT (OHE, PSI & SCADA)FOR 160 KMPH TRAIN OPERATION

DOCUMENT NO. : TI/MI/0060

	PREPARED BY		CHECKED & RECOMMENDED BY	APPROVED BY
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Date	24.11.2022		24/11/22	24/11/22
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Government of Indian

Ministry of Railways

Research Design & Standards Organisation

Manak Nagar, Lucknow – 226011.

Maintenance Instruction No. TI/MI/0060

1. **TITLE**: OHE, PSI & SCADA Maintenance Instruction for 160 KMPH Train Operation

2. **APPLICATION**: Semi High Speed Routes

3. **OBJECTIVE**:

NDLS-HWH & NDLS-BCT routes are being upgraded for 160 kmph Train operation. The OHE will be subject to more severe dynamic oscillations at 160kmph due to the constant contact and movement of the fast-moving pantograph coupled with wind pressure. Hence, in order to achieve HIGH RELIABILITY and ZERO-DEFECT OHE, and to ensure proper current collection and effective maintenance activities to be carried out as per the maintenance schedule, this maintenance manual is being issued.

4. **OHE MAINTENANCE ACTIVITIES:**

Maintenance is the combination of all technical and administrative action including supervision action, intended to retain an OHE Component in, or restore it to, a state in which it can perform a required function.

Administrative action involves the organization and management of the necessary resources, such as personnel and maintenance vehicles/equipment, and is subject to the influence of policy strategies.

Supervision action is designed to observe the condition of the main OHE components and to improve the diagnosis of how well they are operating over time.

The combination of all technical action intended to put every item in a state in which it can perform a required function, is done through maintenance work which is divided functionally into two different ways of intervening, depending on the acceptable probability of fault occurrence defined (preventive and/or corrective maintenance).

4.1 **Corrective maintenance** is always carried out after a fault has been recognized and is intended to put an item in a state in which it can perform a required function.

4.2 **Preventive maintenance** involves supervision of the condition of the OHE to evaluate the extent of maintenance work required and is carried out at predetermined intervals or according to prescribed criteria with the aim of reducing the probability of failure or deterioration of the functioning of an item. Hence the quantity and the quality of maintenance activities may vary from the minimum for the OHE on technologically poor secondary tracks worked by few trains at very low speed to the maximum for the OHE on technologically advanced mainline tracks worked by a large number of trains at high or very high speed.

Preventive maintenance is based on inspections, observations, checks and measurements, examinations, scheduled maintenance and unscheduled maintenance. Scheduled maintenance is carried out in accordance with an established time schedule (hard time maintenance), while unscheduled maintenance occurs after obtaining an indication regarding the condition of an item (on-condition maintenance).

The frequency and intensity of maintenance work depend on the following main criteria:

- importance of the line,
- maximum line speed,
- number of train (or pantograph) journeys per day,
- type of traffic related to the current intake and to the pantograph strip materials and design,
- type of system and characteristics of the OHE,
- condition and age of the OHE,
- type and extent of air pollution,
- magnitude and duration of short-circuit currents,
- number of operating disturbances.

The OHE is kept in good condition and reliable through a number of elementary operations which may belong to seven different categories of activities:

- inspections, observation, surveillance,
- verifications, checks, measurements,
- scheduled maintenance interventions (hard time),
- on-condition maintenance interventions,
- fault repair interventions,
- extraordinary maintenance interventions,
- renewals.

5. Following are the OHE critical component and their failure modes:

i) Contact wire parting due to excessive wear caused by overheating, exceeding contact force, excessive tensile stress, hard spots, OHE and pantograph interaction

ii) Insulator breakage due to fatigue or insulation failure

iii) Steady arm failure due to uplift

iv) Cantilever condition due to corrosion

v) Dropper failure due to fatigue

vi) Mast bending, corrosion, missing counterweights

vii) OHE parameters deviation- contact wire height, stagger, uplift, contact force, arcing rate, contact wire wear, ATD tension, x-y parameters

viii) Defects in Pantograph

The adjustment work is particularly important at crossovers, turnouts and at overlaps spans since any departures from the standards laid down could cause entanglement of the pantograph with the OHE, with serious repercussions.

ix) For efficient condition-based and predictive maintenance following measures may be taken in future:

a. **Environmental Data** like wind speed should be measured through **anemometers**, temperature rise of OHE components through **thermo vision camera**.

b. **Physical Data** like Mast bending, corrosion of overhead equipment, missing counterweights etc., broken dropper & jumpers, x-y distance, bird nesting, mast number, bridges and tunnel location etc. can be detected through image processing techniques like **high speed cameras.**

c. Geometrical data like contact wire height, stagger, contact wire wear, contact wire gradient, uplift of contact wire etc. may be collected through contact less measurement system-**Laser based mounted on OHE Recording Car at speed upto 160kmph.**

d. **Mechanical data** - **Mechanical sensors like strain gauges** may be mounted on high-speed pantograph for measurement of contact force, contact less measurement system may be mounted on vehicle roof for measurement of ATD

tension (measurement of tension in contact & catenary wire), contact force measurement or image processing to detect location of hard spot, uplift of contact wire, OHE elasticity variation, contact wire wear etc. NETRA CAR [Specification No. TI/SPC/OHE/NETRA/0143 (03/2022)] can be used for measurement of Mechanical Data.

e. **Electrical data** – arcing rate (contact loss measurement or current measurement), OHE, Rail & feeder wire current through current sensors, measurement of touch potential, soundness of earth connection etc. Instrumentation as per EN 50317 can be used for measurement of Electrical Data.

6.0 INSPECTION SCHEDULE OF OHE:

The following inspection schedules for maintenance of OHE should be followed to ensure good current collection at 160kmph as well as safety of installations and personnel:

6.1 FOOT PATROLLING OF OHE (Para No. 20322 of ACTM Volume II, Part-I):

1) The object of foot-patrolling is to have visual inspection of every part of OHE (including feeder line) so that any defect and abnormalities noticed are recorded and reported to the maintenance gangs for attention.

2) An experienced OHE Technician (accompanied by a Assistant if deemed necessary by local conditions) should be deputed to patrol the section on foot by day, so as to cover every part of the section including yards once in **10 days and suburban sections once a week**. If this patrolling is done thoroughly, many of the defects will be noticed at the incipient stage, before they develop into major defects.JE, SSE should foot patrol the entire section once in 2 & 4 months respectively.

3) The Technician on foot patrol should be equipped with signal flags, an emergency telephone instrument, **mobile phones** and essential tools required for attending to defects on the spot e.g., spanners for tightening bond connections, Bolts and nuts for bonding, small chopper for clearing small bushes and creepers over the OHE mast, spring balance for pulling the Regulating Equipment for checking free movements etc.

4) The Technician on patrol duty should particularly look for the following –

   a. Chipped or damaged insulators.

   b. Displaced fittings and droppers/**current carrying droppers**

   c. Excessive sagging or hogging of contact wire

   d. Whether compensating plate is tilted

e. Free movement of auto tensioning device and position of counterweight with reference to upper and lower limits of movement marked on the mast.

f. Presence of protective screens, caution and warning boards and Anti-climbing devices.

g. Structural soundness of height gauges at level crossings.

h. Bird nests and pieces of stray wire likely to cause short circuits and branches of trees likely to infringe the OHE.

i. Defective bonds and earth connections.

j. Oil leakage if any from AT and drop out fuse position.

k. Any obstructions including tree branches in the way of free movement of pantograph and trains.

l. Signs of heavy sparking when trains pass.

m. Isolators blades being fully in and for signs of sparking or overheating of Isolators as also condition of locks

n. General condition of switching stations en-route.

o. Tilting of masts especially on high banks and masts with sand core foundations.

p. Number plates

q. Any other abnormal/unusual situation

r. Visual Checking of AEC & BEC connection with each mast and portal

s. Checking of 25kV negative Feeder

5) Major defects noticed by the Technician which endanger safety shall be reported forthwith to TPC through the nearest emergency telephone/mobile/telephone. Full details should be given to enable the TPC to decide on the course of action to be taken and if required to regulate train movements in the affected section.

6) The Technician should himself attend to and rectify such of the minor defects (e.g. loose structure, longitudinal, cross bond and BEC connection) which can be rectified by him on the spot without special assistance. To facilitate this, he shall carry with him a few essential tools. Other minor defects should be noted by him in his diary and entered by him in a Register **(see para 20349)** maintained for the purpose in the depot/sub depot. The roster of patrolling Technicians should be so arranged that they will be able to return to the depot sub-depot for submission of report as above before going off duty for the day. Where this is not convenient, the Technician must report the defects on telephone/mobile to the depot/sub-depot followed by a written report in the register on the next day. The supervisor in

charge of the depot/sub-depot will carefully scrutinize the Register and take prompt action to rectify defects reported, making suitable entries in the Register.

7) Testing of Emergency Telephone Sockets: During patrol duty, the Technician will speak to TPC from every emergency telephone socket in route. Such calls from patrolling Technicians should be recorded in a Register by the TPC indicating the date, time and serial number/location of the socket tested. Defective sockets should be reported promptly to the S&T Department for rectification.

8) Technician shall also check that safety guards provided under the feeders are properly earthed, the clearances are adequate and caution notice boards are in position.

9) Following maintenance schedule should be followed by SSE-Incharge, SSE (Sectional) & JE:

SSE-In charge	SSE(Sectional)	JE
Entire section in one year	Entire section in 4 months	Entire section in 2 months

10) A proforma for Linemen's Foot Patrol Report is given at **Annexure 3.03 (Para 20349 of ACTM Vol. II, Part-I)**

At 160 kmph OHE will be subjected to more vibrations, which are likely to cause premature failure of OHE Components and hence frequency of foot patrolling has been increased. After a year based on feedback from Zonal Railways frequency of foot patrolling may be reviewed.

6.2 Inspection of OHE by footplate (As per Annexure 3.01 of ACTM Para 20320 of ACTM Volume-II, Part-I)

The object of such inspection is to enable supervisors and officers in charge of OHE maintenance to observe closely the OHE under their charge and should be carried out during day time. Officers and senior subordinates shall travel by the cabs of locomotives and EMU trains as often as possible to observe the general condition of OHE and to get first-hand knowledge of operating conditions**.** PCEE of Zonal Railway may decide periodicity of footplate inspection by Supervisors & Officers (ADEE, DEE, Sr. DEE) as per local condition.

6.3 IOH (Intermediate overhauling): IOH is the maintenance of OHE with only single cantilever assembly locations and does not include locations holding 2 or more cantilevers e.g. it does not include UIOL, IOL, T/O, G-Jumpers, feeder jumpers, isolators, RRA etc.

Periodicity: As per Railway Board letter No. 2013/Elect(G)/148/1 dated 10.05.2019 existing periodicity of IOH of single cantilever is after **every two years**. For 160 kmph it should be **Annual** as cantilever will be subjected to more vibration and wear & tear at higher speed.

Para 20961 of ACTM Volume-II, Part-I : Every cantilever assembly shall be adjusted strictly in accordance with the approved structure erection drawing, especially in regard to the positioning of stay arm, bracket tube and register arm. The projection of bracket tube and register arm and the allowance in the stay arm shall be sufficient for slewing of tracks. Normally this allowance is **15 cm to 20 cm** from the centre line of catenary suspension bracket to end of bracket tube and **20 cm** (min.) for register arms. All nuts should be tightened and locking plates provided with split pins or check nuts. Make sure that all temporary earths provided by Contractor's men during construction work have been removed.

In case of Conventional Cantilever assembly, Drop Bracket Assembly should be as per Drawing No. ETI/OHE/P/2360 and steady arm should be as per drawing no. ETI/OHE/P/2390.

6.4 AOH of OHE – ACTM Para 20326: AOH is the maintenance of OHE with locations **holding 2 or more cantilevers**. AOH is important as it have overlaps, turnouts, G-Jumpers, feeder jumpers, isolators, RRA etc.

Checks to be performed:

1) This schedule must be carried out by Inspection Car. **During the schedule, fittings should be dismantled,** all fittings which are found defective must be replaced. In addition, clearances, heights, staggers etc. should be checked and corrected.
2) The details of work to be carried out during this schedule are as under-

(a) **Masts, portals and cantilever supports:**

Check rail level and setting distance against markings on the masts and entries in the Register. **Variation above 30mm in setting distance and 20mm** in rail level should be notified to the PWI for correction. Variations, even within the above limits, should not be permitted if the Schedule of Dimensions are infringed.

(i) Check all steel parts and remove rust, if any, from painted steel work. Rusted portions, after cleaning, must be given **two coats of zinc chromate primer followed by aluminum paint.**

(ii) Check all anchors for tightness of bolts, nuts and check nuts and pins, Lubricate all turn buckles/adjusters and pulleys.

(iii) Examine the base of each structure to ensure that muffs permit drainage of water. Clean the muffs removing any muck or dirt. Cracked or damaged muffs must be recast.

(iv) Check all bonds thoroughly. Defective bonds must be rectified and missing bonds provided,

(v) Check and tighten all G.I. bolts and nuts.

(vi) Check all galvanized pipes and fittings. Where galvanization is found to be chipped off, the fitting of pipe should be replaced. **Minor chippings may be repaired using 'cold galvanizing paint'.**

(vii) Examine register arm and all hooks and fittings for cracks. Check for cracks on steady arm tube also.

(viii) Clean all insulators and carefully check for cracks and broken sheds. If any shed is broken or there is any crack on the core the insulator should be replaced.

(ix) Check and adjust heights and staggers on the basis of setting distance and rail level marked. Close co- ordination with Permanent Way Inspectors is required for keeping the permanent way at the correct location.

(x) Check presence and condition of caution notice boards, number plates, coasting boards, etc. Paint the boards as required. Ensure that they are all well secured.

(xi) Ensure that the drain holes in the tubes are free and not clogged.

(b) Contact and Catenary Wires:107 sq. mm HDGC/**Silver bearing grooved copper contact wire** as per specification no. TI/SPC/OHE/CW (Cu-Ag)/0130(01/2017) is provided with 65 sq. mm Cu-Cd/**Magnesium Copper Catenary wire** as per Specification No. TI/SPC/OHE/CAT(Cu-Mg)/0150.

(i) Check carefully condition of contact and catenary wires, particularly for kinks and twists in contact wire and broken strands of catenary wire. Any stranded conductor (catenary wire etc.) should be spliced if any strand is broken.

(ii) Check condition of PG clamps and jumpers after opening the clamps and tighten properly.

(iii) **Contact wire Hard Spots and wear**: Hard spots are points on the OHE where contact wire wear is likely to be higher than at normal locations, due to less flexibility in the OHE. Smoke pollution aggravates wear at hard spot. The usual spots where the contact wire is likely to show more wear are :

- Support point at curves
- Section insulators
- Splices
- Turn Outs
- Central mast of 2-span un-insulated overlaps of unregulated OHE
- At approaches to tunnels and over-line structures
- Locations where smoke pollution is pronounced
- Pull-offs

At such hard spots, it is important to keep a watch on wear of contact wire by measuring and keeping a record of contact wire thickness periodically. It is essential to concentrate on these spots during annual measurement of contact wire wear.

(c) Droppers:

(i) Check droppers/current carrying droppers

(ii) Check current carrying droppers for any damage like strand cutting, wear of fittings, loose fitting and tighten of bolts with required torque wherever required.

(iii) Availability of U pin in contact clip.

(iii) Make droppers vertical.

(iv) Worn out dropper should be changed.

Current Carrying Droppers

Check Current carrying 'A' dropper as per Specification No. TI/SPC/OHE/CCFD/0160(02/2020)/Drawing Nos. TI/DRG/ OHE/ CCD/RDSO/00001 to 4/20/0 Rev. A for current carrying dropper assembly or one C jumper (in span jumper) in every span is provided.

(d)Turn outs

(i) With OHE Inspection Car running on main line checkup if pantograph glides smoothly under the loop line OHE.

(ii) With OHE Inspection Car running on loop line checkup if pantograph glides smoothly under the main line OHE.

(iii) Check stagger of both the OHEs at turn outs. (It shall not normally exceed 300 mm).

(iv) Check up for hit marks, if any.

(v) As per CEDE/NCR letter no. EL/TRD/NCR/Gatimaan dated 19.11.2018 following checks to be carried out:

1. At obligatory mast vertical gap between main line and turn out contact wire is to be maintained between 50 to 60mm.
2. At 5m distance from obligatory mast, gap is to be maintained at 50 mm.
3. At 10m distance from obligatory mast, gap is to be maintained between 40mm to 50mm.
4. Track separation is to be kept between 290mm to 550mm. Mast should be changed if track separation is less than 290mm.
5. Span length of turnout location reduced during increasing track separation.
6. From main line to loop line "take off" may be maintained in between 720 to 750mm.

(vi) Checkup rail level and setting distance and track separation of the obligatory mast.

(e) Section Insulators Assemblies:

(i) Clean insulators and replace chipped or cracked insulators.

(ii) Check runners for flash-marks, hit marks and proper adjustment.

(iii) Check for excessive contact wire wear near anchor clamps.

(iv) Check the level of the assembly and adjust if necessary.

(v) Tighten PG clamps of droppers and stiffeners.

(f) Isolators: Double pole Isolator type II should be provided at Insulated Overlap of 1250 Amp rating as per Specification No. TI/SPC/PSI/ISOLATOR/0210. Mounting Arrangement should be as per Drawing No. ETI/OHE/G/06005 Sh-2 & ETI/OHE/G/06008 for mast and portals respectively.

(i) Check number plates for cleanliness and security.

(ii) Check correctness of operation, alignment of contacts and arcing horns.

(iii) Check earth continuity where applicable.

(iv) Lubricate moving parts and locks.

(v) Check interlocks where provided.

(vi) Check that the distance between male and female contacts in open position is 380mm to 500 mm depending upon the type of Isolator.

(vii) Wherever Earthing Heels are available with Isolator, ensure the smooth operation of its blade and clearance (minimum 320 mm) in Isolator closed condition.

(g) Short Neutral Section Assemblies (Para 20312 of ACTM Vol. II, Part-I)

SNS maintenance schedule is followed based on the OEM recommendations mainly to maintain profile of runners, insulating rod and to rotate or replace insulating rod when permissible wear is reached.

Short neutral sections assembly incorporating light weight contact wire insulator of composite type (resin bonded glass fibers core protected with PTFE) has now been adopted as standard. Ease of installation even on flat curves and difficult locations, substantially reduced maintenance and other advantages are gained by introducing short neutral section. Conversion of existing overlap type neutral sections to short neutral sections may be done where it is not yet done. Short neutral sections should also be introduced in lieu of insulated overlaps opposite to the feeding posts at sub-stations. (Board's Ref. 86/RE/501/1N/S) dt. 16/22.7.1987.)

1) The essential points to be checked during periodical maintenance are as under:

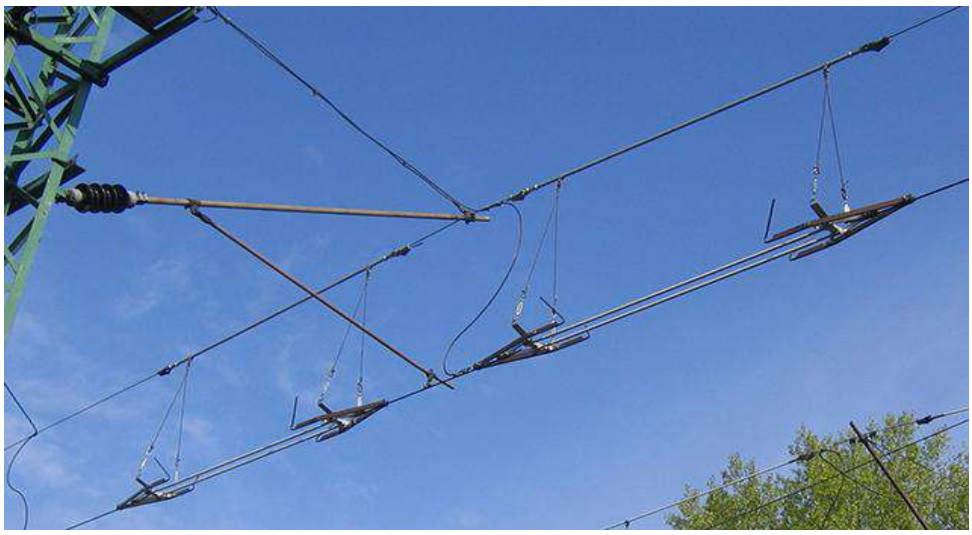
a) PTFE in Arthur Flury make SNS /Rain shed in Galland make SNS. .
b) Electrical erosion of PTFE coating
c) State of cleanliness of insulators.
d) Burning of arcing horns
e) Pantograph hit marks on the underside of Runners, PTFE insulator and end fittings of the contact wire insulators to ascertain need for adjustment of SNS.

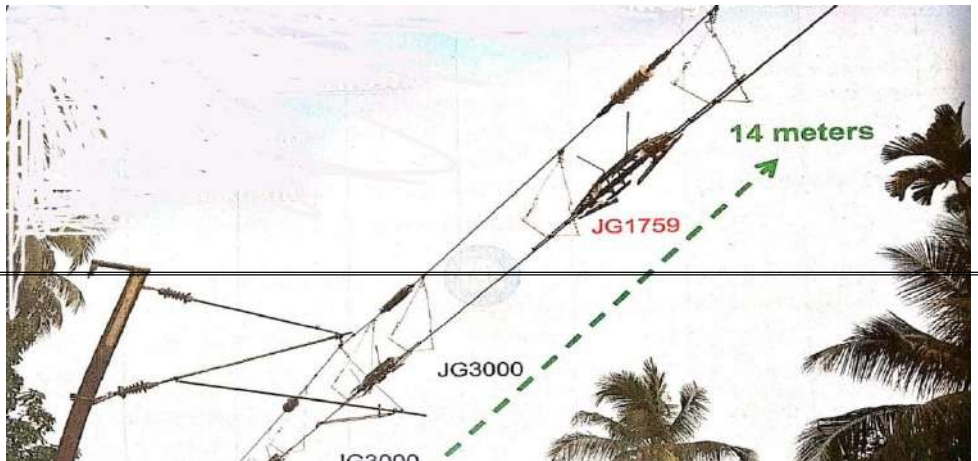
f) Wear of Runner and PTFE Insulator rod (in AF make SNS)/Shoe (in Galland make SNS) , if wear is 2 mm or more than 2 mm then the Runner/Insulator Rod should be replaced.

g) Insulation resistance.

2) As per Railway Board's Letter no. 2013/Eect(G)/148/1 dated 10.05.2019, SNS maintenance schedule is **annual**. For 160 kmph this periodicity may be reduced to **quarterly as OHE will be subjected to more vibration & wear in contact wire side insulating rod**.

Short Neutral Section (SNS)	Maintenance should be carried out **quarterly** along with following: • Cleaning of SNS insulator: Preferably cleaning of SNS insulator shall be done quarterly for normal/non- polluting section. For polluted section cleaning shall be done monthly. In addition, visual check or under power block, cleaning of insulator should be done if locomotive is passing with VCB ON condition. • Adjustment of SNS during change of track layout (gradient, curve, implantation, height etc.) should be ensured.





(h) Overlaps:

(i) Check height and stagger of OHE in the overlap section.

(ii) Check whether the normal minimum clearance of 500mm is available between the two OHEs in an insulated overlap and 200mm in an uninsulated overlap.

(iii) Check whether the lifting of out-of run OHE is correct.

(iv) Check that parallel running of contact wires in the overlap for a minimum 2m in the panto sweep region

(i) Contact Wire thickness (Para 20309 of ACTM Vol. II-Part-I):

The thickness of new contact wire is 12.24 mm. It will be necessary to replace the contact wire when it has worn to a thickness of **8.42 mm**. Measure and record thickness of contact wire as detailed in **Para 20309 of ACTM Vol. II-Part-I**.

(j) Neutral Sections:

Carry out all checks as for an insulated overlap in case of overlap type neutral sections and as for section insulators in the case of section insulator type neutral section.

(k) Overline, Structures/Tunnels

(i) Check and record horizontal and vertical clearances and adjust OHE as required.

(ii) Check for any flash-marks on the underside of the bridge structures.

(iii) Check that the prescribed height of contact wire is available,

(iv) Check that the gradient of contact wire on either side as per SED.

(v) Check that smoke screens are properly secured and have adequate clearance from OHE. If not, get these attended to by Engineering Department.

(vi) In tunnels get necessary repairs done by Engineering Department.

(vii) Check rail level mark on sides of tunnels.

(l) Level Crossings

(i) Check height and gradient of contact wire.

(ii) Check condition of road surface and clearance of height gauge (a red band may be marked on the uprights at a distance of 4m from bottom face of the boom to facilitate measurement of clearance.)

(iii) Check the availability of danger board & public caution boards at height gauges, Staff caution boards and shock treatment board/Chart at gate lodge.

(m) Regulating Equipment: Regulating equipment (Three Pulley Type higher tension) should be provided as per RDSO specification no. TI/SPC/OHE/3PHTATD/0150 with ACS 1 with counter weight eye rod as per drawing no. ETI/OHE/SK/588 Rev. B. Counter weight assembly should be provided as per RDSO Drawing No. ETI/OHE/SK/587 Rev. B & X-Y value adjustment chart as per Drg. No. TI/DRG/OHE/ATD/RDSO/0003/99/1. **Checks to be performed as per SMI NO. TI/MI/00029 Rev. 3.**

Three Pulley Higher Tension ATD:

(i) Check 'X' and 'Y' dimensions three pulley type equipment against prescribed values for the temperature at the time of checking. Make use of turn-buckles to adjust as required.

(ii) Check that the compensating plate is vertical. If not, adjust as required.

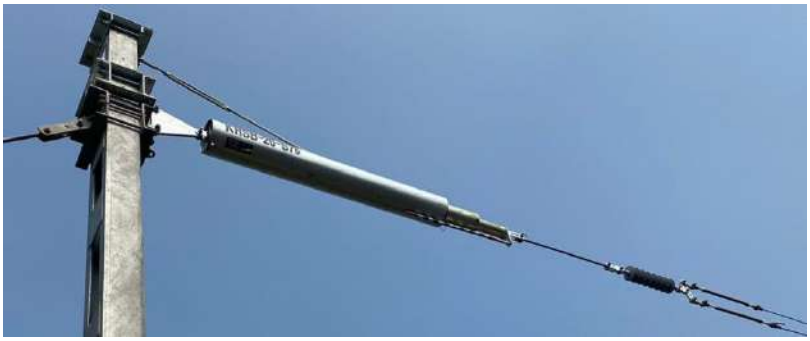
(iii) Lubricate rope and other moving parts.

(iv) Check if 20mm wide bands in black colour are painted on the mast to indicate upper and lower limits of movement of counter weight.

(v) Check condition of stainless steel wire rope for any signs of corrosion and breakage of strands.

Spring Type ATD:

Spring type Auto Tensioning Device, which can be used at locations having space constraint for providing Counter Weights.



Spring ATD is Maintenance-free system with the anticipated service life more than 30 years. It's installation and operation are easier than pulley type regulating equipment. It also minimises human/material resources for maintenance due to Lower weight & Small size. It is safeguard against accidents due to no hanging counter weight as pulley type regulating equipment. Spring ATD can be used for higher tension and high speed.

Checks to be performed

Spring ATD maintenance schedule shall be based on the OEM recommendations However mainly function of each part, activation/movement of Spring ATD, corrosion, crack, and damage, galvanization and attachment of body should be checked.

(n) Bonds & Earthing Connection.

AEC of 12.24 mm dia. ACSR Raccoon conductor erected on the back side of the OHE masts/Portals. BEC of 20 mm dia.(cross section 238.64 mm^2), galvanized steel conductor laid underground along the UP and DN track separately, 300mm below ground surface and approximately one meter away (or as per site conditions) from the OHE foundation towards opposite direction of track. The BEC is connected to each OHE mast/Portal and Feeder mast by same conductor having Tee connector & Lug Connector as per Drawing No. TI/DRG/OHE/TC/RDSO/00001/20/0 & TI/DRG/OHE/SC/RDSO/00001/20/0 . The AEC/BEC and cross bonding scheme is as per drawing no TI/DRG/OHE/ERBOND/RDSO/00001/20/0.

(i) Check tightness of connection of BEC & AEC with mast/structure.

(ii) Inspect earths and record earth resistance. Earths having resistance of over 10 ohms should be attended to.

(iii) The cross bonding of the UP BEC –UP Mast/Portal-UP Traction Rail-DN Traction Rail-DN mast/Portal –DN BEC should be done by 50X6 mm MS/GS flat at every 450 mtr.

(o) Masts:

Check verticality of all masts with plumb-bob and take remedial action as required (Para 20305 **ACTM Vol. II-Part-I**).

(p) Sites affected by accidents:

Such sites should be specially checked and attended to. Porcelain insulators of the affected section should be thoroughly checked for any cracks/damage and to be replaced.

(q) Feeder Lines:

(i) Check guard wires at road crossings, if any.
(ii) Check earthing of Tower/Mast.
(iii) Measure and record earthing resistance of towers.
(iv) Clean insulators and replace those which are cracked or chipped.
(v) Check the jumper connections, strain clamps, PG clamps and bi-metallic strip.

(r) PG clamps:

(i) Check and clean oxide from surface.
(ii) Apply corrosion inhibiting compound.
(iii) Tighten to the prescribed torque as mentioned in Para 6.6.

(s) Cleaning of Insulator

<u>Cleaning of Porcelain Insulator</u> (Para No. 20229 & 20314 of ACTM Vol. II, Part I)

Cleaning of porcelain insulator is to be done by wiping the surface with a piece of dry cloth. A wet cloth may be necessary if the coating is hard. If the deposits are oily, petrol may be used for cleaning. If this too in ineffective where encrustation has become hard due to continued neglect, the coating may have to be removed by rubbing with a wet coir rope using a suitable detergent. After removing the deposits,

the surface of the insulator should be washed well with water, wiped with dry cloth and polished with dry cloth until the normal glaze is restored.

All insulators should be looked for any flashover marks, cracks, chippings. Insulators which are chipped should be replaced. Minor chippings can be rendered impervious to moisture by a light coating of Araldite or similar epoxy resin.

The periodicity of cleaning of insulators in polluted locations should be laid down by local instructions. The affected section should be divided into various zones based on the degree and nature of pollution and periodicity of insulator cleaning to be fixed suitably. The cleaning will be required more frequently in foggy weather compared to dry or rainy season. The periodicity may be reviewed based on effect of special measure.

Other steps for reducing flashovers due to pollution:

i) Measurement of severity level of pollution:

The severity level of pollution to be measured as per RDSO maintenance Instruction No.TI/MI/040 or latest so that adequate creepage distance insulators may be used.

ii) Use of 1600 mm creepage distance Composite insulators as per directives issued by Railway Board vide letter No. 2002/EEM/161/21 Vol. II dt 30.09.2020.

Cleaning of Composite Insulators

Clean all Insulators as per RDSO Instruction No. TI/IN/0040, Rev-0 or latest. Check carefully for any damage on sheath and sheds of composite insulators. If any damage found, Insulator may be replaced. As per this instruction following is to be done:

(A) General Instruction: For cleaning of 25 kV Composite Insulators fitted in polluted/heavily polluted area, following schedule shall be followed:

SN	Type of Insulator	Pollution level	Periodicity
1.	Stay Arm Insulator	Polluted Area/ Heavily Polluted Area	Once in a year
2.	Bracket Tube		

3.	9-Tonne		
4.	Sectioning		

(B) Method:

(i) Composite Insulator shall be cleaned with DRY SOFT COTTON CLOTH to remove the dust/pollution from insulator.

(ii)No water, detergents, any solvents and abrasive material should be used for cleaning as use of such material leads to deterioration of electrical properties causing failure.

(C) Precautions:

Please note that purpose of cleaning of Composite Insulator is only removal of dust/pollutants or any other deposition that adversely affects the electrical properties of Composite Insulators. Hence care should be taken that during dry cleaning the insulator should not be rubbed excessively to make it bright.

Handling of composite insulator:

Since the composite insulators have silicon rubber as a component, they are much more flexible and fragile than the solid core porcelain insulators. Thus special care needs to be taken during their handling. In this regard, an instruction no. TI/IN/0013, Rev-0 or latest with effect from Dec, 2005 has been issued by RDSO which should be strictly followed.

Testing of Insulators before Installation:

To weed out the insulators which may develop defect due to various reason beyond Railways control, each insulator to be tested for routine tensile load test at site/depot before installation as per RDSO's SMI No. TI/MI/0042 (12/08), Rev 0.

Following Check List may be followed for maintenance of 25 kV Porcelain & Composite Insulators

1) <u>OHE DEPOT</u>

S.No.	Instructions	Reference	Remarks
1.	Whether on insulators pre-installation tests has been carried	SMI No. TI/MI/0042	

	out?		
2.	Whether handling instruction for composite insulators followed?	RDSO Instruction No. TI/IN/0013	
3.	Whether ESDD measurement has been carried out?	RDSO SMI No. TI/MI/040, Rev-0.	
3.1	If yes, whether appropriate creepage distance insulators used in the area where ESDD is more than 0.3 mg/cm^2	Railway Board's letter No. 2002/EEM/161/21 Vol. II dt 30.09.2020.	
3.2	Whether stone pelting area has been identified?		
3.3	If yes, whether composite insulators installed/used in stone pelting area?		
4.	Whether make, type, batch & Location wise record of insulators has been maintained?	-	
5.	Whether latest List of Failure Prone insulators Identified by Railway Board/RDSO is available?	RDSO letter No. TI/OHE/INS/GEN/13 dated 20.02.2013.	
6.	Whether any action plan has been prepared to replace the Failure Prone and EPDM/EVA based insulators?		
7.	Replace the Failure Prone and EPDM/EVA based insulators within target period.	RDSO letter No. TI/OHE/INSCOM/BHEL/08 dated 16.07.2008.	
8.	Whether RDSO instruction is being followed in case of failure of insulator?	RDSO Instruction No. TI/IN/0007, Rev-0.	
9.	Whether Anti climbing arrangement used in monkey menace area?	RDSO Maintenance Instruction No. TI/MI/0056	

3) During weekly Foot-Patrolling following shall be checked:

S.No.	Instructions	Reference	Remarks
1.	Chipped or shed damaged insulators	Clause 20322 of ACTM VOL- II Part I	
2.	Whether equalizing plate is tilted		
3.	Free movement of auto tensioning device.		
4.	Bird nests and pieces of stray wire likely to cause short circuits and branches of trees likely to infringe the OHE.		

5.	Availability of bonds and earth connections		
6.	Any other abnormal/unusual situation e.g. deposition of dust on insulator, shed damage etc.		

4) Special Checks (once in three months)

S.No.	Instructions	Reference	Remarks
1.	Whether Section insulators on the main lines such as at neutral sections and Passenger yards cleaned?	Clause 20325 of ACTM VOL- II Part I	
2.	Whether badly chipped or even slightly cracked insulators (Shed tear or sheath damage in case of composite) replaced?		

5) Pre-monsoon checks

S.No.	Instructions	Reference	Remarks
1.	Whether one time cleaning of all type Insulators (Porcelain & composite) in polluted zone to prevent excessive tripping and failures during initial monsoon rains done?	Clause 20325 of ACTM VOL- II Part I and RDSO SMI No. TI/MI/0053	
2.	Whether record of locations of damaged insulators, missing locking devices like nuts, washers and pin, burnt out fittings, deflected strings, damage to protective coatings, cracked insulators (Shed tear or sheath damage in case of composite) has been recorded and rectified?		
3.	Whether Bird droppings, Bird nests, dense spider webs, kites with threads hanging on the insulator string have been recorded and rectified?		
4.	Whether condition of insulators specially that of section - Insulators at major yards having mixed type of traction checked?		

6) Annual Maintenance

S.No.	Instructions	Reference	Remarks
1.	Whether cleaning of all insulators (Porcelain & Composite) have been done?	Clause 20326 of ACTM VOL- II Part I	
2.	Whether all insulators has been carefully checked for cracks and broken (Shed tear or sheath damage in case of composite) sheds?		
3.	Whether insulators with any sheds broken or having any crack on the Core (Shed tear or sheath damage in case of composite) have been replaced?		
4.	Whether cleaning of insulators of Section Insulator Assembly done?		
5.	Whether chipped or cracked insulators (Shed tear or sheath damage in case of composite) of Section Insulator Assembly replaced?		

Modular Cantilever if used, its maintenance schedule shall be based on the OEM recommendations. Periodicity of its maintenance should be six monthly initially.

(t) FITTINGS: AOH schedule must be carried out by inspection car. During the schedule, fittings are not generally dismantled, but all fittings which are found defective must be replaced.

a) Contact wire parting at RRA location: -

i) Special drive should be launched to identify locations where RRA clamp sides are not having curvature.
ii) Provide correct RRA clamp, i.e. RRA Clamp having curvature on both sides.
iii) Check for cracks/damages of contact wire and replace contact wire piece during RRA clamp replacement or otherwise.
iv) Ensure stagger as per drawing (both contact wire and catenary wire have the same stagger).
v) Provide correct RRA dropper length as per drawing. Dropper is in single piece.
vi) Ensure proper gradient, relative gradient of contact wire.
vii) Ensure correct Raised register Arm Tube (RRT) length as per drawing.

viii)Railway should ensure provision of RRA clamp (RI No. 1371-3) made of SGCI as per RDSO drawing no. ETI/OHE/P/1370-1, Mod-J in each overlaps locations in place of RRA clamp made of MCI (Drawing No. ETI/OHE/P1370-1, Mod E).

ix)Inner diameter of RRA clamp should be measured before installation. The inner diameter should be equal to 13mm.

b) **Installation of Ending Clamp as per RDSO drawing for Catenary wire, feeder wire and large span wire:**

i) Position of Joint cone with respect to ending clamp body: Joint cone is shown touching Ending clamp body.

ii) Position of inner and outer strands of conductor with respect to joint cone / Ending clamp body /Joint socket: strands are not touching ending clamp body and have a gap of about 2mm. strands are just beyond the joint socket.

iii)Position of collar of joint socket and Ending clamp body are not touching body each other and have a gap.

iv)All sub-assemblies mentioned in respective drawings of ending clamps for Catenary Wire, Feeder Wire and Large Span Wire stamped with part no. During assembly it is to be ensured that correct part no is used as per respective drawings.

SN.	Assembly	Drawing No.	Sub Assembly	Drawing No.	Part No.
1	Catenary Ending Clamp (65mm2)	ETI/OHE /P/1120	Catenary Ending Clamp Body	ETI/OHE/P/1121	1121
			Catenary Joint Cone	ETI/OHE/P/1094	1094
			Catenary Joint Socket	ETI/OHE/P/1092	1092
2	Feeder Ending Clamp (150 mm2)	ETI/OHE /P/1130	Feeder ending clamp body	ETI/OHE/P1131	1131
			Feeder joint cone	ETI/OHE/P1104	1104
			Feeder joint socket	ETI/OHE/P/1102	1102
3	Large Span Wire ending Clamp (130 mm2)	ETI/OHE /P/1140	Feeder ending clamp body	ETI/OHE/P/1131	1131
			Large Span Wire joint cone	ETI/OHE/P/1143	1143
			Feeder joint socket	ETI/OHE/P/1102	1102

Note: 1. Note carefully the part numbers used for different assemblies.

2. There have been failures when wrong joint cone has been used.
3. This should be understood from drawings and physical appearance.

(u) **OHE inspection:** RDSO issued limits & tolerances in erection with respect to structure erection drawings parameters in new Electrification works vide TI/MI/0049 should be followed.

Height of Contact Wire: This shall be checked at every structure and at mid-span for regulated OHE. A pre- determined sag in the contact wire of 50 mm at mid-span on a 72 m span should exist on the open routes. Height of contact wire at level crossings shall not be less than 5.50 m.

Stagger : Stagger in tangent track shall be to the left and to the right of the alternatively, not exceeding 200 mm on either side of the centre line of the track, except where otherwise specified in Structure Erection Drawings. Stagger for in-running OHE shall not be more than 300 mm at the mast/structure on the outside of curves except in case of overlap spans and also at the turn-outs. Stagger of contact wire at mid-span in transition portion of the curves shall be within 200 mm.

Gradient of Contact Wire: On both side of overline structures, tunnels and level crossings, the gradient of contact wire shall be in accordance with the approved profile. **Contact wire Gradient should be 2mm/m & Relative gradient should be 1mm/m.**

Clearances: The live metallic caps of insulators on out of run wires shall be at least 2m away from adjacent earthed mast/structure (other than the OHE structure). The distance of these insulators shall be 3m from the bracket supporting the OHE in case of insulated overlaps. Clearance of 2m shall normally exist from nearest point of two adjacent elementary sections except at the section insulators. Where clearance of 2m is not available, it shall be not less than the minimum long duration electric clearance of 250 mm. Whenever the OHEs of two elementary sections cross one another, necessary cut in insulators shall be provided.

Bonding: Earthing and Bonding of Every mast/structure supporting OHE as well as platform structures, foot over bridges etc. shall be checked properly.

Power Line Crossings: High voltage transmission line crossings across the tracks shall be checked against the approved plan authorizing the crossing, particularly the clearance between the OHE and the guard wires, duly recording the results individually. If the crossing is not in accordance with the approved plan, the Supply

Authority should be contacted immediately and the infringements should either be removed or necessary relaxation be obtained from PCEE and Electrical Inspector to the Railway.

6.5 POH OF OHE (Para 20329 of ACTM Volume-II , Part - I): The aim of POH of OHE is to ensure that all major defects are rectified, contact wire if worn-out is replaced, ATD POH/Replacement is done etc. The aim of POH is to recondition and restore the installation in the condition it was when it was first commissioned, whereas preventive maintenance has for its objective to take care of the wear and tear during normal service and forestalling possible failures by regular inspection and prompt attention. The POH should be thorough and cover every part of the installation. The work involved during POH is somewhat greater in scope than the pre-commissioning tests, since after years of service many parts would have suffered wear and tear, of which necessary adjustments will have to be made or repairs done to make good the wear, or the irreparable items replaced. For programming POH, the entire section in each Division should be divided into smaller sections. All POH work should be done under the direct supervision of SSE/JE.

The object of POH is to make a thorough inspection of the OHE and to replace such of the worn- out or damaged parts by those, which have been reconditioned earlier in the maintenance depots and kept ready. The parts removed are sent to the maintenance depots for dismantling, thorough examination, re-conditioning if possible and re-assembly for use again as required.

Periodicity: Existing periodicity of POH of OHE after 8 years with 3 IOH in between after every 2 years. POH after every 6 years in coastal and saline area with 2 nos. IOH in between after every 2 years.

For 160 kmph POH of OHE should be initially 4 years with 2 IOH after every two year as due to increase in speed and tension mechanical and electrical stresses in assets will increase.

Checks to be performed

In addition to the items detailed under annual maintenance, the following items should be attended to during POH:

(a) Masts, portals and cantilever supports:

i. At least one complete cantilever assembly per 10 track-km (this may be modified by PCEE if considered necessary) should be removed and taken to the, workshop for dismantling and detailed examination of various components after

thorough cleaning. This test check would reveal the extent to which other cantilever assemblies have to be examined.

ii. All regulating equipment should be replaced by previously overhauled ones and the removed equipment should be sent to the workshop for overhaul.

iii. As the bracket is articulated, check the position with reference to the axis of the mast. The position will vary with temperature and distance from anti-creep. The register arm and steady arm should as far as possible be in the same plane as the bracket.

iv. Check adjustments of cantilever assemblies, their slope and displacements at every structure for compliance with the 'as erected' SEDs.

(b) Catenary and Contact Wires:

(i) Dismantle all jumper connections, clean the conductors, (with emery paper in case of copper or bronze conductors and metallic brush in case of aluminium conductors) clips etc. If the pieces show signs of overheating, this may be because either they are not tightened properly or the clips are deformed and contact surface is insufficient. In the latter case they should be replaced. In case of the contact wire, it is the groove that has to be cleaned with either a fine metallic brush or emery paper. The use of scraper or file is forbidden. Replace frayed or damaged jumpers.

(ii) Remove kinks if noticed.

(c) **Insulated and Un-insulated Overlaps:**

(i) Check the position of contact wire respect to tracks to comply with SEDS.

(ii) Ensure that insulators of anchoring wires are crossing the plane of OHE in correct position as per plan.

(d) **Over-line Structures:** Check the height and gradient of the contact wire and tally the same with 'as erected'.

(e)**Tunnels:**

(i) Check the height and gradient of the contact wire and clearances and adjust as per SED.

(ii) 100 per cent OHE fittings in tunnels should be replaced with new or previously over-hauled fittings and the removed fittings taken to the Workshop for detailed examination.

(f)**Turn outs:** Every turnout all three type of movement (i-Main line to main line, ii-Main line to turn out, iii- Turnout to main line) shall be possible and should be checked during maintenance under power block. It is most critical item of OHE.

Check the position of the contact wires with respect to the track for compliance with SED.

(g) **Overhead Cross-feeders and 25 kV Feeders:**

(i) Examine wires for frayed strands, overheating, pinching or corrosion, especially at suspension clamps and PG clamps. Tighten junction sleeves.

(ii) While tightening PG clamps ensure that all joints are properly coated with Vaseline.

(iii) Check tension in wires and adjust if necessary.

(iv)Other overhead wires such as bypass feeders and earth-wires should be inspected. The insulator attachments should be dismantled, overhauled and put back in position. The insulators should be cleaned at the same time.

(h) Rehabilitation of OHE

For Rehabilitation of OHE components, Railway Board letter No. 2002/ACII/2/10 Vol II dated 29.11.2019 should be referred. PCEE may decide the assemblies to be replaced after a special drive for condition monitoring.

6.6 SPECIAL CHECKS

Gantry: Periodicity for maintenance- **Annual** (Railway Board letter No.2020/EEM/161/1 Vol. II dated 21.09.2020) with checking of following:

(i) Checking of gantry conductors, drop jumpers, PG clamps with thermo vision camera quarterly under the supervision of SSE

(ii) Cross feeder for the first Track should be replaced by connecting jumper directly from gantry mast using standard out rigger arrangement. It will reduce two cross feeders if connected to nearest track OHE.

Thermal Imaging: Temperature of OHE component rises due to traffic load, loose contacts, component under mechanical strain, excessive wear etc. Maintenance

Instruction on Identification of defects on traction installation using thermo-vision camera and preventive action as per **SMI No. TI/MI/0055 Rev. 0**. Should be followed.

Periodicity: Periodicity of Thermal imaging inspection of OHE will be quarterly.

Current collection with OLIVIR G (Para 20324 of ACTM Vol. II-Part-I):

It is necessary to carry out periodic tests to detect points at which contact between the contact wire and pantograph is unsatisfactory resulting in sparking. Such current collection tests are performed at night. This test is conducted by OLIVIR-G equipment which can be fixed on loco focusing the pantograph and data of the sparking locations can be downloaded after the completion of inspection.

The current collection tests as above should be carried out by the depot-in-charge (SSE or JE) quarterly over his entire section. The DEE(TrD)/ ADEE (TrD) should accompany the depot-in-charge during such tests alternately so as to cover their sections once in 3 months respectively. DEE (TRD) should accompany the depot-in-charge so as to cover his jurisdiction once a year.

The form in which a record is to be maintained is indicated in para 20348.

Vide Rly Bd. Letter's no. 2013/Eect(G)/148/1 Dated 10.05.2019, periodicity of Current Collection with OLIVIR-G to be Half Yearly.

Current collection with OLIVIR G for 160 kmph train operation.	Periodicity of Current Collection to be quarterly along with following. • Olivir –G Video should be seen on computer for checking the pantograph passes over turnout, crossover, IOL, UIOL. Its video based findings should also be necessarily recorded in appropriate registers and preventive maintenance done timely.

Olivir-G can be used for identifying hard spots/ hot spots on contact wire, current collection performance, OHE-Pantograph mechanical interaction.

Bi-Metallic Clamps- These should be checked by thermo vision camera for signs of overheating once **in 3 months**.

Earth Connections: Apart from general inspection of bond and earthing connections during foot-patrolling, all such connections should be specially checked for continuity and soundness of connections once in six months. Particulars of all earthing connections (other than structure bonds) should be entered in a Register station-wise for each section and the dates of six-monthly inspection entered therein (see Para 20349).

Cross Feeder & Along Feeder:

(i) Examine wires for frayed strands, overheating, pinching or corrosion, especially at suspension clamps and PG clamps. Tighten junction sleeves.

(ii) While tightening PG clamps ensure that all joints are properly coated with Vaseline.

(iii) Check tension & sag in feeder wires and adjust if necessary.

(iv) Other overhead wires such as bypass feeders and earth-wires should be inspected. The insulator attachments should be dismantled, overhauled and put back in position. The insulators should be cleaned at the same time.

(v) The, clearances to road and rail crossings should be checked with respect to approved plans.

Structure Number Plate:

Retro reflective structure number plate shall be provided as per Railway Board letter No. 2001/Elect (G)/170/1 Pt dated 07.05.2012 .Retro Reflective number plate may be provided at additional masts if required, by Zonal Railway, as per Rly Board"s letter No. 2001/Elect(G)/170/1 Pt dated 18.10.2012.

Jumpers

Proper attention to jumpers during scheduled maintenance is, very important. Jumpers, particularly continuity jumpers, with broken strands should be invariably replaced, failing which the reduced cross-section may cause overheating and eventual failure. Broken strands are most likely at the point of entry into PG clamps, possibly due to sharp edges in the clamp. PG clamps should have properly rounded off edges to prevent the cutting of strands. The clamps should be checked for signs of overheating and proper tightness. G jumper size should be 160 sq. mm.

Bird Menace – For Prevention from Bird Menace on Traction installation (OHE, PSI), **SMI NO. TI/Ml/050 Rev. 1** Should be followed.

Monkey Menace - For Prevention from Monkey Menace on Traction installation (OHE,PSI), **SMI NO. TI/Ml/050 Rev. 2** Should be followed.

Pre Monsoon Checks- For Pre and post Monsoon precaution for traction Installation SMI No. **TI/MI/0053 Rev. 0** should be followed.

6.6 The tightening torque for fasteners of various sizes as per Annexure 2.08 (Para 22015 and 20304 of ACTM Volume II, Part I) is given below:

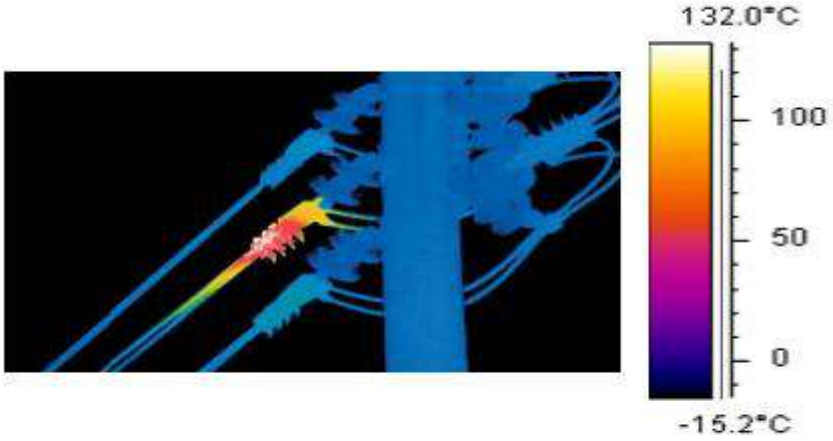
TORQUE FOR VARIOUS SIZES OF BOLTS IN kg.m

Bolt Size	Nominal	Steel	Stainless Steel
10	58	4.73	5.91
12	84.3	8.25	10.31
14	115	13.14	16.42
16	157	20.61	25.61
18	192	28.18	35.23
20	245	39.96	49.95

7.0 Equipment required for condition monitoring:

(i) Thermo - Vision Camera:

Thermo Vision Camera is a device that forms an image using infrared radiation, similar to a common camera that forms an image using visible light. It is a non-contact device which detects infrared radiations and converts it into electronic signals which is then processed to produce a thermal image on a video monitor and perform temperature calculations. It measures infrared (IR) energy and convert the data to images corresponding to the temperature.



Thermal image showing over heated loose connection with temperature chart

In AC Traction sub-station, SP, SSP, thermal scanning will cover: i) All joints connections, terminations, jumpers, PG clamps of incoming switch yard and outgoing switch yard. ii) Transformer bushing connections. iii) Bus bar joints iv) LA, CT, PT connections from bus bar and terminals v) HV side bi-polar Isolators, single pole Isolators contact and bus bar. vi) Connections to buried rail vii) Auxiliary transformer HT connections viii) Cross feeder and drop jumpers and PG clamps ix) Transformer radiator valves. x) Central cable connections in Control Room and Control Boxes of breakers transformer, CT & PT connections.

In AC OHE, thermal scanning will cover: i) All types of jumpers (drop jumpers, C jumpers, turn out jumpers, G jumpers, potential equalizing Jumpers, Anti-theft jumpers, Feeder jumpers, jumpers between Isolator & OHE), All OHE connectors (PG Clamps, Suspension Clamp, Catenary & Contact wire Splices etc.) provided in Contact wire, Catenary wire, Feeders, Negative Feeders, all type of jumpers .

(ii) Anemometers:

Wind speed measurement system (Anemometers) should be installed at locations (TSS/SP/SSP) which are prone to traffic disruption due to heavy winds. Analog Electrical signal of wind speed data shall be interfaced with RTU at concerned switching post so that wind speed alarm is available at MMI of TPC Desk for TPC to take suitable action to open the feeder circuit breaker of the affected zone accordingly, if required. During stormy whether there is instruction for controlling of Trains as per G & SR. Based on the measurement of wind, TPC shall advise section controller who will advise concerned station master and loco pilots to take appropriate action as per G & SR.

(iii) Olivir G:

The OLIVIR-G detects Over Head Equipment (OHE) spark using a video camera. The hardware unit consist of a GPS receiver which track the current position of the locomotive in which the 'OLIVIR-G' is mounted. The OLIVIR mate RT software supplied with the unit identity sparks in real time and save them as images with locations, at the same time continuous video film is also recorded in hard drive. These images can be analyzed to recognize the type of spark (mega pixel) with their locations

RDSO specification no. TI/SPC/OHE/OLIVIR/0051 (or latest) for Overhead line Inspection with Video Recording System for Current collection Test should be referred.

(iv) High Speed Cameras:

High Speed Cameras can be used for monitoring and inspection of pantographs, breakage or any deformation slightest damage or wear and tear of carbon strip precisely and at high speed.

(v) OHE Recording Cum test car for measurement up-to 160 kmph:

Presently, NETRA car is being used for recording & testing of OHE parameters (stagger, dia of contact wire, height & contact force, voltage, gradient) at speed 110kmph.
The OHE parameter recording cum-test car is required to measure and record various parameters i.e. Stagger of contact wire, Height of contact wire, Thickness of contact wire, Gradient of the contact wire, Setting Distance/Implantation, Contact Force etc. of OHE in static/ dynamic conditions under live and non-live conditions of OHE, at speed of 0-160 km/h when coupled to a train/locomotive.
Non-self-propelled OHE parameters recording and testing car (Specification No. TI/SPC/OHE/NETRA/0143 -03/2022) is being planned to consist of LHB Platform upto speed 160kmph for Indian Railways.

(vi) MRI system:

Contact less overhead line diagnostic and measuring equipment can be installed on any type of railway Vehicle for measurement of height, stagger and gradient.

8.0 Particulars of records to be maintained in regard to OHE maintenance are given below (Para 20349 ACTM Vol. II, Part-I and ACS 10 & 13 of ACTM):

1. Daily Report of OHE Maintenance to be submitted by the Supervisor in-charge of field work to JE. This should be in proforma No. 03-1 appended.
   Register for Foot-Patrol Reports: The reports regarding foot-patrolling (para 20322) should be entered by the Technician in a Register to be maintained for the purpose by each Section Supervisor. The Register shall be generally as shown in proforma No. 03-2 appended.

2. Cantilever Assembly Maintenance Register as per proforma No. 03-3. This should be maintained by each depot/sub-depot.

3. Register of Contact Wire Thickness Measurements: This Register shall be maintained in proforma No. 03-4.

4. Register of Clearance under over line Structures as per proforma No. 03-5.

5. Register of Earth Resistance Measurement as per proforma No. 03-6.

6. Register of Current Collection Tests shall be maintained in proforma No. 03-7.

7. Register of Regulating Equipment shall be maintained by each depot/sub-depot for its jurisdiction. This Register should have a page allotted for each Regulating Equipment. Particulars of adjustments carried out, amount of catenary and contact wire cut etc. shall be recorded in this Register, indicating the dates on which these items of work have been done, as per Proforma No. 03-10.

8. Register for Isolator Switches shall be maintained by each depot/sub-depot indicating dates on which the isolators have been Inspected and the details of work carried out, as per Proforma No. 03-11.

9. Register for Turn outs and Cross-overs shall be maintained by each depot/sub-depot. This should indicate the dates on which each turn out/cross-over has been checked for adjustment and particulars of work done, as per Proforma No. 03-12.

10. Register of Vulnerable Foundations: This should contain details of checks carried out on foundations at vulnerable locations, such as on over bridges, embankments susceptible to erosion etc., as per Proforma No. 03-13.

11. Register for Feeder Lines shall be maintained by concerned depots/sub-depots to indicate particulars of patrolling of 25 kV feeder lines and maintenance carried out on such feeder lines.

12. Register of Critical Implantation: The annual check of Implantation at critical locations (para-20306) shall be recorded in this Register as per Proforma No. 03-8.

13. Register of Level Crossings: This should contain dates on which height of contact wire at Level Crossings as well as that of the height gauges at Level Crossings have been checked. See Proforma No. 03-14.

14. Register of Splices as referred to in para 20310 as per Proforma No. 03-15.

15. Register of OHE Break-downs: Each depot/sub-depot should maintain particulars of OHE break-downs occurring in its jurisdiction in Proforma No. 03-9. For each break-down a page should be allotted. Reference to detailed reports submitted should also be given to facilitate investigations subsequently.

16. Register for Thermal Imaging of Electrical Junctions.

17. Register for PTFE Neutral section

18. Register for section insulator assembly

19. Register for power line crossings

20. Register for pantograph joint inspection

21. Register for maintenance of assets

22. Register for Tools and Plants checking

23. Register for Live line tower wagon checking

24. Register for maintenance of 25 kV feeder

25. Register for maintenance of AEC & BEC.

Registers may also be maintained for any other additional items in the proforma prescribed by PCEE.

The Supervisor of the depot/sub-depot will be held responsible for ensuring that these registers are maintained up-to-date. Officers and Senior Supervisors during their inspections should scrutinize these registers and initial a few important entries.

9.0 OHE Maintenance Schedule in Brief is given below:

SN	**Equipment / Name of Activity**	**Existing Periodicity as per ACTM & Railway Board letter No. 2020/EEM/161 /1Vol-II dated 21.09.2020 & 2013 /Elect(G)/148/ 1 dated 10.05.2019.**	**Proposed Periodicity for 160 kmph train operation**	**Justific ation**
1.	Foot Plate Inspection by Supervisor ACTM Para 20320 Annex 3.01	CEE of zonal railway may decide periodicity as per local condition.	PCEE of zonal railway may decide periodicity as per local condition.	-
2.	Foot Plate by officers Sr.DEE, DEE,ADEE ACTM Para 20320 Annex 3.01	CEE of zonal railway may decide periodicity as per local condition.	PCEE of zonal railway may decide periodicity as per local condition.	

<table>
<tr>
<td>3.</td>
<td>Foot patrolling by technician Para 20322 of ACTM Volume-II, Part-I</td>
<td>Annexure 3.03 (Para 20349 of ACTM Vol. II, Part-I)

Fortnightly for open routes and weekly for sub urban section.</td>
<td>Annexure 3.03 (Para 20349 of ACTM Vol. II, Part-I)

10 days for open routes and weekly for sub urban section.

Monthly Schedule of Inspection as given below
<table>
<tr><td>SSE-In charge</td><td>SSE(Sectional)</td><td>JE</td></tr>
<tr><td>Entire section in year</td><td>Entire section in 4 months</td><td>Entire section in 2 months</td></tr>
</table>
</td>
<td>It is necessary to maintain the OHE in perfect condition through proper checks on its geometry and all parameters adopted in the design.</td>
</tr>
<tr>
<td>4.</td>
<td>Single Cantilever

Para 20961 of ACTM Volume-II, Part-I</td>
<td>IOH of Single Cantilever after every Two Years</td>
<td colspan="2">Annual</td>
<td>Cantilever will be subjected to more vibration at higher speed</td>
</tr>
<tr>
<td>5.</td>
<td>Cantilever Assembly POH

Para 20329 of ACTM Volume-II, Part-I</td>
<td>To be dispensed with. However, rusty cantilever must be replaced or painted.</td>
<td colspan="2">To be dispensed with. However, rusty/worn-out cantilever must be replaced or cold galvanized in AOH</td>
<td>After gaining experience, periodicity may be reviewed.</td>
</tr>
<tr>
<td>6.</td>
<td>AOH of OHE with 02 or more cantilever,</td>
<td>Annual</td>
<td colspan="2">Annual</td>
<td>After gaining experience,</td>
</tr>
</table>

	UIOL,IOL,T/O, X/o, feeder jumper, G-Jumper, Droppers Isolators, RRA Clamps Para 20326 of ACTM Volume-II, Part-I			periodicity may be reviewed.
7.	POH Para 20329 of ACTM Volume-II, Part-I	POH after 8 years with 3 IOH in between after every 2 years. POH after every 6 years in costal and saline area with 2 IOH after Every 2 year.	POH after 4 years with 3 AOH after every year.	Due to increase in tension & speed mechanical and electrical stresses in assets will also increase.
8.	AOH of ATD Para 20326 of ACTM Volume-II, Part-I	Annual	Annual	After gaining experience, periodicity may be reviewed.
9.	POH of ATD Para 20329 of ACTM Volume-II, Part-I	POH after 8 years with 3 IOH in between after every 2 years. POH after every 6 years in costal and saline area	POH after 4 years with 3 AOH after every year.	Due to increase in tension ATD will be subjecte

		with AOH in between after Every year.		d to more mechanical stresses.
10.	Gantry	Annual Gantry maintenance retained with checking the following: (i)Checking of gantry conductors, PG clamps with thermo vision camera half yearly under the supervision of SSE (ii) Cross feeder for the first Track should be replaced by connecting jumper directly from gantry mast using standard out rigger arrangement. It will reduce two cross feeders if connected to nearest track OHE.	Annual Gantry maintenance retained with checking the following: (i)Checking of gantry conductors, drop jumpers, PG clamps with thermo vision camera quarterly under the supervision of SSE (ii) Cross feeder for the first Track should be replaced by connecting jumper directly from gantry mast using standard out rigger arrangement. It will reduce two cross feeders if connected to nearest track OHE.	After gaining experience, periodicity may be reviewed.

11.	TURNOUT/CROSSOVERS CEDE/NCR letter No. EL/TRD/NCR /Gatiman dated 19.11.18	Annual	Annual with following checks: 1. At obligatory mast vertical gap between main line and turn out contact wire is to be maintained between 50 to 60mm. 2. At 5m distance from obligatory mast, gap is to be maintained at 50 mm. 3. At 10m distance from obligatory mast, gap is to be maintained between 40mm to 50mm. 4. Track separation is to be kept between 290mm to 550mm. Mast should be changed if track separation is less than 290mm. 5. Span length of turnout location reduced during increasing track separation. 6. From main line to loop line "take off" may be maintained in between 720 to 750mm.	-do-
12.	Thermal Imaging Para 20321 of ACTM Volume-II, Part-I	Half Yearly	Quarterly	OHE will draw more current due to increase in speed, number of trains in the section.
13.	Current Collection with Oliver G	Half yearly along with following: Olivir –G Video should be seen on computer for checking the pantograph	Quarterly along with following: Olivir –G Video should be seen on computer for checking the pantograph passes over turnout, crossover, IOL, UIOL. Its video based findings should also be necessarily recorded in appropriate registers and preventive	After gaining experience, periodicity may be reviewed

		passes over turnout, crossover, IOL, UIOL. Its video based findings should also be necessarily recorded in appropriate registers and preventive maintenance done timely.	maintenance done timely.	.
14.	Short Neutral Section Para 20312 of ACTM Volume-II, Part-I	Annual along with following • Cleaning of SNS insulator: Preferably cleaning of SNS insulator shall be done annually for normal/non-polluting section. For polluted section cleaning shall be done half yearly. In addition, visual check or under power block, cleaning of insulator should be done if locomotive is passing with VCB ON condition. • Measurement	**Quarterly** along with following • Cleaning of SNS insulator: Preferably cleaning of SNS insulator shall be done quarterly for normal/non-polluting section. For polluted section cleaning shall be done half yearly. In addition, visual check or under power block, cleaning of insulator should be done if locomotive is passing with VCB ON condition. Adjustment of SNS during change of track layout (gradient, curve, implantation, height etc.) should be ensured.	OHE will be subjected to more vibration & wear in contact wire side insulating rod.

		of parameters: Measurements should be divided into power block and without power block as divided by the Railway. • Adjustment of SNS: Preferably should be done annually along with the measurement. • All Railways should take appropriate decision based on the local conditions. • Adjustment of SNS during change of track layout (gradient, curve, implantation, height etc.) should be ensured.		
15.	Section Insulator	Annual	Annual	After gaining experience, periodicity may be reviewed.

15.	Tower wagon checking	Half yearly for normal routes and quarterly for suburban routes.	Quarterly	After gaining experience, periodicity may be reviewed.
16.	25kV Feeder Wire Para 20325 of ACTM Volume-II, Part-I	Annual	Annual	-do-
17.	Spring type ATD	-	As per OEM guidelines	-do-
18.	Contact wire condemning diameter & Contact wire Gradient. Para 20309 of ACTM Volume-II, Part-I	Replacement of the contact wire when it has worn to a thickness of 8.25 mm. Contact wire Gradient 3mm/m & Relative gradient 1.5mm/m.	The replacement of the contact wire when it has worn to a thickness of **8.42 mm**. Contact wire Gradient 2mm/m & Relative gradient 1mm/m.	Factor of safety reduced due to increase in tension.
19.	Isolator Para 20326 of ACTM Volume-II, Part-I	Annual	Annual	After gaining experience, periodicity may be reviewed.
20.	Current Carrying Droppers and its	-	Annual with following checks: 1. Wear and tear of fittings 2. Strand cutting	After gaining experience,

	fitting		**3.** Tightening of nut and bolts.	periodicity may be reviewed.

10.0 Maintenance Schedule in brief for PSI is given below:

SN	Equipment/ Name of activity	Existing Periodicity as per ACTM & relevant Rly Board Letter No. (if any)	Proposed Periodicity	Justification
1.	General	• Fortnightly Maintenance (ACTM Para 20225) • Half Yearly Maintenance (ACTM Para 20239) • Yearly Maintenance (ACTM Para 20243)	• Fortnightly Maintenance (Same as specified in ACTM Para 20225 for Sub Station. Also the inspection of SP/SSP is also to be conducted on the lines of substation) • Half Yearly Maintenance (ACTM Para 20239) • Yearly Maintenance (ACTM Para 20243)	The SP/SSP is also provided with Autotransformer, Control & Relay Panel and Circuit Breaker.
2.	Battery	• Fortnightly Maintenance (ACTM Para 20226) • Quarterly Maintenance (ACTM Para 20235) • Yearly Maintenance (ACTM Para 20250)	• Fortnightly Maintenance (ACTM Para 20226) • Quarterly Maintenance (ACTM Para 20235) • Yearly Maintenance (ACTM Para 20250)	---
3.	Battery charger	• Quarterly Maintenance (ACTM Para 20235) • Yearly	• Quarterly Maintenance (ACTM Para 20235) • Yearly Maintenance (ACTM Para 20250)	

		Maintenance (ACTM Para 20250)		
4.	Bonding & Earthing	• Monthly Maintenance (ACTM Para 20227) • Yearly maintenance (ACTM Para 20245)	• Monthly Maintenance (Same as specified in ACTM Para 20227 for Sub Station. Also the inspection of SP/SSP is also to be conducted on the lines of substation The mid-point earthing connection of Autotransformer to be checked visually) • Yearly maintenance (Same as specified in ACTM Para 20245. Also these tests to be made applicable for SP/SSP also.)	The SP/SSP is also provided with Earth mat.
5.	Traction Power Transformer	• Monthly Maintenance (ACTM Para 20230) • Half Yearly Maintenance (ACTM Para	• Monthly Maintenance (ACTM Para 20230, to be made applicable for Autotransformer along with Traction transformer. The temperature reading of FOS (Fibre optic sensor) also to be noted in the register. Further point no. 4 of this Para may be read as "Check silica-gel breather. Traction Transformer have silica gel whose colour changes from orange to dark green as it absorb moisture. If the silica-gel is too wet, check di-electric strength of transformer oil") • Half Yearly Maintenance (ACTM Para 20240 to be made applicable for	Autotransformer has been included. Autotransformer has been included. The Traction

		20240) • Yearly maintenance (ACTM Para 20246) • Overhauling (ACTM Para 20254)	Autotransformer along with Traction Transformer. The midpoint earthing of Auto transformer shall be checked for its intactness. The operation of fan which has been provided for ONAF operation and operation of pump for OFAF mode also to be checked along with indication at RTCC panel). • Yearly maintenance (ACTM Para 20246. Also the mentioned inspection to be done for Auto transformer also). • The Maintenance instruction no. TI/MI/0038 Rev.2 or latest -Inspection test schedule for traction power transformer shall also be followed. • Overhauling (ACTM Para 20254. Also the mentioned inspection to be done for Auto transformer also). • The Maintenance instruction no. TI/MI/0039 Rev.2 or latest- Maintenance Instruction for Overhauling of Traction Transformer shall also be followed.	transformers are with ONAN/ONAF/OFAF mode.
6.	Circuit Breaker	• Monthly Maintenance (ACTM Para 20231) • Overhauling	• Monthly Maintenance (ACTM Para 20231) • Overhauling (ACTM Para 20254) • Specified in Annexure	

		(ACTM Para 20254) • Specified in Annexure 2.06 and annexure 2.07 (Para 20223(6)) of ACTM Volume-II, Part-I.	2.06 and annexure 2.07 (Para 20223(6)) of ACTM Volume-II, Part-I. • The Maintenance instruction no. TI/MI/0054 or latest - Maintenance Instruction and Test schedule for 25 kV Vacuum circuit breaker and Interrupter shall also be followed.	
7.	Isolator	• Monthly Maintenance (ACTM Para 20232) • Half Yearly Maintenance (ACTM Para 20241) • Yearly maintenance (ACTM Para 20247)	• Monthly Maintenance (ACTM Para 20232) • Half Yearly Maintenance (ACTM Para 20241) • Yearly maintenance (ACTM Para 20247)	
8.	Bus Bar, Clamp & Connectors	• Monthly Maintenance (ACTM Para 20233) • Yearly maintenance (ACTM Para 20248)	• Monthly Maintenance (ACTM Para 20233, Further, thermal imaging camera should be used for checking the temperature at joints, nut-bolts, bus connections, clamp etc.) • Yearly maintenance (ACTM Para 20248)	
9.	Auxiliary Transformer	• Quarterly Maintenance (ACTM Para 20238)	• Quarterly Maintenance (ACTM Para 20238)	

10.	PTs & CTs	• Quarterly Maintenance (ACTM Para 20236) • Yearly maintenance (ACTM Para 20251)	• Quarterly Maintenance (ACTM Para 20236) • Yearly maintenance (ACTM Para 20251)	
11.	Lightening Arrester	• Yearly maintenance (ACTM Para 20244)	• Yearly maintenance (ACTM Para 20244)	
12.	Control & Relay Panel	• Monthly Maintenance (ACTM Para 20234) • Half Yearly Maintenance (ACTM Para 20242) • Yearly Maintenance (ACTM Para 20249)	• Monthly Maintenance (ACTM Para 20234, C&R panel has also been provided at SP/SSP) • Half Yearly Maintenance (Same as specified in ACTM Para 20242. Further point no. 4 of this Para may be read as "Check LCD display and relay setting of numerical protection relays") Yearly Maintenance (ACTM Para 20249, some points modified as below:) 20249(1): Same as specified in ACTM However, the referred Para 20221 is deliberated as under- 20221(1,2&3)- Same as specified in ACTM 20221(4)-Same as specified in ACTM, except the Guidelines for setting of relays shall be shared	C&R panel has also been provided at SP/SSP.

			separately. 20221(5)-Same as specified in ACTM. 20221(6) (a) Same as specified in ACTM (b) Test operation (if test button facility available) or by injecting of operating input with secondary injection test kit to confirm that the relays do operate the trip circuits in the manner prescribed. These tests should be carried out by at least at the level of AEE once in a year for all relays. Simultaneously visual checks on relay connections, condition of the trip battery, trip and alarm circuits, LCD display and also the dust-tightness of protective covers wherever applicable should be made. Numerical type relays where sealing cover is not provided, to avoid the unauthorized changes in relay settings, secured pass word protection is to be used by competent authority as decided by user Railway. (c) & (d) Same as specified in ACTM (e) Not applicable 20249 (2): same as	

			specified in ACTM	
13	SCADA system	Specified in ACTM Para 20429	**Preventive Maintenance at RCC:** **(a)Monthly Maintenance:** • Check for satisfactory working of RCC machines. • Check Change over from main to stand by & vice versa. • Check that all the reports are logging properly. • Check that logging in event list and Alarm list is proper. • Delete unnecessary log files in all computers. • Up date Anti virus Software if required. • Check that printers are working properly. • Checking of LAN cables, connectors etc. • Check functioning of UPS by switching off the main power supply for 15 minutes duration. • Check functioning of projector/display wall. **(b) Yearly Maintenance:** In addition to daily, monthly maintenance schedules **c**leaning of Cable Trays, dust accumulated under PC tables shall be done using vacuum cleaners. The earthing of RCC equipment must be checked. **(c) Maintenance of UPS & Battery at RCC:** Maintenance shall be carried out as per	

			maintenance manual given by UPS & Battery Set supplier separately. In this connection Annual capacity test and Ah efficiency test of battery shall be carried out as preventive maintenance measures as per manufacturer's recommendation. **Preventive Maintenance at RTU:-** (a) **Quarterly Maintenance** • Cleaning of dust inside RTU. • Visual Checks for any abnormality • General Connection tightness. • Ensure free movement and proper working of contactors. • Measure earth resistance of earth pit provided for RTU. Note: The specific maintenance instructions issued by the respective suppliers of SCADA systems should also be followed.	
14.	Pre Monsoon Check	Specified in ACTM Para 20253	Same as Specified in ACTM Para 20253	
	Schedule of Monthly Inspection	Specified in Annexure 2.01 (Para 20202, 20223) of ACTM Volume-II, Part-I.	Same as specified in Annexure 2.01 (Para 20202, 20223) of ACTM Volume-II.	

	Check List for inspections	Specified in Annexure 2.02 (Para 20223) of ACTM Volume-II, Part-I.	Details Specified in Annexure 2.02 (Para 20223) of ACTM Volume-II, Part-I to be modified as below: 1.0 - Same as specified in ACTM 2.0- Same as specified in ACTM 3.0- Same as specified in ACTM 4.0- (a) Same as specified in ACTM (b) Interrupter should be read as "circuit breaker and interrupter". (c) Same as specified in ACTM (d) Same as specified in ACTM (e) Same as specified in ACTM (f) Along with existing point 1 & 2, new point number 3 should be added as Buried rail connection. (g) Same as specified in ACTM (h) New para (h) added as Auto transformer wherein the following to be checked. 1. OTI and WTI temperature – present and maximum readings. 2. Oil level in conservation tank 3. For abnormal humming. 4. Colour of silica gel. 5. For leakage of oil on transformer body, conservator tank, oil drain valve and radiator.	Circuit Breakers are also provided at Switching stations. Autotransformers have been provided as Switching Stations.

Note:

1. All relevant paras of ACTM should be read in conjunction with schedule maintenance of the equipment mentioned above.

2. The latest Instruction/ Special Maintenance Instruction issued from time to time should be strictly followed for the equipment installed and commissioned in the TSS/SSP/SP.

11. References:

(i) ACTM Volume-II, Part I

(ii) Instruction TI/IN/0042- OHE GUIDELINES FOR ZONAL RAILWAYS FOR INCREASING SPEED POTENTIAL TO 160KMPH ON NDLS-HWH (INCLUDING KANPUR-LUCKNOW) & NDLS-BCT (INCL. VADODARA- AHMEDABAD) ROUTE

(iii) Rly Bd's. Letter no. 2013/Eect(G)/148/1 dated 10.05.2019

(iv) UIC 791-1

Annexure 3.01
(Para 20301,2,4)
20320

SCHEDULE OF MONTHLY INSPECTIONS

SN	Nature of Inspection	SR.DEE	DEE	ADEE	SSE-In charge	SSE(Sectional)	JE*
1.	Locomotive Cab	1	1	2	2	2	2
2.	OHE Inspection Car	1	2	3	4	4	6
3.	Foot patrolling	0	0	0	Entire section in year	Entire section in 4 month	Entire section in 2 month

4.	OHE Depot	1	2	4	4	-	-
5.	Station	1	1	2	4	4	4
6.	Night Inspection	-	1	1	2	2	2
7.	Office Inspection	1	1	1	1	-	-

Notes:

i. These Inspections are the minimum quantum per month.
ii. In respect of Supervisory Staff, the inspections pertain to their respective jurisdiction.

iii. Brief checklists of items to be broadly covered are indicated at Annexure 3.02. Detailed maintenance schedules prescribed should also be kept in view.

iv. Quota of Inspections by HQ officers may be laid down by PCEE

Annexure 3.02

(Para 20302)

CHECK LIST FOR INSPECTIONS

1.0 OHE Depots & Subordinate Offices

(a)OHE Depots

1. Staff grievance register.
2. Quarter register.
3. Attendance registers.
4. Availability of all drawing (latest), SWRs with latest correction slips.
5. Cleanliness of depot.
6. Upkeep of Stores.
7. Stock position of stores.

8. Upkeep of wiring train, OHE Inspection car, ladders, tools etc.

b) Subordinate office:

1. Attendance registers.
2. Compliance of audit & account Inspection notes.
3. Compliance of Officer's inspection notes.
4. Test & Trial report.
5. Latest drawings & specifications.
6. Planning & progress of section

2.0 Station

a) SWR

1. SWRs and its Appendix G with latest correction slips.
2. Display of traction working diagram and its correctness at SM room & cabins.
3. Traction Key Board and key register for its proper maintenance.
4. Knowledge of traction working of SM/ASM on duty.
5. Validity of the competency certificate of SM/ASM.
6. Availability of Hand Gloves for isolator operations and Power block collars.

b) CLS Board in SM room/cabin

1. AT standby supply.

c) Isolator.

1. Locking arrangements.
2. Correct alignment of blade tip in the fixed pole contact jaws.
3. Correct matching & alignment of arcing horns.

d) General

1. Fire extinguishers, sand/water buckets, Respiration chart, First Aid Box, Tools & Plants.

2. Working of TPC phones & emergency telephone sockets.

3. History sheets of various equipments.

3.0 Cab Inspection

a) Condition of OHE

1 Flashed/damaged insulators

2. Displaced fittings & droppers

3. Balance weight in reference to upper & lower limits marked on masts.

4. Number plates, warning board for rusting & tightness.

5. AT : Oil leakage and deposits of pollutants on insulators

b*)* Obstruction to OHE:

1. Birds' nests

2. Tree branches near OHE.

c) Cab equipments

1. Focusing of head lights & flasher light.

2. Voltage on loco voltmeter at FP & SP locations.

d) Driving technique of Driver

1. Exchange of signals with station staff.

2. DJ opening & closing at neutral section.

3. Observation of caution orders.

e) Night Inspection

1. Incidence of sparking from the rear cab of locomotive.

2. Other items as above.

3. Observe any glow in the OHE connection with Equipment or jumpers at SSP, SP, Isolators.

4.0 **Inspection with OHE Inspection Car**

***a*) Mast, portals and cantilever supports.**

1. Structures and galvanized tubes for rust & chipping off galvanization.

2. Cracks on steady arm & register arm.

b) Contact &\Catenary wires

1. Kinks & twists on contact wire.

2 Broken strands on catenary wire.

3. PG clamps, Jumpers, **current carrying droppers.**

4 Contact wire wear at selected locations.

5 Height and stagger at selected locations.

c) Section insulators

1 Flash or hit marks on and adjustment of runners.

2 Level of assembly & alignment.

3. Chipped/cracked insulator.

d) Turn -out

l. Stagger of both the OHES.

2. With Inspection Car running on loop line, check up if the-main line OHE passes smoothly under the pantograph.

3 With Inspection car running on main line, check up if the loop OHE passes smoothly under the pantograph.

4. **Turn out parameters**

e) Overlaps:

1. Height and stagger of OHE in the overlap section.

2. Whether normal minimum clearance of 500mm is available between the two OHEs in an insulated overlap and 200mmin the case of uninsulated overlap.

3. Check up whether lifting of out-of-run contact wire is correct.

(f) Overline structures

1. Horizontal & vertical clearances.
2. Flash marks underside of the structures.
3. Gradient of contact wire on either side.
4. Insulation on catenary wire under the structure.

(g) Level Crossing.

1. Height & gradient of contact wire.

(h) Regulating Equipment:

1. X-Y values with temperature.
2. Free movement of counter weights.
3. Lubrication of pulley and other moving parts.
4. Stainless Steel wire rope for opening of strands, broken or rusted strands.

Annexure 3.03

(Para 20321)

FOOT PATROL DIARY ……

DEPOT……..

JURISDICTION …….

NAME …….

	ITEMS OF OBSERVATION	OBSERVATIONS	
		SECTION	SECTION

			DATE	DATE
FOUNDATIONS	1.	DAMAGED OR CRACKED		
	2.	SINKING OR TILTED		
	3.	WATER COLLECTION AROUND FOUNDATION		
	4.	SIDE EARTH FILLING REQUIRED.		
	5.	TOP OF FOUNDATION NOT CLEAR.		
OHE MASTS AND PORTALS	1.	MAST DEFLECTED TOWARDS TRACK.		
	2.	MAST DEFLECTED AWAY FROM TRACK.		
		Other than those already under observation & thus painted with yellow band.		
	3.	HIT MARK OR DAMAGE TO MAST.		
	4.	NUMBER PLATE MISSING		
	5.	NUMBER PLATE DAMAGED.		
	6.	HRL/IMP NOT PAINTED.		
ANCHOR	1.	NUT, CHECKNUT OR LOCK PLATE· PIN MISSING FROM ANCHOR BOLT.		
	2.	-DO - GUY ROD.		
	3.	ANCHOR BOLT RUSTING.		
BRACKET ASSEMB	1.	BRACKET INSULATOR DAMAGED.		

	2.	STAY INSULATOR DAMAGED.		
	3.	9-TONNE ANCHOR INSULATOR DAMAGED.		
	4.	ANY OTHER DEFECT NOTICED.		
SECTIONS INSULATOR	1.	ABNORMAL WEAR ON RUNNERS.		
	2.	CORE INSULATOR VERY DIRTY.		
	3.	CORE INSULATOR HAVING FLASH MARKS/DAMAGED.		
REGULATING EQUIPMENT	1.	'Y' DISTANCE IS ABNORMAL		
	2.	MOVEMENT OF B.W. NOT FREE.		
	3.	SS ROPE OVER-RIDING ON THE DRUM GROOVES.		
	4.	SS ROPE STRANDS FOUND CUT.		
	5.	WHETHER EQUALISING PLATE IS TILTED.		
AUX. TRANS FOR CLS SUPPLY	1.	DROP OUT FUSE FOUND FALLEN.		
	2.	SOUNDNESS OF EARTH CONNECTION.		
OHE SPAN	1.	SPAN CURRENT CARRYING DROPPERS, ABNORMALLY OUT OF PLUMB.		
	2.	SPAN DROPPERS DAMAGED.		
	3.	ANY ABNORMALITY IN RESPECT OF JUMPERS.		
	4.	DAMAGE TO CATENARY STRANDS.		
	5.	CHECKNG OF PG CLAMPS		

	6.	EXCESSIVE SAGGING OR HOGGING OF CONTACT WIRE.		
ISOLATOR	1.	ISOLATOR NO. PLATE MISSING.		
	2.	ISOLATOR LOCK MISSING/DAMAGED.		
	3.	ANY SIGNS OF SPARKING/ OVERHEATING		
AEC, BEC & 25kV Negative Feeder	1.	VISUAL INSPECTION OF CONNECTION OF AEC & BEC WITH MAST AND PORTALS		
	2.	DAMAGE TO FEEDER WIRE STRAND		
	3.	DAMAGE TO AEC		
	4.	Check tension & sag in feeder wires and adjust if necessary. Checking of clearances to road and rail crossings should be checked with respect to approved plans.		
GENERAL CHECKING	1.	DANGER AND CAUTION BOARDS		
	2.	HT. GAUGES AT LEVEL X-ING.		
	3.	EMERGENCY SOCKETS FOUND DAMAGED/ OUT OF ORDER.		
	4.	EARTHING OF OLS/PLATFORM SHEDS ETC.		
	5.	BONDS FOUND DISCONNECTED/MISSING.		
	6.	PROTECTIVE SCREENS ON FOB/ROB.		
	7.	TREE BRANCHES NEAR OHE.		
	8.	BIRD NESTS AND PIECES OF STRAY WIRE.		
	9.	DEFECT IN TRANSFORMER SECONDARY NEUTRAL CONNECTION TO RAIL AT FP.		

	10.	SIGNS OF HEAVY SPARKING WHEN LOCO PASSES		
	11.	GENERAL CONDITIONS OF SWITCHING STATIONS ON ROUTE.		
	12.	MINOR DEFECTS RECTIFIED IF ANY DURING PATROLLING.		
	13.	MAJOR DEFECTS NOTICED		

Signature of Lineman

Foot Patrolled

Date:

Signature of station masters/ Yard masters/ Cabin master with date and time

Checked by

SSE/JE/ELC (OHE)

Annexure 3.4
(Para 20349)

Annexure A

PROFORMA 03-1

Date .....

1. Power Block in sub-sector/Elementary Section :

   Time asked Time received

   Time returned

   Remarks

2. Staff utilized

   Skilled Semi skilled Unskilled

3. Details of work carried out in Power block:

	Type of work	**Locations**	**Staff/ Supervisor**
3.1	Cleaning of Insulator-ST, BT & 9-T		
3.2	Section Insulator		
3.3	OHE checking and adjustment		
3.4	Height & stagger of contact wire		
3.5	Dia of contact wire measured		
3.6	Clearance checked at locations		
3.7	Insulated overlaps locations		
3.8	ATD locations		

4. General Report on OHE of section. Preventive actions suggested_____

5. Report on catenary / jumper damage in the section. Preventive actions suggested_____

6. Details of work carried out under Non-power block

	Type of work	**Locations**	**Staff/ Supervisor**
6.1	Muff cleaned		
6.2	BEC/Bond checking		

6.3	Rail level & Implantation checked		
6.4	Repainting of R/L and implantation		

7. Report of foundation/muff conditions, leaning of masts. Preventive actions suggested_____

8. Report on changes in RL/implantations. Preventive actions suggested_____

Station Sup.

Signature_____

Dated_____
Designation_____

Annexure B

PROFORMA 03-2

Register for Foot Patrol Report

Section_____

SN	Location	Defect	Category (A or B)	Date	Noticed by	Supervisor remarks			Date attended
						Name/Sign	Date	Action proposed with PDC	

Category 'A'- means defect related to safety and train operation

Category 'B'- All other excluding A

Annexure C

PROFORMA 03-3

Tower wagon/ Cantilever Assembly Maintenance Register

KM_____ Section_____

SN	Location	Type of location	No. of cantilevers	Attention				Insu. Make batch			CW		Clearance	Condition of fittings	Staff / Supervisor	Remarks
				Date of checking	Work done	Sch/ Unsch	Due Date.	9T	ST	BT	Ht.	St.				

Annexure D

PROFORMA 03-4

Record of Contact Wire Wear and splices

03-04 & 03-15 merged

SN	Type of location (specify if stop signal/ hard spot location/ tunnel/ROB/FOB/ L.x gate or any other location	Location no.	At support		AT MID SPAN		Dt. Of provision of CW splice	Observation	No. of catenary strands out	Dt. of prov. Of catenary splice	Staff / Sup.	Remarks
			Thickness	Wear since last check	Thickness	Wear since last check						

Annexure E

PROFORMA 03-5

Register for Features of overline structure

FOB/ROB..... Between Location.....

Station/Section.....

Line no.	Date	Span	Rail Level	Contact Wire Height at ends and midway	Clearance		Features Present						Sup/ Staff	Remarks
					END1	END2	Crossing	Pipes	Protective screen	Caution Board	Earthing	Pr. of- False Cat		

Annexure

PROFORMA 03-6

Register of Earth Resistance Measurements

Station..... Nearest Location.....

Earth Pit No.....

Sl.. No.	Date of Test	Resistance in Ohms	Over all Resistance	Initials of Supervisors	Remarks if any,

Note - 1. Half page to be allotted for Each pit.

2. Earth test should be carried out on a dry day preferably in March/April once a year.

Annexure F

PROFORMA 03-7

Record of current collection test

Date

Time

Done by

Train No.

From_____ To _____

Section

Location	Category			Corrective action	Dt. Of corrective action	Supervisor/Staff	Remarks
	Heavy	Medium	Light				

Annexure G

PROFORMA 03-8

(03-8 & 03-13 merged)

Record of Implantation & Foundation

Section _____

SN	Location no.	Date of checking	Foundation type	Type of soil	Implantation		Step distance	HRL mark height above RL	Amount of leaning at CW level		Amount of leaning at 1.85 m above HRL		Reason for leaning	Action taken	Supervisor/Staff	Remark
					As per SED	Actual			Towards track	Away from track	Towards track	Away from track				

Note: One page in the register to be allotted for each location

PROFORMA 03-9

..... RAILWAY

..... DIVISION

TRACTION DISTRIBUTION SECTION

Register of Break-downs/ Accidents involving OHE

1. Date of accident/break-down .....
2. Station .....
3. OHE Locations affected .....
4. Details of damages .....
5. Probable cause .....
6. Brief description and remedial action taken .....
7. Reference to detailed reports sent .....
8. Remarks, if any .....

Note :- One page in the register to be allotted for each case.

PROFORMA 03-10

..... RAILWAY

..... DIVISION

TRACTION DISTRIBUTION SECTION

Regulating Equipment

Location no. _____ Section:_____ Elementary section _____

Sl. No.	Date of Checking	Tension length m	Noted Value			Adjustment require		Date of Adjustment	Adjustment done			Temp °C	Final value		Whether greased	Whether replacement of ATD done with the overhauled one	Signature of SSE/ JE	Remarks
			Temp °C	X/ mm	Y mm	X/ mm	Y mm		By turn buckle	Wire cut			Xmm	Y mm				
										Catenary	Contact							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

(N.B.- One page to be allotted for each ATD location)

PROFORMA 03-11

..... RAILWAY

..... DIVISION

TRACTION DISTRIBUTION SECTION

Isolator Switches

Isolator Switch no. _____ Section/ Station:_____

SN	Location	Particular of isolator Switch	Elementary section connected	Date checked	Condition	Particulars of Work done, if any	Remarks
1	2	3	4	5	6	7	8

(NB - Half page to be allotted for each switch)

Performa 03-12

_____RAILWAY
_____ DIVISION
TRACTION DISTRIBUTION BRANCH
Turnout and Cross Overs

TURNOUT/CROSSOVER NO.---------- SECTION/STATION----------

S.N	Description		Std. value	Measured value			
1	Particulars of Turnout/crossover(Give the number i.e.1:8½ , 1:12 etc.)		-	-	-	-	-
2	Section		-	-	-	-	-
3	Location No.		-	-	-	-	-
4	Date Checked		-	-	-	-	-
5	Type of Arrangement - Crossed type/Overlap type		-	-	-	-	-
6	Height of Contact Wire above rail level at support at Obligatory Structure	Main Line Contact Wire (mm), (H)					
		Turnout Contact Wire (mm)	H+50 *				
7	Turnout span (m)	54 (Max) Span length of turnout location reduced during increasing track separation.					

8	Height of Contact Wire in Overlapping Zone	Mainline Contact Wire (mm) (H1)					
		Turnout Contact Wire (mm)	H 1+(50-60) *				
9	Stagger of Contact Wire at Obligatory Structure	Mainline Contact wire (mm) Turnout Contact wire(mm)	200 max. 300 max.				
10	Sag of section insulator of Turnout/Crossover		Zero				
11	Movement of tower wagon from mainline to turnout a) Take off b) Point of take off (in m from O/S)		720 mm to 750 mm from centre line of pantograph ---				
12	Movement of tower wagon from turnout to mainline a)Take on b) Point of take on (in m from O/S)		720 mm to 750mm from centre line of pantograph ---				
13	Stagger of section insulator at turnout/crossover		+/- 100 mm				

14	Track separation at the location of section insulator (m) (a) Runners towards the centre of turnout (b) Runners away from the centre of turnout		1.65 Min 1.45 Min				
15	Condition of ATD of turnout/mainline OHE		Free to move				
16	Length of pipe provided in hex tie rod of limiting device to bridge redundant length of hex tie rod.		As per SMI No. TI/MI/0035 Rev.1				
17	Setting distance (implantation) of obligatory structure (m)		3.0 Min				
18	Track separation at obligatory structure (mm)		290 to 550				
19	Distance of 'G' jumper from obligatory structure (m)		5.6				
20	Length of 'G' jumper. (m)		4.0				
21	Deviations from SEDs						
22	Adjustments done ,if any						
23	Remarks						
24	Name of supervisor and designation						
25	Signature of Supervisor						

* **In case of overlap type arrangement.**

As per CEDE/NCR letter no. EL/TRD/NCR/Gatimaan dated 19.11.2018 following checks should also be carried out:

(i) At obligatory mast vertical gap between main line and turn out contact wire is to be maintained between 50 to 60mm.

(ii)At 5m distance from obligatory mast, gap is to be maintained at 50 mm.

(iii)At 10m distance from obligatory mast, gap is to be maintained between 40mm to 50mm.

(Proforma 03-13) merged with 3-08

(Proforma 03-14)

..... RAILWAY

..... DIVISION

TRACTION DISTRIBUTION SECTION

Level Crossing Gates

S.No.	Location of level X-ing	Line	Date of checking	Height of Contact wire	Condition of height gauge	Height of Height gauges from road level	Availability of 25 kV danger boards & Public caution boards at height gauge	Whether manned or un-manned, If manned Availability of staff warning board and electric shock treatment board at gate lodge	Remarks
1	2	3	4	5	6	7	8	9	10

(Half page for each level crossing)

(Proforma 03-15) merged with 3-04

सत्यमेव जयते

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय Ministry of Railways

निर्देश संख्या. टी आईएम/ आई /0061
MAINTENANCE INSTRUCTION No.
TI/MI/0061

ओवरलाइन संरचना के अंतर्गत 'कम्पोज़िट हाई वोल्टेज इंसुलेटिंग कोटिंग' के प्रावधान के लिए रखरखाव अनुदेश, जहाँ भी रिड्यूस्ड इलेक्ट्रिकल क्लियरेंस को अपनाया जाता है ।

Maintenance Instruction for Provision of 'Composite High Voltage Insulating coating' under the Overline Structure, wherever the reduced Electrical Clearances are adopted.

(April 2025)

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक (कर्षण संस्थापन) Principal Executive Director (TI)	17/04/2025
अनुशंसित Recommended by	कार्यकारी निदेशक (कर्षण संस्थापन) Executive Director (TI)	17/04/25

जारी कर्ता/ ISSUED BY:

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Signature & Date	17.04.25	17.04.25	17/4/25
Designation	SSE/ TI-2	ADE/ TI-2	DIRECTOR/ TI-2

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1. TITLE:

Maintenance Instruction for Provision of 'Composite High Voltage Insulating coating' under the Overline Structure, wherever the reduced Electrical Clearances are adopted.

2. BACKGROUND:

RDSO vide letter No. TI/OHE/EC-AC/11 dated 24.11.2011, Letter No: - TI/OHE/INSCAT/12 dated 15.02.2013 & RDSO-TI0LKO(OHE)/83/2020-O/o PED/TI/RDSO dated 09.02.2022 has recommended the use of Composite High Voltage Insulation Coating for increasing the OHE clearances.
Wherever the reduced Electrical Clearances are adopted, 'Composite High Voltage Insulating coating' must be used to insulate Overline Structure. The range of thickness shall be 3 mm (three millimeter) minimum. This compound is used to prevent insulation breaking from dust and moisture.

3. OBJECTIVE:

The objective of this SMI is to provide 'Composite High Voltage Insulating coating' under the Overline Structure, wherever the reduced Electrical Clearances are adopted by Zonal Railways to increase headroom clearance with other options (Use of insulating sheet, Use of insulated Cantilever Assembly & Running of parallel contact wire below overline structure).

4.0 INSTRUCTIONS:

4.1 (a) Composite high voltage Insulating coating should be provided at least in the pantograph zone running area on the Girder/Rob/FOB/Tunnels.

(b) Coating thickness of the Composite high voltage Insulating coating shall be minimum 3.00 mm. Coating thickness shall be measured with a suitable coating thickness meter for metal as well as concrete substrates and duly recorded.

(c) Before application of Composite high voltage Insulating coating the substrate shall be adequately cleaned and scrapped for all foreign materials/rust/contamination by suitable means to ensure adhesion of the coating to the substrate to provide long service life.

(d) The Coating thickness shall be monitored at regular intervals. The Railways should ensure the proper conditions and monitoring at regular intervals. Periodicity and methodology to be decided by PCEE of the zonal railway to assess any deterioration in thickness of the coating due to surrounding pollutants and erosion. The maximum interval of the said checking can be once in every 12 months.

(e) The Composite high voltage Insulating coating can be applied on concrete as well as metal substrates based on site condition where available headroom clearances are not adequate.

(f) Samples of Composite high voltage Insulating coating shall be tested through NABL accredited laboratory before installation. The test report of the same should be examined by zonal railway for achieving the following.

I. Composite high voltage Insulating coating should withstand 42 Kv AC for 1 minute without puncture. Coating thickness should be 3.00 mm. Testing should be conducted as per ASTM D149 or IS 2584.

II. Composite High Voltage Insulation Coating should have a Breakdown Voltage of >=55 Kv AC with a coating thickness of 3.00 mm. Testing should be conducted as per ASTM D149 or IS 2584.

TABLE - 1

Parameters	Test Standards	Value
Cure System	Visual	Neutral Air Drying moisture cure
Percent Solid Contents		>85%
Drying Time of Finished Coating	Visual/Ford Cup Method	45 – 50 Minutes
Specific Gravity of finished coating	ASTM D297	1.10 – 1.50
Proof voltage withstand @3.00mm Coating Thickness	ASTM D 149 / IS 2584	42KV AC (Withstand for 1 Minute)
Minimum Breakdown Voltage of Insulation Coating at 3.00 mm Coating Thickness	ASTM D 149 / IS 2584	>=55 kV AC
Volume Resistivity	ASTM D 257	>2.20 X 10^{11} ohm/in
Surface Resistivity	ASTM D 257	>1.5 X 10^{11} ohm
Temperature Stability		-20 Degrees C to 100 Degrees C. No cracking observed on the coating material.
Water Absorption after 12 hours immersion.	ASTM D 570	<= 0.02%
Loss Tangent @ 50 Hz @ 500 V	ASTM D 150	Max 0.05
Comparative Tracking Index	UL 745 or IEC 60112	>=600
Resistance to Tracking & Erosion Test	IEC 60587:2022	2.5 Kv – 1 Hour Pass 2.75 kV – 1 Hour Pass 3.00 kV – 1 Hour Pass 3.25 Kv – 20 minutes Pass
Adhesion Test @ 20 Kg Load	ASTM D 2197	Pass
Fire Resistance Test Horizontal & 30 sec burn		Pass. Should not spread flame.

4.2 Zonal Railways are advised to use 'Composite High Voltage Insulating coating' under the Overline Structure first on trial basis for a period of six months at very limited locations as approved by PCEE. After getting the satisfactory performance, Zonal Railways may provide on other location as per local requirement duly approved by PCEE of the ZRs.

5.0 AGENCY FOR IMPLEMENTATION:

Composite high-voltage insulating coating arrangements may be provided under the Overline Structure (OLS) wherever reduced electrical clearances are adopted or flashing occurs under/over the OLS, as approved by the PCEE.

6.0 MAINTENANCE OF RECORDS:

Railways are advised to inspect the Overline Structure for the condition of the insulating paint once every three months or as per the inspection schedule approved by the PCEE. Records should be maintained in the prescribed format for the inspected locations.

Proforma for Performance Feedback

SNo	Description	Remarks
1	Location where applied (FOB/ROB/Girder Bridge/Tunnel)	
2	Type of overline structure (FOB/ROB/Girder Bridge/Tunnel)	
3	Substrate of overline structure (Metal/Concrete)	
4	Clearance of Catenary Wire from the overline structure	
6	Peeling off/Damage or Raised Surfaces/Air Pocket.	
7	Flashmarks/Black Spots/Tripping Marks on the surface of the coating.	
8	Comparison of OHE Tripping before and after providing the coating.	
9	Date of Composite High Voltage Insulating coating applied.	
10	Make, type, grade of Composite High Voltage Insulating coating.	
11	Approximate area of Composite High Voltage Insulating coating applied.	

7.0 General Requirement and precautions to be taken: -

1. Before Application of Composite High Voltage Insulation Coating, the substrate shall be duly cleaned, scrapped and remove all foreign particles on the area where it is being applied. This shall ensure proper adhesion of the coating material to provide longer service life.

2. Composite High Voltage Insulation coating material base coating should have an inherent anti corrosive property and the top layer should be water

repellent in nature. This shall ensure that there is NO breakdown due to dust and moisture.

3. Coating should have adequate mechanical and adhesion strength to sustain repeated vibration from running of locos/trains over a period of time.

4. Zonal railways should take proper precautions and avoid applying any silver paint of top of the said coating. Engineering/Bridges department should be duly informed about the same.

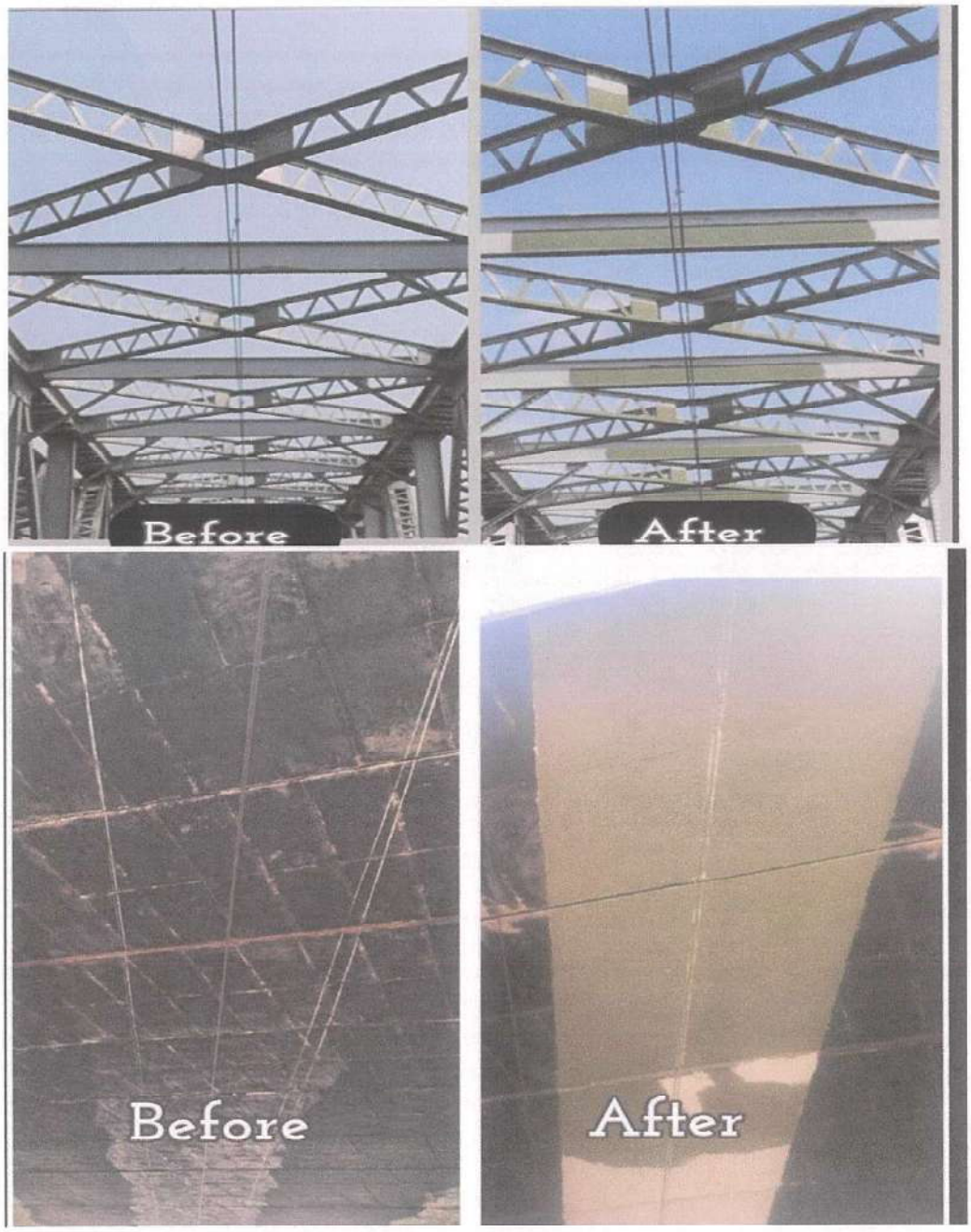
5. Coating thickness can be checked once every year to ensure that there has been no deterioration from the original coating thickness. This may be jointly checked with the execution agency. Non – destructive coating thickness meter for metal as well as concrete substrates are available to check the coating thickness. The meter should be having a valid calibration certificate during checking. Coating thickness to be checked using Non – destructive coating thickness meter (i.e. *Elcometer or similar meters as available in the open market).*

6. During maintenance activities of OHE assets, adequate care should be taken to avoid any physical damage of the coating area or use of sharp tools which can damage the coating surface.

7. In highly polluted areas if there are excessive carbon deposits or contaminants deposited on the surface of the coating it is recommended to clean surface with a lint – free cloth. However if the contaminants are difficult to remove it is recommend use of isopropyl alcohol or a standard non polar solvent mixed with 50% clean water. This procedure can be done once in 24 months depending on the extent of deposition if required.

8.0 Photographs :

Some photographs of the Composite High Voltage Insulation Coating are given as below for guidance:



	Prepared By	Checked By	Issued by
Signature & Date	17.04.25	17-04-25	17/4/25
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सत्यमेव जयते

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय Ministry of Railways

निर्देश संख्या. टी आई/एमआई /0062

MAINTENANCE INSTRUCTION No.
TI/MI/0062

ओवरलाइन संरचनाओं के अंतर्गत फॉल्स कैटनरी की मानक व्यवस्था का प्रावधान एवं रखरखाव अनुदेश।

Maintenance Instruction for provision of standard arrangement of the false Catenary under overline structures.

(April 2025)

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक (कर्षण संस्थापन) Principal Executive Director (TI)	24/04/25
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Signature & Date	24.4.25	24/04/25	24/4/25
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5.	PHOTOGRAPHS.	04

1. TITLE:

Maintenance Instruction for provision of standard arrangement of the false Catenary under overline structures.

2. BACKGROUND:

RDSO vide letter no. TI/PSI/PROTECT/FAILURE/12 dated 18.03.2016 and Railway Board vide letter No. 2003/RE/161/1/Vol-III/Pt. dated 19.06.2017 had recommended that "to avoid breaking of catenary strands, provision of contact wire over catenary wire using PG clamps should be ensured under over line structure."

North Central Railway vide letter no. Elect/TRD/NCR/UOR-AGC dated 18.11.2024 issued technical instruction to all Divisions of NCR for arrangement of false catenary system under over line structures.

3. OBJECTIVE:

The objective of this SMI is to ensure the use of an adequately sized contact wire as a jumper/shunt across back-to-back ending clamps used during arrangement of false catenary under overline structures. The wire should be secured with two PG clamps on each side to ensure better current flow, prevent potential hotspots, avoid breaking of catenary strands, and enhance mechanical strength—thereby improving the reliability of the OHE system during the provision of contact wire over catenary wire using PG clamps under the overline structure.

4.0 INSTRUCTIONS:

(a) To avoid breaking of catenary strands, provision of contact wire over catenary wire using PG clamps should be ensured under over line structure.

(b) Locations which are more prone to catenary strands breakage, use of contact wire in place of catenary wire may be adopted.

(c) It was observed that the non-standard arrangement of the false Catenary had been provided in Zonal Railways, wherein Contact wire used as the false Catenary was bent twice and used as a parallel Contact wire with one PG clamp on either side. This non-standard practice may lead to inadequate current flow and mechanical instability.

(d) A sample photograph of the correct arrangement (Picture-II) compared to the incorrect arrangement (Picture-1) is enclosed for your reference and better understanding in this matter.

(e) All Zonal Railways are advised to ensure that the standard system as prescribed in the (Picture-II) shall invariably be implemented at all locations of the false Catenary system.

(f) A standard arrangement given in this SMI should be strictly implemented.

(g) Adequately sized contact wire shall be used as a jumper/shunt across back-to-back ending clamps. With 65mm^2 & 125mm^2 Catenary wire, minimum 107 sq.mm and 150 sq.mm Contact wire respectively should be used as jumper wire.

(h) The jumper shall be secured with two PG clamps on each side. Both ends of jumper contact wire should be bent by 90 degree.

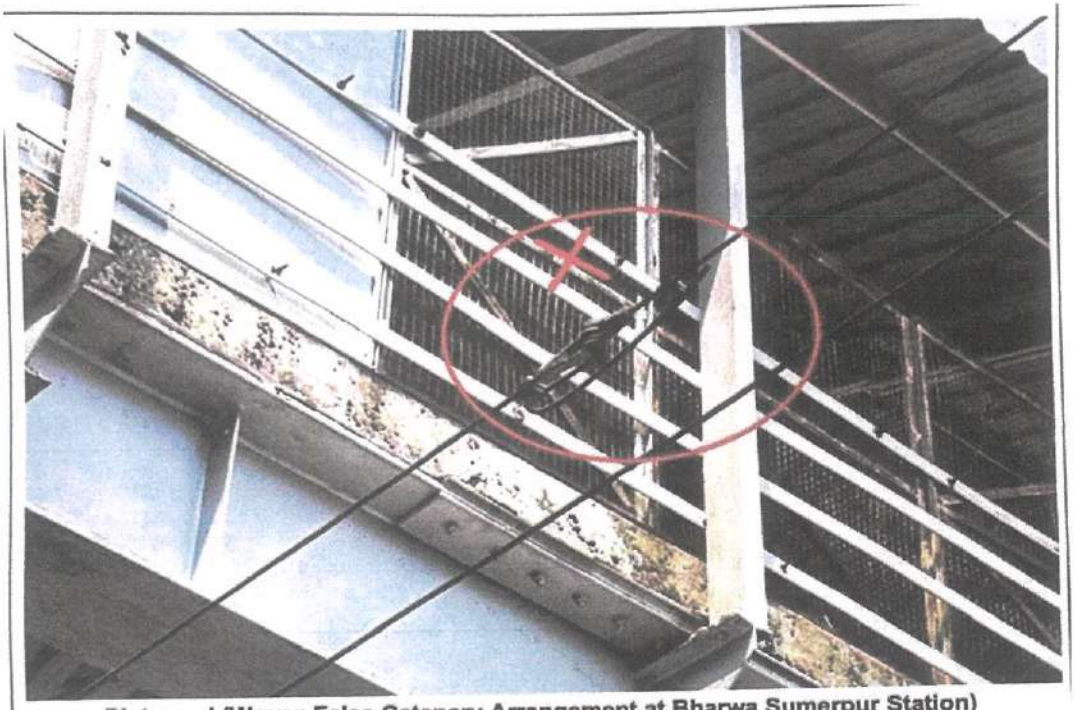
(i) This ensures proper current flow, avoids potential hotspots, and improves mechanical strength.

(j) For identification of hotspot, regular thermal scanning of false catenary joints shall be done as per revised Maintenance Instruction No. TI/MI/0055, Rev.2 and temperature rise of ending clamps and jumper shall be compared with the adjacent Contact and catenary wire. All measured temperature values along with ambient temperature shall be recorded properly.

	Prepared By	Checked By	Issued by
Signature & Date	24.04.25	24/04/25	
Designation	SSE/ TI	ADE/ TI-2	DIRECTOR/ TI-2

5.0 Sample photographs of false catenary arrangement are given below for reference:

- **Picture-I**: Incorrect arrangement
- **Picture-II**: Correct arrangement



Picture - I (Wrong False Catenary Arrangement at Bharwa Sumerpur Station)

Picture - II (Correct False Catenary Arrangement)