



सत्यमेव जयते

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय Ministry of Railways

निर्देश संख्या. टी आई/एम आई /00 52
INSTRUCTION No. TI/MI/0052 Rev.01

4-व्हीलर टॉवर वैगनों डीएचटीसी के लिए रखरखाव निर्देश
DRAFT COPY OF REVISED
MAINTENANCE INSTRUCTIONS FOR 4-WHEELER TOWER WAGONS
COVERING INSTRUCTIONS FOR DHTC
(February , 2025)

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**MAINTENANCE INSTRUCTIONS FOR 4-WHEELER TOWER WAGONS
COVERING INSTRUCTIONS FOR DHTC**

INSTRUCTION No. TI/MI/00 52 Rev.1

Amendment History:

Amendment Number	Date of Amendment	Total pages including Annexure.	Amendment/Revision
0	27.06.2017	78	First issue
1	xx.xx.2025	xxx	Second issue

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RDSO INSTRUCTION No. TI/MI/00 52 Rev.1**MAINTENANCE INSTRUCTION FOR 4-WHEELER TOWER WAGONS COVERING
INSTRUCTIONS FOR DHTC.****OBJECTIVE: To upkeep 4 W Tower Wagons and its all-time availability in working conditions.****1.0. Back ground:**

This documents should be read in conjunction with RDSO Maintenance Instruction No. TI/MI/0043 Rev.03. 4 W 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 :

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PART- I: Engine, Compressor.

PART- II: Hydraulic Transmission, & Controls (Driver Desk Cubicle1 & 2 Control Cubicle 1 & 2 Resistor Panel, Motor Switch Group Cubicle-MSGC).

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, 24V Battery, Pantograph, suitable capacity of DG-set for operation swiveling platform, 2KVA portable DG- set cum welding machine, 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 4-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 (TXR)	Major Schedule (at Nominated Electric Loco Shed or Diesel Loco Shed or EMU/MEMU Car Shed or Diesel/Electric Loco trip Shed / C&W depot)		
Daily	Monthly Schedule (1 month \pm 3 days)	45 \pm 3 days days/4500km whichever is earlier as per Note given below	AOH Schedule (12 month \pm 15 days)	IOH Schedule (36 month \pm 30 days)	POH Schedule (72 month \pm 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** of RDSO Maintenance Instruction No. TI/MI/0043 Rev.03.

(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** of RDSO Maintenance Instruction No. TI/MI/0043 Rev.03.

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List of proposed Diesel Shed nominated by Zonal Railways for carrying out IOH/POH of Tower Wagon is attached as **Annexure-2** of RDSO Maintenance Instruction No. TI/MI/0043 Rev.03.

(3.) Details of items to be checked during Safe to Run Examination (TXR) is attached as **Annexure- 12** of RDSO Maintenance Instruction No. TI/MI/0043 Rev.03. which has been extracted from RDSO Report No. TI/REPORT/OHE/2021/00137 for TXR.

3.2 The periodicity of Maintenance Schedule for Diesel Engine of CILmake 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 3 years 24 month whichever is earlier
POH	An overhauling POH is required after 06 years (72-Months).

3.3 List of Tools plant facilities to be with Maintenances Depot/Shed is attached as **Annexure-7** of RDSO Maintenance Instruction No. TI/MI/0043 Rev.03.

4.0. Reference documents:

Following are the lists of the drawing for 4-wheeler tower Car manufactured by different vendors.

4.1 Drawing no. of M/s BEMLS 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

4.2 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

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(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

4.3 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

4.4 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

4.5 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)

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4.6 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

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.

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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 Maintenance of engine:**A-Check: On daily basis**

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.

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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 pressure both at idling and maximum speed.	If there is a change in oil 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	Refer 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.

5.2 Maintenance of engine

B – Check: Every 300 Hrs or 6 Months whichever is earlier

S.N.	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of 'A' check	--
2.	Change engine oil.	When lube oil is examined through lube 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.

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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 value 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.	me oil as used in oil pan.
12.	Check and adjust belts. New belts will stretch within one hour of use. They must be readjusted.	Tighten belt tension (use ST – 1293)

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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.	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.	-----

5.3 Maintenance of engine

C – Check: Every 1500 hours or 1 year which ever is earlier

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, 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.	-

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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 blow by.	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 compressor	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.

5.4 Maintenance of engine

D-Check: Every 6000 hours or 3 years whichever is earlier.

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

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		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	<p>Must be done only if performance deterioration is evident. Some of the indications for performance deterioration are.</p> <p>Black smoke</p> <p>Change in fuel manifold pressure</p> <p>Loss of power</p> <p>Malfunction of aneroid.</p> <p>Clean and calibrate all injector.</p> <p>Check fuel pump calibration.</p> <p>Replace aneroid bellows & calibrate.</p>
8	Replace fuel pump filter screen and magnet.	
9	Steam clean engine.	If steam is not available, then use clean soap water.

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 through OEM in POH in every six year. 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** of RDSO Maintenance Instruction No. TI/MI/0043 Rev.03) is prepared for satisfactory work.

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PART– II**MAINTENANCE OF TOWER WAGON- HYDRAULIC, ELECTRICAL TRANSMISSION & CONTROLS SYSTEM:****6.0. Maintenance of Tower Wagon- electrical transmission & controls****System:**

It may be followed as per Clause no. 6.0 (Page No. 18) of No. RDSO MI no. TI/MI/0043 Rev.03 for 8Wheeler SMI. may be followed if applicable.

6.1 TRANSMISSION

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.

6.2 Maintenance of VOITH hydraulic transmission.**6.3 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

6.4 Maintenance after 20,000 km

Check the oil level.

6.5 Maintenance after 300,000 km

Oil change

i. Oil change :

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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.

- ii. Replace all filters. For this purpose, drain off the oil first, then remove the filters, take off the caps and remove filter elements.
- iii. Check control parts such as governor, standstill detector valve, operating cylinder, and main control valve for proper operation, leakage and wear.

6.6 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.

6.7 Maintenance of Hindustan Motor hydraulic transmission

6.8 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.

6.9 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.

6.10 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.

6.11 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.

6.12 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.

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6.13 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.

6.14 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.

6.15 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.

6.16 Trouble shooting of HM hydraulic transmission

Causes	Remedy
A. LOW CLUTCH APPLY PRESSURE	
Low oil level	Add oil to correct level
Clogged oil strainer	Clean strainer
Clogged oil filter	Replace filter element
Inching control adjustment not fully retracted	Check, adjust linkage
Air leak at intake side of oil pump	Check pump mounting bolts.
External oil leakage	Tighten bolts or replace gaskets
Brake hydraulic (or air) pressure applying clutch cutoff valve	Check brake residual pressure (brakes released); check brakes for full release.
Internal failure	Overhaul transmission, or repair subassembly
B. OVERHEATING	
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

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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
VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED	
Low clutch apply pressure	Refer to A
Low converter out pressure	Refer to A
Engine malfunction	Check engine; refer to engine service manual
Aerated oil	Refer to C
G. CLUTCH CUT-OFF VALVE INEFFECTIVE	
Valve or plug sticking	Rebuild control valve body assembly
Brake apply hydraulic pressure incorrect	Check pressure at control valve (min-max limit - 9.15 kg/cm ² -140.7 kg/cm ²)
Brake apply air pressure not reaching air cylinder	Check air cylinder (15.85 kg force required to stroke valve)
Plunger sticking in air cylinder	Check operation of air cylinder
Air entering at valve (air actuated)	Check operation of air cylinder (seals)

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6.17 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

6.18 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.

6.19 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.

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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.

6.20 Maintenance of KPC HYDRAULIC transmission

6.20.1 Maintenance

6.20.2 Hydraulic system

- i. The oil capacity of transmission is 20 litres.
- ii. 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.
- iii. Oil must be changed after 1000 Hrs. of operation.
- iv. Drain valve is provided for draining the oil without loss. Connect hose to the drain valve and then open the valve.
- v. 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.
- vi. Replace filter element as per recommendations. Remove the filter cover and replace filter element. Use new gasket, if necessary, for the filter cover.
- vii. Suction strainer: Unscrew plug on top of strainer housing for strainer removal. Clean strainer thoroughly 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.
- viii. Remove the breather assembly every 1000 Hrs. of operation. Flush the oil breather assembly.

6.20.3 Inspection – Daily

- i. Check oil level. Add if necessary.
- ii. Check all pipelines, end connections for leakages. Replace damaged parts to stop leakages.
- iii. Check all pressure/ temperature gauges for proper functioning. Replace damaged gauge immediately.
- iv. Check oil leakage from oil seal bolted joints. Replace damaged oil seals. Tighten loose bolts/ screw to stop leakages from joints.
- v. Check strainer and clean.
- vi. Check filters element and clean if necessary.
- vii. Check and tighten all bolted joints including mounting bolts.

6.20.4 Inspection – Weekly

~~a. Check strainer and clean.~~

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~~b. Check filters element and clean if necessary.~~

~~e. Check and tighten all bolted joints including mounting bolts.~~

6.20.5 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.

6.20.6 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.

6.21 Trouble shooting of KPC hydraulic transmission

Symptom	Cause	Remedy
Over heating	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> a) Clogged strainer. b) Stuck pressure regulation piston in selector valve assembly. c) Broken piston rings in clutches. d) Damaged or worn oil pump assembly. e) Clogged or plugged orifice plate in selector valve assembly. f) Low oil level. g) Foamed oil. 	<ol style="list-style-type: none"> 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 assembly. 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	<ol style="list-style-type: none"> a) Faulty pressure gauge b) Low oil level or empty sump . c) Fully clogged oil strainer. d) Damaged oil pump. 	<ol style="list-style-type: none"> 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	a) Low oil pressure.	a) Add oil to maintain oil level.

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performance	b) Improper oil. c) Clutch slipping	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.

6.22 KPC axle drive maintenance schedule

6.22.1 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.

6.22.2 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.

6.22.3 Every 750,000 Kms.

Subject all components to a major inspection and replace if necessary.

6.22.4 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.

6.22.5 Axial clearance check, Tapered Roller Bearings:

Proceed in accordance with the guidelines and instructions. The bearing clearance must be maintained.

6.22.6 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.

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PART-III**MAINTENANCE SCHEDULE OF CAR BODY, UNDER FRAME, BOGIE, BRAKE SYSTEM, BRAKE RIGGING, LIFTING & SWIVELING PLATFORM etc.****BRAKE SYSTEM****7.0. Air pressure system****7.1 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 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.

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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.

7.2 Important valves and their functions.

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

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.

7.3 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.

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7.4 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.

7.5 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.

7.6 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.

7.7 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.

7.8 A1 Check valve

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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.

7.9 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.

7.10 Automatic drain valve

The automatic drain valve automatically discharges precipitated moisture from a reservoir with each operating cycle of the control device.

7.11 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.

7.12 Maintenance of the valves

Cleaning, Inspecting and Repairing

- i. With the brake valve completely disassembled, all parts must be cleaned and inspected.
- ii. 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.
- iii. All Gasket, Diaphragms, and "O" rings must be replaced.
- iv. All Packing rings should be replaced.
- v. Clean all springs using a wire brush and suitable solvent and inspect for pitted marks distortion, or permanent set. Replace where necessary.
- vi. Replace all parts that are cracked, broken, worn excessively, damaged or in such a condition as would result in unsatisfactory operation.
- vii. 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.
- viii. Promptly blow the parts dry with low pressure jet of clean and dry air.
- ix. Discard the filter unit and replace with a new one.
- x. 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.
- xi. The spring must be replaced if it is rusted, distorted or has taken a permanent set.
- xii. 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.

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8.0 Maintenance guidelines and schedule (carriage part) of 4 – wheeler tower car**8.1 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 equipment (under slung, onboard and roof mounted) shall be removed from the Tower Car.

8.2 Inspection of under frame

- 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: -
 - a. Sole bar, body pillars, and trough floor.
 - b. Sole bars, body pillars above lifting pads.
 - c. Sole bars and pillars behind the door pockets.
 - d. Sole bars and pillars at the door corners.
 - e. Head Stock
 - f. Sole bars and pillar.
- iv. Procedure for inspection of under frame members for corrosion attention is laid down in RDSO technical pamphlet No C-7602. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI-04 issued in 2015 or latest.**

8.3 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.

8.4 Sole bar and pillar above the lifting pads

- (i) Examine the above members in the same manner as described in clause 25.3 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

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the structural members, clean and examine minutely to ascertain the extent of corrosion.

8.5 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.

8.6 Sole bar & body pillar at locations other than described above

(i)	Examine visible portion of sole bar through the end from above of the under frame.
(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.

8.7 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.

8.8 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.

8.9 Corrosion repairs to under frame members

(i)	Corrosion repairs shall be carried out as per instruction laid down in RDSO technical pamphlet No G-7602 . Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.
(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

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	<p>IS/IRS specifications.</p> <p>Corrosion resistant steel sheet for trough floor, pillars, sidewall and roof should conform to IRS M-41.</p> <p>Electrode: IRS class A3/B2 of approved brands.</p> <p>Paints: Red oxide zinc chromate primer – IS 2074-92. Black synthetic enamel paint to IS:8662.</p>
(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 under frame or its paint coat is damaged, the under frame 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 under frame 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.

8.10 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. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest..** Only corrosion resistant steel (IRS M-41 or IS:2062 Fe 410 Cu WC) should be used for head stock repairs.

8.11 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 Tower Car body should be lifted and kept on trestles.

8.12 Corrosion repair of sole bar

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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 G-7602~~. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.**

8.13 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 G-7602~~. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.**

8.14 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 **annexure-IV** of RDSO ~~technical pamphlet No G-7602~~. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.**

8.15 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 G-7602~~. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.**

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 G-7602 . Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest. , 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.

8.16 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.

8.17 Repairs of body side door

The body side doors shall be repaired as per **annexure VIII** of RDSO ~~technical pamphlet No G-7602~~. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.**

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8.18 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.

8.19 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. **Carriage maintenance Instruction CMI no. RDSO/2014/CG/CMI -04 issued in 2015 or latest.**

8.20 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.
(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.

8.21 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.

8.22 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.

8.23 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.

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(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.

8.24 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
Safe guard for safety of heads of inspecting staff.	9. Phosphating plant

8.25 Examination and repair practice in maintenance depot shall be as per

As per para No.11.0 to 11.4 of this documents

9.0 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

9.1 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

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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.

9.2 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 **Daily, Monthly, Yearly, IOH and POH** overhaul as per the details given in Para 11.0 to 11.5 of this Maintenance Instruction. While carrying out the overhauls instructions as given in the following paragraphs should be strictly followed.

9.3 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

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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.

9.4 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 under frame 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 under frame.			
	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.			
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				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.

9.5 **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 Para 4.0 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 Para 4.1 to 4.6 should be strictly adhered to and a record of wheel pressing on pressure maintained.
(vii)	Weld reclamation of Axle should never be done.

9.6 **Roller bearings (For all 4 W Tower cars)**

Axle boxes are fitted with roller bearing as per Drawing mentioned in **Para 4.1 to 4.6** .

(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

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BPCL	-	Polypak 3
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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 dismantled and thoroughly inspected. If the grease is in good condition, bearing need not be dismantled, but be washed and cleaned in position with petrol or white spirit.
(iii)	When dismantled, 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 dismantled 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 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 inner ring the bearing can be easily dismantled by turning the withdrawal screw.
- (ii) After removing the bearing, remove the rear cover and the sealing ring.

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(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°C - 50 °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 along with 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)	Liberal, 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.

9.7 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.

9.8 Axle box springs (except mark – III)

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Axle box springs are as per respective drawings of different manufacturers as mentioned in para 4.0 manufactured as per RDSO spec. WD-01-HLS-Rev-05 Dec 2024 or 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 (2001 or 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

9.9 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.

9.10 Axle guide assemblies (except mark – iii)

Axle box set guides are accurately machined and welded to the under frame 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.

i) 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

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				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.

9.11 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 (Rev-05 Dec 2024 or 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.

9.12 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.

Running clearances (except mark – III)

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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.

9.13 **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 withdrawn 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. <u>Note:</u> 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 sickliness should have an impress 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 of oil leakage or other damages, the same should be replaced with a shock absorber completely overhauled. For this purpose, the sickliness should maintain 'imprest' for use as unit change assemblies. Leaking shock absorbers should be sent to the workshop for overhauling. The shock absorbers should be checked 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

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	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.

9.14 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 be 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.

9.15 Brake gear

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- (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.

9.16 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 (March 2006 or Latest revision).

10.0 Maintenance of lifting and swiveling platform:

For Maintenance of Lifting and Swiveling platform Instruction No. TI/MI/0043 Rev.03. may be followed.

11.0 Daily Schedule:

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,			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
	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			
1.9	Fill water in lavatory overhead tank.			
Suspension				
1.10	Visually examine axle box springs for breakage/damage.			
1.11	Visually examine axle box clearance.			
1.12	Examine vertical shock absorbers for damages.			
Brake rigging				
1.13	Check brake-rigging arrangement for any defects/deficiencies.			
Draw gear				
1.14	Check conditions for the screw coupling and its components and replace if required.			
1.15	Examine visually draft key locking pins.			
Buffing gear				
1.16	Visually examine buffer plungers for damage/drooping/stroke length.			
Running gear				
1.17	Examine visually axle box for grease oozing out, warm axle box if any.			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
1.18	Visually inspect axle box covers.			
Bogie frame				
1.19	Examine visually the condition of bogie side frame,transom,longitudinal,bolster etc. at all welded locations.			
1.20	Examine rubber stopper/stop screw of axle box crown for damage/ missing /loose.			
1.21	Inspect brake hanger brackets for damages.			
1.22	Inspect safety brackets for brake hanger pins.			

11.1

Monthly schedule (weekly +monthly merged)

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 :

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			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
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	on			
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.			Shifted to Daily Schedule
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.			Shifted to Daily Schedule
5.7	Examine vertical shock absorbers for damages.			Shifted to Daily Schedule
6.0	<i>Brake rigging</i>			
6.1	Check brake rigging arrangement for any defects/deficiencies.			Shifted to Daily Schedule
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			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
	necessary.			
6.7	Visually inspect damaged/ missing brake gear bushes and replace if necessary.			
6.8	Examine lever hanger pins.			
7.0	Brake System			
7.1	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			
7.2	Check and attend brake block adjuster.			
7.3	Examine and attend brake levers.			
7.4	Examine and attend brake hanger lever brackets.			
8.0	Draw gear			
8.1	Check and replace damaged/ missing split pins/cotter/ rivets.			
8.2	Examine draw hook, draw bars and rubber pads for damages.			
8.3	Check conditions of the screw coupling and its components and replace if required.			Shifted to daily schedule
8.4	Check condition of draw beam and locating pins on it.			
8.5	Examine visually draft key locking pins.			Shifted to daily schedule
9.0	Buffing gear			
9.1	Visually examine buffer plungers for damage/drooping/stroke length.			Shifted to daily schedule
9.2	Examine buffer mounting bolts and attend if necessary.			
9.3	Examine visually buffer casing for cracks/damages.			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
10.0	<i>Running gear</i>			
10.1	Examine visually axle box for grease oozing out, warm axle box if any.			Shifted to daily schedule
10.2	Visually examine wheel tyre profile and thickness of tyre and check with tyre profile gauge if they appear to be near condemning limit.			
10.3	Visually inspect axle box covers.			Shifted to daily schedule
10.4	Inspect wheel tread for shattered rim, spread rim, shelled tread, thermal cracks, heat checks.			
10.5	Check the oil level of axle drive, if found less, add upto maximum mark.			
11.0	<i>Seats</i>			
11.1	Examine the holding/securing brackets for seats and attend if necessary.			
11.2	Examine and repair damaged upholstery cushions			
11.4	Seats and frames should be cleaned.			
11.5	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.			
12.0	<i>Doors</i>			
12.1	Examine doors for proper functioning and securing with hinge pivots. Doors should not graze with floor or doorsill plates.			
12.2	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.			
12.3	Visually examine window shutters for smooth working and proper locking.			
13.0	<i>Windows</i>			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
13.1	Check window-balancing mechanism for proper functioning.			
13.2	Examine window safety catches for proper engagement in their slots.			
13.3	Window bars should be provided and fixed in prescribed manner and replaced if damaged.			
14.0	<i>Interior fittings</i>			
14.1	Examine laminated panels and mouldings for damage/cracks.			
14.2	Examine tower bolts of backrests for proper working.			
14.3	Examine ventilation grills for damages.			
15.0	Wash-Basin fittings Lavatory and lavatory fittings			
15.1	Intensive cleaning of lavatory pans and commode with cleaning agent			As per 8WSMI Instruction No. TI/MI/0043 Rev.03
15.2	Check lavatory hinge door for proper function			As per 8WSMI Instruction No. TI/MI/0043 Rev.03
15.3	Examine lavatory door latches/ tower bolts for proper function			As per 8WSMI Instruction No. TI/MI/0043 Rev.03
15.4	Examine push cock for proper function			
15.5	Check and attend leakage in pipe, pipe fittings.			

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No.	Details of work to be carried out	Condition/Action	Sign.	Remarks
15.6	Clean drain grills and drain holes of wash basin if found choked			
15.7	Check and replace damaged/ missing mirrors / shelves / soap dishes			
16	<i>Suspension</i>			
16.1	Add specified grade of oil in dashpot.			
17.0	Bogie frame (As mentioned in WSMI Instruction No. TI/MI/0043 Rev.03)			
17.1	Examine oil level in side bearer oil-bath and oil-filling cap replenish oil if needed.			
17.2	Inspect axle box safety straps/ loops for damage/breakage/ missing.			
17.3	Inspect bolster safety straps/loops for damage/ breakage /missing.			
17.4	Check visually BSS hanger brackets.			

11.2 **AOH (yearly schedule): (quarterly+six monthly +yearly merged)**

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Under frame, 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 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	<i>Secondary Suspension</i>			
4.1	Check Axle Box Crown clearance.			
5.0	<i>Shell</i>			
5.1	Thoroughly clean and remove dust, rust accumulated at under frame and pillars with coir brush and compressed air.			

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5.2	Examine for corrosion of sole bar and other under frame members with torch light or inspection lamp.			
5.3	Touch up damaged paint both inside and outside.			
5.4	Check roof ventilator for damages.			
6.0	<i>Suspension</i>			
6.1	Check and attend axle guide assembly if necessary.			
6.2	Check axle box clearance with gauge.			
7.0	Secondary Suspension (as mentioned in WSMI Instruction No. TI/MI/0043 Rev.03)			
7.1	Check Bolster clearance			
8.0	<i>Draw gear</i>			
8.1	Ensure that wear on screw coupling shackle pins, trunion pins, shackle/link holes and draw hook holes should not exceed 3mm.			
8.2	Ensure that wear at any section on draw hook should not exceed 10mm.			
9.0	<i>Buffing gear</i>			
9.1	Ensure the length is within 584-635mm.			
9.2	Inspect buffer plunger false plate for wear and profile.			
10.0	<i>Running gear</i>			
10.1	Check with wheel distance gauge for loose or tight wheel.			
11.0	<i>Flooring</i>			
10.1	Inspect and attend damaged/cracked flooring.			
10.2	Examine and attend opened joints.			
10.3	Examine Drain holes in trough floor for accumulation of water due to clogging if noticed. Inspect affected area for corrosion.			
11.0	Thorough flushing of water tanks			
12.0	Overhaul all brake equipments, except brake cylinder.			
13.0	Replace rubber kits during yearly			

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	repairing of pneumatic valves.			
14.0	Ultrasonic Testing of wheel set.			

Note 1. All rubber items should be replaced during POH.

2. All rubber items should be replaced on condition basis during AOH/IOH also.

11.3 **IOH (thirty six monthly schedule):**

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Under frame, Brake rigging etc.)

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	Run out the Wheels/Axles and attend all the items as mentioned in para 9.0			
3.0	<i>Brake</i>			
3.1	Overhaul the safety switch.			
3.2	Clean the chokes, exhaust plugs, mesh filters in the distributor valves and check proper functioning of all sub-assemblies.			
3.3	Overhaul the drivers brake valve. Replace all the rubber items, clean filters.			
3.4	Check for proper functioning of relay valves and replace the damaged/ worn out items.			
3.5	Replace rubber-sealing washer of air brake hose coupling.			
3.6	Check all the hose assemblies of brake system for damage or over ageing replace if required.			
3.7	Remove the brake cylinder and over haul 100% rubber parts replacement.			
3.8	Overhaul all valve magnets, speed cylinders, direction cylinders and gear cylinders by replacing 100% rubber parts.			

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	<i>Bogie frame</i>			
	Examine condition of side bearer wearing piece and wearing plate.			

Note 1. All rubber items should be replaced during POH.

2. All rubber items should be replaced on condition basis during AOH/IOH also

11.4

POH (seventy two months)

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Under frame, Brake rigging etc.)

4-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 Bogie			As per 8WSMI Instruction No. TI/MI/0043 Rev.03
14.	Repair and maintenance of Axle Box Guide Arrangement as per para 9.0			
15.	Repair and maintenance of brake system including overhauling of Distributor valve.			
16.	Repair and maintenance of rolling gear			
17.	Lowering of Tower Car body on Wheels/ Axles.			
18.	Brake Testing			

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SN	Details of work to be carried out	Condition/ Action	Sign.	Remarks
19.	Testing of branch wiring			
20	Testing of electrical equipment			
21.	Final Inspection & Dispatch			
22.	Maggering and continuity check of electrical equipment to be carried out. Same should also be tested on test bench.			

11.5

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. CO2 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
Safe guard for safety of heads of inspecting staff.	9. Phosphating plant

11.6 Examination and repair practice in maintenance depot shall be as per Clause 11.0 and its sub clauses.

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Part-IV-Others items**12.0 Suitable capacity of DG-set for operation swiveling platform:**

Maintenance of DG set shall be done as per recommended relevant OEM' s maintenance manual.

13.0 2 KVA portable DG- set cum welding machine:

Maintenance of DG set shall be done as per recommended relevant OEM' s Maintenance Manual.

14.0 Pantograph maintenance:

Pantograph maintenance shall be done as per following RDSO maintenance instructions:

SN	SMI No. (Latest version to be used)	Description
1	RDSO/ELRS/SMI/64	Static Balancing Procedure For Pantograph Type AM12 and Type AM18
2	RDSO/ELRS/SMI/75	Ensuring Proper Raising and Lowering of Pantograph Type AM12
3	RDSO/ELRS/SMI/192	Periodic Maintenance/Checks For Pantograph AM12 Type And Of Similar Design
4	RDSO/ELRS/SMI/198	Lubrication Schedule for Improving Reliability of Pantograph AM-12 Type and of Similar Design
5	RDSO/ELRS/201	Grease Pan for Pantograph Type AM12 or Similar Design
6	RDSO/2007/EL/TC/0094	Components to be Changed During AOH / IOH & POH of Similar Design Pantograph Type AM12, IR 01 and Pan 01.

15.0 OHE sensing device:

Maintenance of OHE Sensing Device shall be done as per recommended relevant OEM' s Maintenance Manual.

16.0 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.

17.0 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.

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- 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.

18.0 **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.

19.0 **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.

20.0 **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 damaged.
- Clean the Search Lights lens using a cleaning solution suitable for use on acrylic materials.
- Replace cover if cracked, chipped or otherwise damaged.

21.0 **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.

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Part-V

22.0

List of “ Must Change Items during POH” for 4-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 (if applicable)		
i)	Gear case	To be replaced on condition basis	To be replaced
ii)	Gear case oil	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 <i>(lubricating pad assembly- replacement during every POH)</i>	Remetalling/ Replacement on condition basis <i>(lubricating pad assembly- replacement during every POH)</i>
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)	Gauge glass oil seal	To be replaced	To be replaced
x)	TM support arm, Gear case support arm & Axle guide rod	To be replaced	To be replaced
xi)	Traction Motor bellow	To be replaced	To be replaced
xii)	Traction Motor pinion	To be replaced	To be replaced
xiii)	TM suspension tube bolt	To be replaced on condition basis	To be replaced
xiv)	PE end bearing	To be replaced	To be replaced
xv)	CE end bearing	To be replaced	To be replaced
xvi)	Brush holder assembly of TM	To be replaced on condition basis	To be replaced on condition basis
xvii)	All carbon brushes liners, gaskets, needle roller bearings of TM	To be replaced	To be replaced
xviii)	Teflon ring of armature/PTFE	To be replaced	To be replaced
xix)	Insulating rod	To be replaced on condition basis	To be replaced
2	Wheel items		
i)	Axle box bearing, MSU & its bearings, (DE & NDE side) MSU bolts, Axle box	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
	complete		
ii)	Axle box ' O' ring and cover bolts	To be replaced	To be replaced
iii)	Wheel turning	To be done	To be done
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,	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
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	To be replaced	To be replaced
xi)	Servomotor piston packing ring	To be replaced	To be replaced
xii)	Bearing for pedestal, push rod, lower & middle articulation	To be replaced on condition basis	To be replaced on condition basis
xiii)	Foot insulator	To be replaced on condition basis	To be replaced on condition basis
xiv)	Marking on pantograph (for stagger measurement)	To be replaced	To be replaced
4	All Damping circuit (if applicable)		
i)	Capacitors 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

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
5	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
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
6	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
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 must be replaced in each POH. CAM switch must be replaced on condition basis in POH	To be replaced on condition basis. Fixed contact finger, moving contact must be replaced in each POH. CAM switch 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	To be replaced on

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
		condition basis	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
xxi)	Speedometer (as per 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
7	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

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
vi)	All gauges and meters	To be replaced on condition basis	To be replaced
vi)	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.
vii)	Auto Drain Valve	To be overhauled. Rubber kit to be replaced.	To be overhauled. Rubber kit to be replaced.
viii)	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.
ix)	Safety Valve	To be replaced on condition basis	To be replaced on condition basis
x)	Emergency Valve	To be replaced on condition basis	To be replaced on condition basis
xi)	Solenoid Valve	To be replaced on condition basis	To be replaced on condition basis
xii)	NRV & check valve	To be replaced on condition basis	To be replaced on condition basis
xiv)	Various ball type isolating cocks, check valve, pressure cut out switch etc.	To be replaced on condition basis	To be replaced on condition basis
xv)	Direction Cylinder (in case of DHTC, mounted on Hydraulic transmission)	To be replaced on condition basis	To be replaced on condition basis
xvi)	MR & other auxiliary reservoir	Painting to be done	Painting to be done
xvii)	Air treatment (filter, regulator cum regulator in DHTC)	To be replaced on condition basis	To be replaced on condition basis
xviii)	Governor	To be replaced on condition basis	To be replaced on condition basis
xix)	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
xx)	BC (Brake Cylinder)	Overhauling to be done	Overhauling to be done
	BC (Brake Cylinder) parts: Piston, dust excluder, Jubilee clamp (2" & 4) and spring, pawl, Sir clip, to be replaced	To be replaced	To be replaced
xxi)	Parking Brake manual switch	To be replaced	To be replaced
xxii)	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)
xxiii)	Throttle valve	To be replaced on condition basis	To be replaced on condition basis
xxiv)	Magnet valve	Overhauling to be done	Overhauling to be done
	Magnet valve parts:	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
	Rubber kit		
xxv)	Deadman valve	Overhauling to be done	Overhauling to be done
xxvi)	Deadman valve - Overhauling to be done	To be replaced	To be replaced
xxvii)	DV (Distributor)	Overhauling to be done and Item kit to be replaced	Overhauling to be done and Item kit to be replaced
xxviii)	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
xxix)	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
xxx)	Electro-pneumatic contactor (in MSGC)	To be replaced on condition basis and gasket to be changed Power contractor pair, Gasket, gycowasher, stem, stem valve to be replaced	To be replaced on condition basis and gasket to be changed Power contractor pair, Gasket, gycowasher, stem, stem valve to be replaced
xxxi)	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, gycowashe, finger contactor, stem, stem valve to be replaced.	To be replaced on condition basis. Gasket, gycowashe, finger contactor, stem, stem valve to be replaced.
xxxii)	Hinges of all doors	To be replaced	To be replaced
8	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
9	Under frame		
i)	Battery 24V Lead Acid (LMLA)	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	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
	sling/rope		
iii)	Replacement of Vertical/horizontal dampers	To be replaced	To be replaced
iv)	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
10	Bogie Frame		
i)	Axle box spring	To be replaced on condition basis	To be replaced on condition basis
ii)	Spring seat & equalizer of trimount bogie	To be replaced	To be replaced
iii)	Lower rubber washer	To be replaced	To be replaced
iv)	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
v)	Complete brake rigging along with pins, bushes & fasteners	To be replaced	To be replaced
vi)	All rubber components and fasteners on the bogie	To be replaced	To be replaced
vii)	Wearing plate, all, oil seal felts, pins, bushes, high tensile fasteners of bogie & axle box etc.	To be replaced	To be replaced
viii)	Foot step assembly	To be replaced	To be replaced
ix)	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
x)	Replacement of Brake hanger	To be replaced on condition basis	To be replaced on condition basis
xi)	Replacement of safety sling of brake hanger	To be replaced on condition basis	To be replaced on condition basis
xii)	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
11	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	To be replaced on

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
		condition basis	condition basis
iii)	The lateral bump stops	To be replaced on condition basis	To be replaced <u>on condition basis</u>
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
12	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, 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
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 (braided or non-braided)	To be replaced	To be replaced
13	Electrical items		

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
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
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 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
14	Tower Wagon Body		
i)	PU painting of Tower Wagon	To be done	To be done
15	Exterior		
i)	Seals involved in fitment of side body and roof filters	To be replaced	To be replaced
16	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	To be replaced
iv)	Striker block wear plate.	To be replaced	To be replaced
17	Buffers		
i)	Buffers along with fasteners/fixing bolts	To be replaced on condition basis	To be replaced

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S.N.	Item and its sub-assemblies	Replacement during First POH	Replacement during Second POH
ii)	All rubber rings.	To be replaced	To be replaced
18	Cattle guard		
i)	Cattle guard along with its hardware	To be replaced on condition basis	To be replaced
19	Doors and steps		
i)	Door seals	To be replaced	To be replaced
ii)	Door locks	To be replaced	To be replaced
20	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.
21	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
22	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
23	Interior		
	Driver Seat		
i)	The seat cover and cushion & resin of driver seat	To be replaced	To be replaced
ii)	Driver seat and Asstt. Driver seat	To be replaced	To be replaced

Note : Above must change item are applicable if they are exist in 4 wheeler Tower wagon

Additional list of Must chage items for existing MI

(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

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		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 colored	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

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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)

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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

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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:

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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

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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

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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

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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

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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 sandwich 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

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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

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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