# Maintenance Instruction No. TI/MI/0052 Rev.0



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# GOVERNMENT OF INDIA
# MINISTRY OF RAILWAYS

# SPECIAL MAINTENANCE INSTRUCTION
# For
# 4-WHEELER TOWER CAR

# (JUNE, 2017)

**ISSUED BY:**

**TRACTION INSTALLATION DIRECTORATE**
**RESEARCH, DESIGNS & STANDARDS ORGANISATION**
**MANAK NAGAR,**
**LUCKNOW - 226 011.**

# SPECIAL MAINTENANCE INSTRUCTION
# for
# 4-WHEELER TOWER CAR

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# SPECIAL MAINTENANCE INSTRUCTION
# for
# 4-WHEELER TOWER CAR

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SPECIAL MAINTENANCE INSTRUCTION FOR
4-WHEELER TOWER CARS

1.0 Objective: For upkeep of tower wagons and all time availability of Tower Cars in working conditions.

2.0 Back Ground: Tower Cars are used for maintenance and attending to break downs of overhead equipment (OHE) for quick restoration of power supply to OHE. This Special Maintenance Instruction (SMI) has been prepared to maintain Tower Cars so that its availability can be ensured all the time.

Following maintenance instructions are to be followed for maintenance of various items of Tower Cars.

3.0 Monthly Schedule (With engine stopped).

3.1 Contactor and relays:
(i) Inspect visually.
(ii) Manually operate contactor to check operation.
(iii) Check interlock and contactors.
(iv) Check operations and contactors.
(v) Clean the interlock of contactor & relays.

3.2 Resistor & blocking diode: Check values and function of all resistors and diode and record it.

3.3 High and low voltage circuit: Check ground record insulation resistance of power circuit

3.4 Batteries:
(i) Clean dirt or any oil on top of battery.
(ii) Keep all terminal tight, clean and apply vaseline petroleum jelly.
(iii) Ensure that vent plugs are clean.
(iv) Check specific gravity of electrolyte
(v) Top up the distilled water as per the requirement i.e. twice in summer season and once in winter season in a month based on the float guide indicator.

3.5 Traction Motor: (i) Brush off loose dust or dirt before removing commutator cover.

(ii) Clean the commutator veering. Remove any copper beads from the commutator surface with fine caborandum cloth.
(iii) Deposit from dirt or greasy hands should be removed from solvent.
(iv) Examine the brush gear and clean the insulation of the brush arm.
(v) Check that the brush ring sits correctly on the carbons and that the springs are in good condition.
(vi) Check carbon brushes for wear. Fit new brushes in place of worn out carbon brusher or any one which are unlikely to last until the next inspection. See data for minimum length and brush grade.
(vii) Check carbon brushes for freedom in the brush holder and if striking cleans both the brush and inside of the brush holder.
(viii) Do not shake the carbon, as solvent will eventually ooze out affecting the commutator and causing the brush to jam in the brush holder. If the brush appears to be excessively slack in the brush holder, check the brush size and discard the brush holder as the case may be.
(ix) Top up suspension bearing lubrication oil and cardium compound of traction motors, gearbox.

3.5 Traction Alternator: (i) Brush off loose dust or dirt before removing cover.
(ii) Check tightness of connections.
(iii) Check for any loose hardware especially on the rotating rectifier assembly.

4.0 Three Monthly Schedule (with engine stopped)
4.1 Repeat all checks followed in monthly check.
4.2 Contactor and relays: (i) Inspect visually.
(ii) Manually operate contactor to check operation.
(iii) Check interlock and contactors.
(iv) Check contactors contact tips for pitting.

4.3 Resistor and blocking diode: Check values and function of all resistors and diode.

4.4 High and low voltage: Check for ground , record insulation circuits Resistance of power circuit and control circuit.

4.5 Batteries:

(i) Clean dirt or any oil on top of battery.
(ii) Keep all terminals tight clean and apply Vaseline petroleum jelly.
(iii) Ensure that vent plugs are clean.
(iv) Check specific gravity of electrolyte.
(v) Check the specific gravity & cell to cell voltage of each Cell of battery. If specific gravity is found below the requirement limit, maintain it to its required value.
(vi) D.M. water as per requirement and float guide indicator.

4.6 Traction Motor: Repeat the monthly service with following additional schedules.

(i) Blow out machine using clean dry compressed air. Take particular care to direct air under the commutator in order to remove dirt lodged in the armature core ducts.
(ii) Check tightness of all brush gear bolts.
(iii) Check tightness of bolts securing axle caps and gear case
(iv) Check air inlet bellows for cracking, tearing or collapsing.
(v) Check for the leakage from the gear case and suspension bearings Ensure the lids of the axle suspension bearing oil wells fit correctly.
(vi) Check all external leads for chaffing.
(vii) Measure insulation resistance, it should not be less than one mega ohm.

4.7 Traction Alternator: Monthly Service plus.

(i) Wipe off loose dirt on the outside surface of the alternator with a clean filter free cloth.
(ii) Remove stubborn accumulation of dirt using xylene
(iii) Clean all ventilating parts with filtered and compressed air at pressure of 1.75 to 2.8 $kg/cm^2$.
(iv) Clean inside of alternator using dry compressed air of a pressure of 1.75 to 2.8$kg/cm^2$.

4.8 Cable Connections: Check for loosening adjoins on terminal board & Equipments. Check for insulation damage also.

## 5.0 HALF YEARLY SCHEDULE (WITH ENGINE STOPPED)

| | |
|---|---|
| Master controller | Clean and inspect contact, fingers. Check mechanical Interlock |
| Control equipments shunts. | Check condition and flexibility; replace worn frayed broken or corroded braided shunt. |
| Control equipments | Check terminal connectors and tighten if required. |
| Control Equipment | (i) Clean contactors<br>(ii) Replace contact tips if worn or pitted. |

| | |
|---|---|
| Safety devices<br>(i) Cooling water temperature switch<br>(ii) Engine over speed switch | <br>(i) Remove and check on test bench and adjust if required.<br>(ii) Remove and check on test bench and adjust if required. |
| Engine RUN/STOP switch | Check and clean contact |
| Battery | Remove boxes from tower wagon. Clean and repaint. |
| Load Ammeters | Check calibration |
| Traction Motor suspension bearing | (i) Change oil.<br>(ii) Change wick lubricator if damaged.<br>(iii) Check bearing cap bolts for tightness.<br>(iv) Check bearing cap bolts for tightness.<br>(v) Check wear on motor suspension and nose suspension.<br>(vi) Check suspension bearing suspension. |
| Traction Motor | Repeat three monthly service including following additional schedules:-<br>(i) Clean the grease escape drain from P.E. outer bearing cap and P.E. end shield.<br>(ii) Clean all pinion and gear wheels check for tooth wear.<br>(iii) Clean lubricant from each gear case to ensure that it is not cracked and the seals are in good condition.<br>(iv) Replace felt seals if necessary. |

## 6.0 MAINTENANCE OF TRACTION MOTOR

Overhaul: An overhaul is required after three to five years service. Following schedules are to be ensured:

(i) Remove as much dirt as possible particularly around the commutator covers the axle-cap filler pipes and the armature bearing caps.

(ii) Check the lateral and diametrical clearances of the axle suspension bearings; fit new bearings if the existing bearings are worn beyond the limits recommended (see data as given in the manual).

(iii) Remove the motor from the bogie and using the oil-injection equipment, remove the pinion.

(iv) Before dismantling the motor, give it a light run at 1500-2000 rev/min to check that the bearings are not noisy and that the vibration is not excessive.

(v) Dismantle the motor (see under dismantling & reassembling). Clean the armature thoroughly, also the interior of the frame. Bake each at 90$^{o}$C to remove moisture. (See Workshop Manual). After drying, check the insulation resistance while the machine is still hot. This should be at least one Meg. Ohm, if it is, apply a high voltage test. (See under HIGH VOLTAGE TESTS). Apply a commutator bar to bar comparison test to check for open or short circuited coils.

(vi) Remove and clean the brush holders. Examine each brush holder for brush clearance, for brush spring pressure, for damaged insulators, for spring-hub wear, for loose or defective support pin insulator and burnt spots. Recondition as necessary. Fit new brushes if necessary.

(vii) Check the wear plates on the nose suspension for wear, check also axle ways and the axle caps for wear, distortion and cracks. Examine all cables, fit a new cable in place of any that is chafed or otherwise damaged.

(viii) If the field coils and the connections are tight, dry and are in good condition, repaint the whole of the interior with silicone gray finishing paint.

(ix) If field coils have to be removed, recondition them individually, and on reassembly, refill the counter bores around the top pole studs with Tar Compound, class IV (Supplied by M/s Shalimar India) to exclude moisture.

(x) Inspect all other motor components for wear, distortion or for any other defects. Fit new bearings if necessary.

(xi) Inspect the shaft for damage to threads, bearing and whether pinion fits and ensure that the shaft is straight. Further inspect the armature for loose bands, solder throwing or other defects. Recondition the armature as necessary.

(xii) Treat the reconditioned or repaired armature with solventless

polyester (GE 702 or equivalent) insulating varnish. (For procedure, see Workshop Manual). The number of such treatments will depend upon the condition of the armature, but normally, twice will be sufficient.

## 7.0 OVERHAUL DURING IOH/POH

During the overhaul the pantograph must be removed from the Tower Wagon.

Bearings: After dismantling, check all ball bearings for wear of cage ball etc. and replace if necessary

Mechanical parts: The upper and lower articulation tubes must be dismantled and repaired if bent. The middle articulation shaft triangular bracket and equalizer arm etc. should be checked thoroughly for damages.

Throttle valve: Dismantle and over haul throttle valve.

Self starter: Self starter motor for Mark-II, Mark-III tower wagon to be overhauled in every IOH/POH & replaced in second POH.

Alternator: Engine driven alternator to be overhauled in every IOH/POH and replaced in second POH.

Painting: Scratch the old paint. Clean the surface and apply paint.

## 8.0 MAINTENANCE OF RECTIFIER

Except for blower, the rectifier unit as such is a static equipment with no moving parts, hence little maintenance is required. However, regular inspection is necessary if trouble free operation is required.

(i) The unit must be periodically cleaned with air blast. For inspection the front door can be opened easily by opening the locks and doors can be kept aside according to convenience.
(ii) Checkup various contacts and terminal connections in the initial stage of operation and later once in six months.

9.0 MAINTENANCE OF ENGINE:

Daily check **A-Check**

| S.N. | Maintenance steps | Remarks |
|---|---|---|
| 1 | Check previous days engine log book | Correct as required. |
| 2 | Drain Water and sedimentation from fuel filter through drain cock. | Before starting the engine. |
| 3 | Check engine oil level and top up if necessary | Must be slightly less than or equal to 'H' mark on dip stick when engine is stopped and has stood for 20 minutes or more (must be measured after all oil is drained back into oil pan) |
| 4 | Check for fuel, oil, water and exhaust leaks | Correct if leaking. |
| 5 | Fill radiator/surge tank with treated water (Chromate concentration 3500 PPM) | Radiator cap must be firmly tightened back into the radiator/surge tank neck. Engine must not be operated without the aeration and overhauling of the coolant check, engine radiator water level. |
| 6 | Check air cleaner, oil level and change oil, if required( if oil bath type) clean dust pan | Use clean engine oil |
| 7 | Check airline connection for leaks | Correct as required. |
| 8 | Remove and clean air compressor breather, if equipped. | Fill with clean oil upto the mark. |
| 9 | Drain air receiver tank at the beginning of every day and close the drain cock. | - |
| 10 | Clean crank case breather. | Discard paper type element if clogged. |
| 11 | Check oil level in hydraulic governor, if provided. | Check for leaks. Use engine oil for topping up (as shown in fig 3.1) |
| 12 | Start the engine and note the oil | If there is a change in oil |

| | | |
|---|---|---|
| | pressure both at idling and maximum speed. | pressure from that recorded in the log book on earlier occasion then stop engine and check through trouble shooting technique the cause for oil pressure change and correct if necessary. |
| 13 | Record oil pressure | Refere operation and maintenance manual for lube oil pressure limits |
| 14 | Fill fuel tank at the end of the day | Use clean fuel and a strainer. Also clean the cap and surrounding area before opening the filler cap. Fill fuel at the end of the day allowing diesel to settle. Drain sediment from fuel filter water separator bowl. |

3.2 Check Every 300 Hrs or 6 Months whichever is earlier **B -Check**

| S.N. | Maintenance Steps | Remarks |
|---|---|---|
| 1. | Repeat all maintenance steps of 'A' check | -- |
| 2. | Change engine oil. | When lub oil is examined through lub oil analysis in a laboratory, oil change period may be extended. In such cases, refer to your service representative. |
| 3. | Fit new lubricating oil full flow filter element. | Inspect the changed filter element and check for metal particles and oil sludging/oxidation. |

| S.N. | Maintenance Steps | Remarks |
|---|---|---|
| 4. | Remove, clean and inspect dry type air cleaner element. Remove and clean dustpan. Inspect element for holes and tears. Check gaskets and 'O' rings for damage. | Blow out dust with compressed air in the opposite direction of the normal air flow. If very dirty, wash in solution of warm water. (48.9°C-60°C) and non sludging detergent. Allow it to dry first then use compressed air. Replace if washed two times. Caution: Excess air pressure will damage paper. Air nozzle must be kept at least 8" from the element. Must not be used if even one pin hole exists. Discard element if punctured and also change gasket along with element. |
| 5. | Clean oil bath air cleaner tray screen. | ----- |
| 6. | Change lubricating oil by-pass filter element and gasket if provided. | Record oil pressure |
| 7. | Clean float tank and/or main fuel tank breather. | ----- |
| 8. | Check coolant PH value/concentration of DCA/chromate concentration (3500 PPM). | Change corrosion resistor element if PH calue is below normal range 8.5 – 10.5. Check chromate concentration at 3500 PPM. |
| 9. | Check magnesium plate in assembly corrosion resistor. Change water filter element. | Check magnesium plate for pitting or being eaten away. Change if more than 50% of area is lost. Use DCA service element or chromate element bags AR 95679 if concentration is low. |
| 10. | Change fuel filter element washer and 'O' ring on mounting bolt. | Clean shell fuel filter. Change element when restriction exceeds vacuum 20.32cm of mercury. |
| 11. | Check oil in aneroid control, If equipped. | Use same oil as used in oil pan. |

| S.N. | Maintenance Steps | Remarks |
|---|---|---|
| 12. | Check and adjust belts. New belts will stretch within one hour of use. They must be readjusted. | Tighten belt tension (use ST – 1293) |
| 13. | Tighten foundation bolts and flexible coupling bolts of engine and alternator. | ----- |
| 14. | Check all air cleaner connections for cracks-chafing etc. Tighten all air intake connections. | Correct as required. |
| 15. | Check fan hub and drive. | Use special tool no. ST 845 or ST 893 for tightening the fan hub nut. |
| 16. | Clean/change air compressor breather element. | Change element for naturally aspirated engine. Clean screen for turbo engine. |
| 17. | Check throttle linkage. | ----- |

EVERY 1500 HOURS OR 1 YEAR WHICH EVER IS EARLIER **C - Check**

| | | |
|---|---|---|
| 1 | Repeat all maintenance steps of Checks `A' & 'B' | |
| 2 | Check thermostat operation | It should start opening |
| 3 | Check fan hub and drive | Check mounting bolts & bearing end play |
| 4 | Check impeller water pump for play | Correct if necessary |
| 5 | Check for turbocharger oil leaks | Correct as required |
| 6 | Tighten turbocharger mounting nuts | Tighten to the specified torque. Do not tighten when engine is hot condition. |

| | | |
|---|---|---|
| 7 | Check inlet air restriction | Check after cleaning dry type air cleaner element. If restriction is in excess of 25" water, a new element must be fitted. |
| 8 | Clean oil bath air cleaner | Remove complete assembly and clean inclusive of fixed screens. |
| 9 | Clean and tighten all electrical connections. | - |
| 10 | Check generator brushes and commutators | Replace and clean as required |
| 11 | Clean entire engine | High pressure and soap water mixture preferred after spraying engine with cleanser taking care of protecting electrical system. |
| 12 | Tighten all mounting bolts and nuts | Tighten as required. Over tightening may result in distortion or damage. |
| 13 | Clean aneroid air breather. If provided | Replace breather if necessary. |
| 14 | Check engine blowby. | Reading in excess of recommended limits. Corrective action must be taken through analysis with the help of trouble shooting chart. |
| 15 | Clean radiator | Blow air through the radiator core in opposite direction to the normal flow of air, if working under dusty/dirty condition.( Reserve flushing operation) |
| 16 | Check air compressure | Check shaft and clearance. |
| 17 | Adjust injectors and valves | Clean fuel inlet connection screens. Final adjustments must be carried out with engine hot and with correct torque as specified (refer O & M manual) |
| 18 | Change hydraulic governor oil/ aneroid oil | Use engine lubricating oil |
| 19 | Check vibration damper | If steam is not available, then use clean soap water solution as outlined in 'C' checks it. |
| 20 | Fuel & lube oil filters | Replace fuel & lube oil filter elements with sealing rings and clean the filter housing. |

EVERY 6000 HOURS OR 3 YEARS WHICHEVER IS EARLIER. **D-Check**

| SN | Maintenance Steps | Remarks |
|---|---|---|
| 1 | Repeat all maintenance steps of check A, B & C | |
| 2 | Check exhaust and inlet manifold and nuts. | |
| 3 | Tighten all mounting bolts and nuts. | |
| 4 | Clean Turbocharger diffuser and impeller and check end float. | |
| 5 | Check turbo charger bearing clearances | Only end float on semi floating bearing if in excess of limits, replace it. |
| 6 | Check crank shaft end float | If in excess of recommended limits, corrective action is indicated |
| 7 | Clean injector inlet screens | Must be done only if performance deterioration is evident. Some of the indications for performance deterioration are.<br>1. Black smoke<br>2. Change in fuel manifold pressure<br>3. Loss of power<br>4. Malfunction of aneroid.<br>5. Clean and calibrate all injector.<br>6. Check fuel pump calibration.<br>7. Replace aneroid bellows & calibrate. |
| 8 | Replace fuel pump filter screen and magnet. | |
| 9 | Steam clean engine. | If steam is not available, then use clean soap water. |

## 10.0 MAINTENANCE OF TRANSMISSION

| | |
|---|---|
| (i) | Maintenance steps: Check the transmission oil level and top up, if necessary. It must be equal to H mark on the dip stick. When engine is stopped and has stood for 20 minutes or more (must be measured after oil, get back into the transmission housing) |
| (ii) | Clean the transmission and check the transmission oil leakage. Rectify the same if leakage observed. |
| (iii) | The oil should be changed every 1000 hours of operation or sooner, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odour. The filter screen in the sump should be removed and cleaned with mineral sprits at each oil change. |
| (iv) | The filter element should be replaced at each oil change and at 200-hour intervals between oil changes. The filter shells should be cleaned. New gaskets and seal rings must be used when replacing filter elements. After installation, check the filter for oil leakage while the vehicle engine is running. |

## 11.0 MAINTENANCE OF AXLE DRIVE

| | | |
|---|---|---|
| 1 | Three years or (approx 3,00,000 kms which ever is earlier. | Remove the final drives from the car & disassemble the gears, shaft & sub-assembly. Inspect the gears and bearing. The defective components must be replaced before re – assembly. |

## 12.0 MAINTENANCE OF LIFTING AND SWIVELLING PLATFORM.

| | | |
|---|---|---|
| 1 | Replace suction strainer. | Yearly |
| 2 | Replace return line filter element. | Yearly |
| 3 | Drain oil tank, clean it and change oil. | Yearly |
| 4 | Replace seals of hydraulic cylinder | Two yearly |
| 5 | Replace guiding pads between telescopic structures. | Two yearly |
| 6 | Major over haul | At 72 months Replacing guide pads between telescopic structures and replacing seals of |

| | | |
|---|---|---|
| | | hydraulic cylinder constitute a part of major over haul. |

13.0 Requirement of spares for maintenance during various schedules.

The items of maintenance spares required to be stocked along-with the list of must change items in respect of carriage, diesel engine, transmission system including traction motor spares are enclosed as annexure-V.

14.0 4-wheeler tower Cars shall have twin beam head light and LED type flasher light. Earlier tower wagons, which are not provided with twin beam headlight & LED type flasher light, shall be provided with twin beam headlight & LED type flasher light during major overhaul with modification in the shell.

15.0 OVERHAUL DURING IOH/POH

| | |
|---|---|
| (i) | During the overhaul the pantograph must be removed from the Tower car. |
| (ii) | All the electrical equipments like traction motor to be overhauled as per the guidelines explained in the proceeding para. |
| (iii) | After dismantling, check all ball bearings for wear of cage ball etc. and replace, if any. |
| (iv) | The upper and lower articulation tubes must be dismantled and repaired, if bent. The middle articulation shaft triangular bracket and equalizer arm etc. should be checked thoroughly for damage. |
| (v) | Dismantle and overhaul throttle valve |
| (vi) | All mechanical parts, brake equipments, transmission system etc. to be thoroughly checked and accordingly carryout all repair /replacement for safety and smooth functioning as suggested in this document/Maintenance Manual of the equipment/ supplier. |
| (vii) | Scratch the old paint. Clean the surface and apply paint as per colour scheme. |

## TRANSMISSION

16 The transmission and control equipment were supplied by two firms viz. M/s Kirloskar Pneumatic Co. Ltd., Pune and M/s Venkateswara transmission private Ltd. (VENTRA) Hyderabad. Hydraulic transmission offered by M/S KPC is of their own design and that of M/s Ventra is of Hindustan Motors. However five numbers 4 wheeler tower wagons were provided with Voith transmission system.

A common power pack is used for both the two designs. A Kirloskar Cummins Ltd. model N-743-L naturally aspirated diesel engine developing 210 horsepower at 2100 rpm has been used. The transmission of both powers from diesel engine to wheels is by means of hydrodynamic system incorporating torque converter and gears.

The final power transmission in both designs is through cardan shaft and axle drives. In the KPC design the transmission output is directly connected to the axle drive on the rear axle by means of a long cardan shaft using axle drives of two different overall gear ratios. This transmission also incorporates reversing arrangements with the use of plate clutch unit.

In the VENTRA design the transmission output is connected to the axle drive through an intermediate gearbox of a differential gear unit and a hydrodynamic torque converter incorporating speed change provision. The final drive from diesel engine is through a slip- clutch assembly properly aligned with in the engine flywheel housing.

16.1 MAINTENANCE OF VOITH HYDRAULIC TRANSMISSION.

16.2 Maintenance Schedules

| Maintenance interval | Work to be performed |
|---|---|
| 20,000 km | Check oil level |
| 300,000 km | Oil change, inspection of control parts, replacement of filter, replacement of disposable filter. |
| 900,000 km | Major overhaul |

16.3 Maintenance after 20,000 km

Check the oil level.

16.4 Maintenance after 300,000 km

a) Oil change

Under normal operating conditions, the oil filling lasts for a distance of approx. 300,000km . This period can be extended if

the oil sample is still within the tolerance of the specification for new oil.

For changing the oil, drain it from valve while it is at operating temperature and drain the oil cooler too. If oil of a different approved brand is to be filled in, flush the transmission and cooling system with half the quantity of the new oil needed for a complete fill.

b) Replace all filters. For this purpose, drain off the oil first, then remove the filters, take off the caps and remove filter elements.

c) Check control parts such as governor, standstill detector valve, operating cylinder, and main control valve for proper operation, leakage and wear.

16.5 Major Overhaul

A major over haul of the transmission is recommended after approx. 900,000 km of operation, depending on operating conditions and duty. During this over haul, the transmission is stripped as far as necessary. Bearing labyrinth rings, shaft seats etc. are inspected and damaged parts are replaced.

## 17.0 MAINTENANCE OF HINDUSTAN MOTOR HYDRAULIC TRANSMISSION

### 17.1 Control Linkage

Check the transmission shift control linkage and the directional linkage to ensure that the linkages are free and that the selector levers are properly positioned. The Shift levers should engage in all shift tower positions freely. Inspect the linkages for binding, wear, cracks, breaks or defective cotter pins.

### 17.2 Cold Oil Level Check

The cold check (engine not running) is made to determine if there is sufficient oil to safely start the engine - especially if the vehicle has been idle. The oil level should be at or near the full-level check plug. Some transmissions have one plug, others have two plugs, an ADD and a FULL plug.

### 17.3 Hot Level Check

Oil level must be checked with the engine running at 1000 rpm, transmission in neutral and with the transmission at normal operating temperature (82.3°C - 93.4°C). The upper check plug (if there are two

plugs) indicates the full oil level while the lower plug is the add level. The oil must be maintained at the FULL level. If there is only one check plug, the oil level must be maintained at this level. Add oil if necessary to bring the level to the FULL mark.

17.4 Oil, Filter Change

The oil should be changed every 1000 hours of operation or sooner, depending upon operating conditions. Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odor. The filter screen in the sump should be removed and cleaned with mineral spirits at each oil change.

The filter elements should be replaced at each oil change and at 200 hour intervals between oil changes. The filter shells should be cleaned. New gaskets and seal rings must be used when replacing filter elements. After installation, check the filter for oil leakage while the vehicle engine is running.

17.5 Keeping oil clean

It is absolutely necessary that the oil put in the transmission be clean. Oil must be handled in clean containers, filler etc., to prevent foreign material from entering the system.

17.6 Filling of Transmission Oil

At temperature above -23.3°C, pour hydraulic transmission fluid type C-2 into filler opening. At temperature below -23.3°C, an auxiliary preheat is required to raise the temperature in the sump. Use only C-2 fluids from approved manufacturers.

17.7 Care of Breather

The breather should be kept clean at all times. It should be checked and cleaned regularly and as frequently as necessary, depending upon the operating conditions. A badly corroded or plugged breather restricts proper breathing, causing oil leaks.

17.8 Control Linkage Adjustment

Manual shift linkage must be adjusted so that the operator's control is positioned to exactly match the detent position of the selector valve on the transmission. Adjust the linkage so that it can be freely connected

without moving either the valve or the operator's control. Then operate the range selector lever, the directional selector lever and the output disconnect (if applicable) through each position. Make minor adjustments, if necessary, to insure that each of the selector levers seats in each position of the operator's control. Then inspect the control linkage for binding wear or breaks.

## 17.9 TROUBLE SHOOTING OF HM HYDRAULIC TRANSMISSION

| Causes | Remedy |
|---|---|
| A. LOW CLUTCH APPLY PRESSURE | |
| 1. Low oil level | Add oil to correct level |
| 2. Clogged oil strainer | Clean strainer |
| 3. Clogged oil filter | Replace filter element |
| 4. Inching control adjustment not fully retracted | Check, adjust linkage |
| 5. Air leak at intake side of oil pump | Check pump mounting bolts. |
| 6. External oil leakage | Tighten bolts or replace gaskets |
| 7. Brake hydraulic (or air) pressure applying clutch cutoff valve | Check brake residual pressure (brakes released); check brakes for full release. |
| 8. Internal failure | Overhaul transmission, or repair subassembly |
| B. OVERHEATING | |
| 1. High oil | Restore proper oil level |
| 2. Clutch failed | Rebuild transmission |
| Causes | Remedy |
| 3. Vehicle overloaded | Reduce load |
| 4. Low clutch apply pressure | Refer to A. |
| 5. Engine water overheated | Correct engine overheating |
| 6. Cooler oil water line kinked or clogged | Clean or replace line |
| C. AERATED (foaming) OIL | |
| 1. Incorrect type oil used | Change oil; use proper type |
| 2. High oil level | Restore proper oil level |
| 3. Low oil level | Restore proper oil level |

| | |
|---|---|
| 4. Air entering suction side of oil pump | Check oil pump bolts and gasket |
| 5. Air entering at clutch cutoff valve (air actuated) | Check plug seal and seal ring of valve. |
| D. VEHICLE WILL NOT TRAVEL | |
| 1. Low clutch apply pressure | Refer at A |
| 2. Selector linkage broken or disconnected | Repair or connect linkage |
| 3. Internal mechanical failure | Overhaul transmission |
| E. VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED | |
| 1. Selector linkage out of adjustment | Adjust linkage |
| 2. Clutch failed (won't release) | Overhaul transmission |
| Causes | Remedy |
| F. VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED | |
| 1. Low clutch apply pressure | Refer to A |
| 2. Low converter out pressure | Refer to A |
| 3. Engine malfunction | Check engine; refer to engine service manual |
| 4. Aerated oil | Refer to C |
| G. CLUTCH CUT-OFF VALVE INEFFECTIVE | |
| 1. Valve or plug sticking | Rebuild control valve body assembly |
| 2. Brake apply hydraulic pressure incorrect | Check pressure at control valve (min-max limit - 9.15 kg/cm2 -140.7 kg/cm2) |
| 3. Brake apply air pressure not reaching air cylinder | Check air cylinder (15.85 kg force required to stroke valve) |
| 4. Plunger sticking in air cylinder | Check operation of air cylinder |

| | |
|---|---|
| 5. Air entering at valve (air actuated) | Check operation of air cylinder (seals) |

## 18.0 MAINTENANCE OF VENTRA DROP GEAR BOX

General

Ventra drop gearbox is a single stage gearbox, all the bearing and gears are adequately rated to give a longer life. This gearbox transmits the power from converter/ transmission to the rear axle drive gearbox through cardan shaft of adequate design.

Description

The input flange is key mounted on the input pinion shaft, which runs on the spherical roller bearings. The input pinion is meshed without put gear, which is key mounted on the output shaft. The output flange is key mounted on output shaft. The output shaft runs on spherical roller bearings. The gears and bearing are lubricated through pipe by means of a Hypo pump mounted on the output shaft. Oil seals are provided at input and output end to prevent the oil oozing through the end covers

## 18.1 Maintenance

1. Daily oil level to be checked through the level plug /indicator, if necessary, top up the oil.

2. Daily check the oil leakage through input, out put oil seals, through the end cover s and through housing joints etc. if so, rectify the oil leakage by changing the new oil seals or by tightening the respective bolts and nuts.

3. Once in a week take out the magnetic drain plug from the gear boxes and check for any wear out particles or debris, if heavier particles found, the gear box has to be opened and checked.

4. For the new gears, first oil changing period is one month Then once in three months, the specified oil to be changed

   Note: Before changing the equivalent oil, clean the gearbox with kerosene or diesel. Then pour the equivalent oil and drain out 1/2 to 1 litre of the same oil through the drain plug. Then put the oil little above the level plug / indicator

5. Breather must be cleaned thoroughly once in three months.

18.2 Ventra Axle Drive Maintenance Schedule

The final drive to the tower wagon is affected by the axle mounted right angle drive gear box. The input and intermediate shaft run spherical roller bearing. The axle also run on spherical roller bearing the gear box housings have been provided with oil pockets and gears and bearings get abundant lubrication. The bottom housing serves as the oil sump. Level, drain plug and inspection door have been provided for regular maintenance.

1. Daily oil level to be checked through the level plug and if necessary top up with the same oil (please refer oil chart for quantity/grade).

2. Check for oil leakage through oil seals and housing joints. Seal are to be replaces or housings are to be tightened according to the prescribed tightened torque, if necessary.

3. Once in a fortnightly take out the magnetic drain plug from the gear box and check for any wear particles or debris; if heavier particles are found the gear box has to be inspected by opening the cover at the top.

**Note for Change of Oil**

For a new gear box, first oil change shall be done after one month. During changing, clean the gear box with kerosene or diesel after draining out the sump. Pour the recommended/equivalent oil and drain out 1/2 to 1 litre oil again. Close the drain. Fill the sump with specified quality.

**Periodicity for change of oil - every three months.**

18.3 Maintenance of KPC HYDRAULIC transmission

18.3.1 Maintenance

18.3.2 Hydraulic system

a. The oil capacity of transmission is 20 litres.

b. Oil level should be checked daily through the oil level gauge in transmission. Oil level should be checked at idling engine speed, it should be between high & low marks.

c. Oil must be changed after 1000 Hrs. of operation.
d. Drain valve is provided for draining the oil without loss. Connect hose to the drain valve and then open the valve.
e. Fill the oil in transmission through breather cap hole. Run the engine and check the oil level. Replace the breather cap or alternatively, remove plug provided on cover top & fill oil. Refit plug after oil filling.
f. Replace filter element as per recommendations. Remove the filter cover and replace filter element. Use new gasket, if necessary, for the filter cover.
g. Suction strainer: Unscrew plug on top of strainer housing for strainer removal. Clean strainer throughly by flushing in clean diesel oil. All foreign particles must be removed from the strainer before refitting it. Ensure air tightness after replacing plug on housing strainer. Thread sealing compound may be used to avoid leakage of air in to the circuit.
h. Remove the breather assembly every 1000 Hrs. of operation. Flush the oil breather assembly.

18.3.3 Inspection - Daily

a. Check oil level. Add if necessary.
b. Check all pipelines, end connections for leakages. Replace damaged parts to stop leakages.
c. Check all pressure/ temperature gauges for proper functioning. Replace damaged gauge immediately.
d. Check oil leakage from oil seal bolted joints. Replace damaged oil seals. Tighten loose bolts/ screw to stop leakages from joints.

18.3.4 Inspection – Weekly

a Check strainer and clean.
b Check filters element and clean if necessary.
c Check and tighten all bolted joints including mounting bolts.

18.3.5 Inspection After Each 1000hrs Of Operation

a Change oil in the sump and fill new recommended oil
b Clean selector valve.
c Check all gauges for their correctness.

18.3.6 Periodic Overhaul

A complete over haul of the transmission should be done simultaneously with overhauling of engine. The period is approximately 4000 Hrs of operation or 18 month whichever is earlier.

## 19.0 TROUBLE SHOOTING OF KPC HYDRAULIC TRANSMISSION

| Symptom | Cause | Remedy |
|---|---|---|
| Over heating | a. Insufficient heat exchanger capacity.<br>b. Insufficient cooling water flow.<br>c. Clutch slipping.<br>d. Oil level too high.<br>e. Improper oil.<br>f. Clutch plates warped | a) Install heat exchanger of sufficient capacity.<br>b) Check pipe lines and heat exchanger for clogging. Check correctness of pipe size used.<br>c) Low clutch oil pressure (see low oil pressure).<br>d) Correct oil level.<br>e) Use only recommended oils.<br>f) Replace clutch plates. |
| Low oil pressure | a) Clogged strainer.<br>b) Stuck pressure regulation piston in selector valve assembly.<br>c) Broken piston rings in clutches.<br>d) Damaged or worn oil pump assly.<br>e) Clogged or plugged orifice plate in selector valve assembly.<br>f) Low oil level.<br>g) Foamed oil. | a) Remove & clean strainer .<br>b) Remove selector valve assembly and clean piston.<br>c) Disassemble clutches and replace piston rings.<br>d) Remove oil pump. Replace damaged /worn assly.<br>e) Remove orifice plate and clean<br>f) Add. oil to maintain proper oil level.<br>g) Check for air leak in suction line. |
| No oil pressure | a) Faulty pressure gauge<br>b) Low oil level or empty sump .<br>c) Fully clogged oil strainer.<br>d) Damaged oil pump. | a) Replace pressure gauge .<br>b) Check gaskets, seals for leakage. Replace parts causing leakage. Maintain correct oil level.<br>c) Remove & clean it.<br>d) Replace oil pump. |
| Poor performance | a) Low oil pressure.<br>b) Improper oil.<br>c) Clutch slipping | a) Add oil to maintain oil level.<br>b) Use recommended oil .<br>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.<br><br>b) Bearing failure | a) Check and tighten all joints. Replace damaged end fittings/hoses /pipes.<br>b) Disassemble transmission. Replace damaged bearings. |
| Neutral | a) clutch plates warped. | a) Replace clutch plates. |

20.0 KPC Axle Drive Maintenance Schedule

1. Periodic maintenance

Daily - Check oil level daily. It should be at the upper mark. Refill the oil, if the level has dropped below the minimum mark. Be sure to use the same oil brand.

Check the bolts and screws and re-tighten if necessary. Inspect the torque reaction rod assembly and its mounting to base frame.

2. Every 375,000 Kms

Subject all parts to an intermediate inspection. Check the bearing pattern on the bevel gear drive. Check the taper roller bearings for proper axial clearances.

3. Every 750,000 Kms.

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

4. Oil Change

After a new axle drive has been in use for 50 Hrs., the oil must be changed. Further oil change must be made after every 6000 Hours of operation.

Remove the oil drain plug to drain the oil from the drive. If excessive metal particle are detected on the magnetic plug or in the oil, it shows that some components have rubbed each other. Open the axle drive and inspect, Remove the plunger type pump and clean pump strainer.

Clean the housing from oil sludge. Replace the drain plug. Fill with new filtered oil through the filler neck.

5. Axial clearance check, Tapered Roller Bearings:

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

6. Check of Bearing Pattern, Bevel Gear Drive:

To enable this inspection the axle drive must be opened. Lightly coat three or four teeth on bevel pinion with blue coloring. Rotate the driven gear by hand. Check the bearing pattern on the contact surfaces. The bearing pattern should be centered on the working surface or pointing a little toward the minor diameter. If the bearing pattern falls short of this requirement, readjust.

# BRAKE SYSTEM

21.0 Air Pressure System

21.1 Introduction

Air pressure system in the Tower car mark III carry out the following operations -

i) Operation of the brake cylinders

ii) Control system

iii) Signal Horns

iv) Parking brake

When the power pack of tower car works, the entire air pressure system is charged by the integrated diesel engine air compressor. The main reservoir pressure is kept between 7 to 8 kg/cm2 with the help of governor, time relay auto drain valve (fitted with main reservoir) and unloader. There is one another Safety valve set at 9.5 kg/cm2 which can save the air pressure system in the worst case, when the usual safety valve (unloader and auto drain valve with time relay) fails.

Duplex pressure gauges have been provided in both the Driver’s cabins which will show the M.R. and B.P. of the air pressure system. Two nos. gauges have been also provided in the Driver's cabin to show the Brake cylinder pressure when brake is applied. Another two nos. gauge have been provided for control system (one in each Driver’s.’s cabin) One no. of pressure gauge has been provided on control box which will show the actual pressure receiving by the control system. There is one air pressure oiler fitted with service pipe line to control box to facilitate the lubrication of pneumatic valves and equipment fitted in control board.

Condemned water from the system can be removed by means of drainage valve provided in air supply tanks. There are 4 nos. of brake cylinders (one for each wheel) to facilitate perfect brake on the tread of wheels from both sides.

There are two spring brake actuators provided specially for parking brake. It can park the Tower car when there is no air in the system. In the normal running condition due to air pressure, brakes are in the released condition.

It will function as emergency brakes when the air pressure drops below the spring break hold off pressure, the spring pushes the piston and the push rod out to apply the brakes.

21.2 Important valves and their functions.

21.2.1 C3W distributor valve

The C3W distributor valve consists of the following major parts.

i) Main valve
ii) Quiere service valve
iii) Inshot valve
iv) Cut off valve
v) Double release valve
vi) Auxiliary reservoir check valve
vii) Freight to passenger change over device or lock.
viii) Application and release chokes

21.2.2 Operation

The compressed air from brake pipe charges into (CR) control reservoir of the C3W valve and auxiliary reservoir (AR) through cut off valves. When the BP pressure is reduced by the Driver's brake valve due to differential pressure across the main valve diaphragm, the hollow stem lefts and allow AR pressure into B.C (brake cylinder) through inshot valve. The B.C pressure also acts on top of the upper diaphragm bringing the main diaphragm assembly down wards and finally to cap position. In this position B.C pressure is held against permissible leaks. Every time B.P. pressure is reduced in steps this phenomenon repeats.

The quick service valve helps in quick propagation of B.P (Brake pressure) reduction through the length of the train also. When the B.P. (Brake pipe pressure) is increased by Driver's brake valve, the hollow stem of main valve is brought to normal position by neutralizing the pressure differential across the main valve diaphragm and the B.C. pressure is released through the hollow stem to the atmosphere. As in the application, the upper diaphragm balance against upward force and comes to the lap position. Every time B.P. pressure is increased in steps, this phenomenon repeats.

There is on lever provided in C3W valve, by pulling it, the brakes can be released manually. The passenger freight change over device helps to achieve required brake application and release timings depending on the type of service either freight on passenger.

22 Spring brake actuator

Function

To produce braking forces at the wheel for parking brake

Operation.

In the normal running condition the chamber air is pressurized and the piston compresses the spring and the brakes are in released condition.

23 Spring brake application (Parking brake):-

When the air pressure in the Chamber is depleted, the spring pushes the piston and thereby the push rod out and applies the brakes through the slack adjuster.

24 Emergency brake:-

When the system air pressure drops below the spring brake hold off pressure, the spring pushes the piston and the push rod out to apply the brakes through the slack adjuster.

Mechanical Release:-

To release the brake temporarily for towing the vehicle, the wind off nut is unscrewed after loosening the lock nut, thus retracting the push rod.

Brake Cylinder:-

In tower car 4 nos. of brake cylinders have been used which have been fitted at rear end and front end. One brake cylinder works on each wheel.

When C3W valve BC lines operates, the air pressure rush into the cylinder and compress the spring and ultimately push out the piston and apply the brake on wheels treads from both sides with the help of mechanical levers and brakes shoes. If the driver release the brake with the help of auto brake valve A9,the pressure is released by C3W valve as well as through shut off vent type.

25 Auto Brake Valve (A-9 Automatic Valve):-

It is valve by which drivers can apply the brake to the tower car as well as release the brake to run the vehicle (Tower car)

Description

The A-9 Automatic Brake Valve is a compact self-lapping, pressure maintaining brake valve which is capable of graduating in

application or release of tower wagon brakes. The A-9 Automatic Brake valve has five positions: Release, minimum Reduction, Full service, over - reduction and emergency. The full service application position is preceded by a zone in which brake pipe air is supplied or exhausted in proportion to brake valve handle movement through this zone, thus providing the graduation of an automatic application or release of the tower wagon brakes.

The A-9 Automatic Brake Valve consists of a self-lapping regulating portion, which supplies or exhausts the brake pipe pressure and a vent valve which is actuated only when the brake valve handle is placed in Emergency position for the purpose of venting brake pipe pressure at an emergency rate.

26 Double check valve

Function

To charge central line in a selected manner from two independent sources.

Operation

When a pressure differential exists between the two end ports, the higher air pressure forces the check valve over to seal against its seat on the low-pressure side. This closes the passage between the low pressure port and the common port in the body. Air then flows from the high-pressure port through the common port to the device under control.

27 A1 Check valve

Check valves are used in pneumatic brake system to allow - compressed air to flow in one direction only. The A1 check valve is metal seated check valve and is used in compressor delivery line. When compressed air flows in the right direction, the valve of the check valve lifts by the upward air force acting underneath the valve and allows air to pass through the outlet connection. In case of reverse flow, the valve is pressed on its seat tightly due to air pressure acting on top face of the valve.

28 Safety Valve

The J1 safety valve is installed vertically in the main reservoir system, vents pressure at a pre determine setting to atmosphere in order to prevent excessive main reservoir pressure build up.

29 Automatic Drain Valve

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

30 J air filter

The J-air filter function to assist in preventing the passage of dirt and moisture which may be mixed with the air flowing from the main reservoir into the air brake equipment.

31 MAINTENANACE OF THE VALVES

Cleaning, Inspecting and Repairing

- With the brake valve completely disassembled, all parts must be cleaned and inspected.
- All the parts (excepting rubber parts) must be washed in a suitable solvent that will dissolve oil or grease and permit all the parts to be thoroughly cleaned without abrasion. The exterior of the body must be thoroughly cleaned by means of a cloth or rag saturated with a suitable solvent.
- All Gasket, Diaphragms, and "O" rings must be replaced.
- All Packing rings should be replaced.
- Clean all springs using a wire brush and suitable solvent and inspect for pitted marks distortion, or permanent set. Replace where necessary.
- Replace all parts that are cracked, broken, worn excessively, damaged or in such a condition as would result in unsatisfactory operation.
- The spring may be wire brushed to assist in the removal of rust and scale. After cleaning, blow all metal parts with a low pressure jet of clean and dry air.
- Promptly blow the parts dry with low pressure jet of clean and dry air.
- Discard the filter unit and replace with a new one.
- Inspect all other parts. Reject and replace any part that is cracked, cut damaged, worn excessively or is in such a condition that would result in unsatisfactorily operation.
- The spring must be replaced if it is rusted, distorted or has taken a permanent set.
- Frequency of overhauling of valves is to be decided by depots depending upon the utilization of tower wagon. However overhauling is to be carried out at least once in year.

NOTE : All the gauges and meters are to be calibrated once a year.

# MAINTANANCE GUIDELINES AND SCHEDULE (CARRIAGE PART) OF 4 -WHEELER TOWER CAR

## 1.0 BODY REPAIRS

(i) Inspection and repair of body members are done after the Tower Car body is lifted off the wheels and axles are placed on trestles.

(ii) All furnishing and other components from coach shell, which are stripped, are to be sent to the respective sections for maintenance.

(iii) For major repairing work all the equipments (under slung, onboard and roof mounted) shall be removed from the Tower Car.

## 2.0 INSPECTION OF UNDERFRAME

(i) The underframe members should be thoroughly inspected for locating cracked/bent/corroded members. Corrosion is indicated by flaking of paint of metal, pitting and scale formation. Components like sole bar and trough floor which are not visible from both sides should be examined by tapping with a spiked hammer , Proper illumination will be required to carry out the check. A component will require repair / replacement if it has lost more than 20% of its thickness.

(ii) The underframe and shell members are categorized as vulnerable and not so vulnerable areas for corrosion.

(iii) Particular attention should be paid to the vulnerable members and locations listed below: -

- Sole bar, body pillars, and trough floor.
- Sole bars, body pillars above lifting pads.
- Sole bars and pillars behind the door pockets.
- Sole bars and pillars at the door corners.
- Head Stock
- Sole bars and pillar.

(iv) Procedure for inspection of underframe members for corrosion attention is laid down in RDSO technical pamphlet No C-7602.

## 2.1 SOLE BAR, BODY PILLAR

(i) Examine visually supplemented by tapping with a spiked hammer sole bars, body pillars in the bays under after removing the accumulated dirt and cleaning the surface.

(ii) If incidence of corrosion is noticed in the bottom half of the sole bar, the trough floor should be cut to a width of 300 mm and requisite

length for examination of inside top half.

(iii) If heavy corrosion is noticed, the sidewall should be cut to a height of 500mm from the bottom of covering sufficient length and all the exposed parts, after scraping and cleaning should be examined to determine the extent of corrosion.

2.2 SOLE BAR AND PILLAR ABOVE THE LIFTING PADS

(i) Examine the above members in the same manner as described in clause 2.1 above.

(ii) If signs of corrosion are noticed, the sidewall sheet above the lifting pads should be cut to a height of 500mm. above and to a length of half meter, on either side of lifting pads. Scrape the structural members, clean and examine minutely to ascertain the extent of corrosion.

2.3 SOLE BAR AND PILLAR AT THE DOOR CORNERS

Examine the above locations visually. If corrosion is noticed, cut to a width of half meter from the door corner. Remove accumulated dust. Structural members should be thoroughly scraped, cleaned and examined to assess the extent of corrosion.

2.4 SOLE BAR & BODY PILLAR AT LOCATIONS OTHER THAN DESCRIBED ABOVE

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

(ii) Remove the accumulated dust and scrape structural members to the extent possible. If corrosion is noticed, sidewall sheet in the area of corrosion should be cut to a height of 450mm from the bottom of covering for sufficient length for thorough examination.

2.5 HEAD STOCK

(i) Examine visually inner headstock, outer headstock, stiffening immediately behind the buffers and the junction of the sole bar at the headstock for incidence of corrosion.

(ii) Examine carefully the base of buffer assembly as corrosion has been primarily noticed at this location.

(iii) Examine carefully the buffer base of headstock by chalk test or sound test for cracks and dents. Buffers fixing holes should not be elongated and no minor cracks to be allowed. Replace headstock if the wear is more than 4 mm i.e. when the thickness is below 4mm.

## 2.6 TROUGH FLOOR

(i) Examine the trough floor in the bays adjoining the wash basin and from below for signs of corrosion, supplemented by tapping with a spiked hammer.

(ii) If signs of corrosion are noticed in the above examination, the part should be thoroughly cleaned by scraping and an intensive inspection should be carried out to detect the extent of corrosion in the trough floor.

## 2.7 CORROSION REPAIRS TO UNDERFRAME MEMBERS

(i) Corrosion repairs shall be carried out as per instruction laid down in RDSO technical pamphlet nos. C-7602

(ii) It is essential to use corrosion resistant steel sheets for corrosion repairs of tower cars. Welding electrodes and paints should be of the prescribed quality conforming to the relevant IS/IRS specifications.

- Corrosion resistant steel sheet for trough floor, pillars, sidewall and roof should conform to IRS M-41.
- Electrode: IRS class A3/B2 of approved brands.
- Paints: Red oxide zinc chromate primer – IS 2074-92. Black synthetic enamel paint to IS:8662.

(iii) Where the corrosion noticed is of a very minor nature and has just started, there is no need to renew the parts. In those areas, the paint and the rust should be thoroughly cleaned to reach the bare metal and the surface treated with two coats of red oxide zinc chromate primer to IS:2074-92 to a DFT of 50 microns followed by two coats of black synthetic enamel paint to IS:8662 to a DFT of 40 microns

(iv) Where the corrosion repairs are carried out on the underframe or its paint coat is damaged, the underframe should be painted with two coats of red oxide zinc chromate primer to IS:2074-92 to a DFT of 50 microns followed by two coats of black synthetic enamel paint to IS:8662 to a DFT of 40 microns.

(v) For carrying out corrosion repairs to underframe members, the Tower Car body should be lifted off the Wheels & axles and kept on trestles. For repairs to sidewall and end wall, no lifting is required.

## 2.8 Head stock

For replacement of headstock, the following parts need to be stripped first:

- Side buffers
- Compreg board and Aluminum chequered sheet flooring
- End partition and electrical wiring
- Draw gear assembly
- End portion of BP/FP

Before the corroded portion is cut off, the auxiliary headstock and the two sole bar ends should be firmly supported on trestles. The corroded headstock is then replaced as per annexure-v of RDSO technical pamphlet No. C-7602. Only corrosion resistant steel (IRS M-41 or IS:2062 Fe 410 Cu WC) should be used for head stock repairs.

2.9 SOLE BAR

For carrying out repairs to sole bar, it is necessary to strip first the interior fittings, laminate paneling and window frames. Before cutting off the corroded portion of sole bar, both the adjacent ends should be supported on trestles. The new sole bar piece should be welded from outside and inside. To facilitate welding from inside, the Tower Car body should be lifted and kept on trestles.

2.10 CORROSION REPAIR OF SOLE BAR

Repairs to sole bar for replacement of corroded portions at the locations mentioned below should be carried out as per Annexure-II of RDSO technical pamphlet No. C-7602

2.11 SIDE WALL MEMBERS

For repairs to side wall sheets, the interior fittings, laminate paneling and window frames should be stripped first. Corrosion repair of side wall sheets and body pillars should be done as per annexure-III of RDSO technical pamphlet No. C-7602.

2.12 TROUGH FLOOR

For replacement of trough floor, first Compreg board and Aluminum chequered sheet flooring needs to be stripped. Corrosion repairs to trough floor should be done as per the annexure-IV of RDSO technical pamphlet No. C-7602.

2.13 ROOF

a) Roof repairs

Tower car, roof should be checked for corrosion. Special attention should be paid at location where gutter mouldings are

welded and ventilators bolted. Corroded roof should be repaired according to the instructions given in annexure VII of RDSO technical pamphlet no. C-7602.

b) TRA type roof ventilators repairs

(i) Examine the roof ventilator for damage or corrosion or leakage. If no corrosion is observed then seal the joints and crevices with waterproof sealing agent as per IS/IRS Specification. Ventilators found beyond repairs should be replaced as per RDSO technical pamphlet no. C-7602, Annexure-VII.

(ii) After repairs and refitting, ventilators should be tested for water leakage at their base joints at the time roof testing.

c) Roof testing

Tower car after POH repairs should be tested under water spray for roof leakage before they are finally turned out from the workshop. For this purpose, a fixture designed to simulate monsoon conditions should be provided in the workshop.

2.14 REPAIRS TO DOOR HANDLES

Examine the door handle for breakage, damages. If the fixing bolts are loose or missing, tighten the bolts. Replace the door handles, which are found beyond repairs.

2.15 REPAIRS OF BODY SIDE DOOR

The body side doors shall be repaired as per annexure VIII of RDSO technical pamphlet no. C-7602

2.16 REPAIRS TO DOOR PIVOTS

Examine the door pivots for corrosion, breakage or wear by cutting the bottom portion of outer panel. Cut the corroded portion of the door pillar (Z molding) and weld new piece joining the door pivot pin. If the female socket is worn or damaged beyond repairs then replace it. Replace the bush provided in the socket.

2.17 REPAIRS TO PARTITION WALL PILLAR/MOUNTING PLATE

Examine pillar/mounting plate for corrosion or breakage, etc. at bottom ends. If found corroded, repair the same as per RDSO technical pamphlet no. C-7602

2.18 REPAIRS TO DRAW AND BUFFING GEAR SUPPORT STRUCTURE

(i) Examine the draw gear support structure for corrosion, breakage, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or gusset plate with new support angle.

(ii) Similarly examine the buffing gear support structure for corrosion, breakage, etc. if the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion is heavy, replace the corroded angle or stiffeners.

(iii) Examine the body bolster for corrosion, breakage, wear, etc. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakage or wear are beyond repair, replace the body bolster. Check the area surrounding centre pivot pin mounting holes for cracks.

2.19 WATER TANK SUPPORT STRUCTURE

Examine the water tank support structure for corrosion, breakage, wear, etc. if the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded angle with new angle of suitable size as per the requirement. Replace the rubber/wooden packing if perished or damaged.

2.20 REPAIRS TO THE FLOOR CHANNEL

Examine the floor channel for corrosion, breakage, wear, etc. by cutting open the Compreg board and Aluminum chequered sheet flooring where the corrosion is suspected. If the corrosion is light, scrap off the rust to bare metal, clean well and re-paint. If the corrosion, breakages are beyond repair, replace the corroded channels with new channel of suitable size as per the requirement.

2.21 GENERAL

(i) All repairs of cracks should be carried out by gouging and welding by suitable electrodes.

(ii) CAUTION: No electric welding on the Tower Car should be carried out without proper earthing from near the portion being welded. And in no case the earthing through Axle box/wheels and rails shall be permitted. In the absence of such earthing, the return current passes through axle roller bearings causing pitting of rollers and bearing failure in

service.

(iii) Distorted and bent parts should be heated and straightened.

(iv) The parts used for repairs should be given proper surface treatment and applied with protective paint. Relatively thick sections such as sole bars, cross bearers, etc. should preferably be grit blasted and immediately thereafter given a protective coat of red oxide zinc chromate primer paint.

(v) Welder's Qualification: Welders deputed to carry out welding work on coaches and coach components should be only those tested and certified as adequately skilled for welding work on coaches and coach components.

## 2.22 LIST OF TOOLS AND PLANTS

| Lifting shop | Corrosion repair shop |
|---|---|
| 1. EOT cranes | 1. EOT cranes |
| 2. Trestles for Tower Car body | 2. Trestles for Tower Car body |
| 3. Inspection torches | 3. Gas cutting plants |
| 4. Spiked hammers | 4. Multi-operator welding plants |
| 5. Ball peen hammers | 5. $CO_2$ welding plant |
| 6. Goggles for inspection staff | 6. Electrical angle grinders |
| 7. Measuring tape | 7. Pneumatic hand grinders |
| 8. Measuring scale | 8. Component painting equipment |
| 9. Safe guard for safety of heads of inspecting staff. | 9. Phosphating plant |

2.23 Examination and repair practice in maintenance depot shall be as per Annexure – IV.

Annexure -II

# SUSPENSION, WHEEL & AXLES

## 1.0 BRIEF DESCRIPTION OF SUSPENSION

Suspension arrangement for 4-W Tower car (Except Mark-III) consists of helical springs working in parallel with hydraulic shock absorbers. Axles with their self-aligning spherical roller bearings mounted inside cast steel axle boxes are guided by axle guide assemblies.

Following are leading particulars of the 4-Wheeler Tower car:-

| Particulars | 4-Wheeler Tower car | | | | |
|---|---|---|---|---|---|
| | BEML/PHOOLTAS/ VENTRA | | BHEL | JAMALPUR | |
| | | | | Mark-III | Mark-IV |
| Rigid Wheel Base | 6100 mm | 6100 mm | 6100 mm | 6100 mm | 6100 mm |
| Diameter of wheel on Tread. | 915 mm. | 915 mm. | 952 mm | 952 mm | 915 mm. |
| Axle Load | 16 t | 16 t | 16 t | 16 t | 16 t |

## 2.0 FEATURES WHICH CONTRIBUTES TO IMPROVED RIDING COMFORTS (Except Mark III)

Axles mounted on self-aligning spherical/cylindrical roller bearings, with helical springs working in parallel with shock absorbers of specified characteristics have all contributed to superior riding comforts. It is therefore, essential to ensure that these features are well maintained in service so as to obtain the desired performance throughout the life of the 4W-Tower Car.

Riding comfort offered by the 4W-Tower car depends exclusively on above design features and unless they are properly maintained and attended during periodical maintenance schedules & overhauls, riding deteriorates leading to subsequent heavier and costly maintenance.

## 3.0 OVERHAULING (Except Mark III)

TOWER Car suspensions are designed for good riding comforts with the help of self aligning spherical roller bearings, hydraulic shock absorber, helical springs for suspensions. Proper handling and maintenance of these will result in longer life and satisfactory service performance.

Tower Car requires to be given thorough periodical over haul (POH). The intermediate overhaul (IOH) as per the details given in Annexure-IV. While carrying out the overhauls instructions as given in the following paragraphs should be strictly followed.

3.1 LIFTING THE BODY OFF THE SUSPENSION (For all OHE Car)

Tower car body can be lifted off the suspension by either:

(i) Two electric cranes of minimum 10t capacity each with suitably designed swings and cradles, or

(ii) Four Hydraulic/electrical lifting jacks of 10t capacity each simultaneously operated by single control switch. The 4-W Tower Car should not be lifted from any other point but from lifting pads.

Note: Under no circumstances a lifting jack or sling should be applied on at any other location except on lifting pads in the workshops.

(iii) Cranes or jacks used for lifting should be operated uniformly and simultaneously without jerks, before lifting the 4-W Tower car, following components should be disconnected.

(a) Propeller shaft (For Diesel Hydraulic) coupling connecting axle drive
(b) Standstill detector connected on axle drive
(c) Speedometer cable connection on axle drive
(d) Disengage all axle box safety straps
(e) Torque arm assembly connecting axle drive and underframe
(f) Shock absorbers connecting axle box and underframe
(g) Brake tie members and brake block hanger bracket
(h) Safety chain link connection axle drive with underframe
(i) Motor connections (For Diesel Electric Tower Car)

*Note: Before finally lifting 4-Wheeler Tower car body, the axle drive should be supported by steel/wooden blocks of requisite thickness, so as to avoid the axle drive from overturning in case of hydraulic transmission.*

Tower Car should never be lifted from one end only as the axle guides and lower spring seats are likely to suffer damage and dents may occur on body panel. The 4-Wheeler Tower car may be lifted by means of a crane or screw jacks as mentioned above till all the 8 guide

bushes disengage from the lower springs seats and wheels are rolled out.

3.2 ATTENTION TO SUSPENSION COIL COMPONENTS (Except Mark III)

Following attention should be paid to 4-W Tower car suspension components during POH before assembling them.

(i) After through cleaning check for any possible cracks, particularly at places where axle guide flanges and safety strap bracket are welded. Circlip groove should also be checked for damages. Normally squareness and alignment of axle guide does not require checking. If biased wheel flange wear or wear in the rear cover of the roller bearing axle box have been observed, the squareness of guides and their alignment should be checked thoroughly with the help of alignment gauges. In the event of misalignment of axle guides or damaged guides, which require replacement, following procedure may be adopted.

(a) Whenever a axle guide is damaged it is to be replaced.

(b) Where the measurements of guides shows a deviation from the dimension given in fig.1 (Applicable for BEML 4 Wheeler Tower Car only .For other make of tower cars their Trammeling Drawing can be obtained from their respective manufacturer). The concerned pair of guides should be cut and re-welded in position. Guide should always be cut in pairs, as the adjacent guide distance has to be maintained. In case of BEML it is $630 \pm 1$ mm .

(c) While cutting out guides, care should be taken that only weld metal is cut and guide flange or underframe is not damaged.

(d) Guides which are cutout, need not be scrapped but the flange periphery should be built up by welding wherever spoiled or pitted by gas cutting and ground to shape, care should be taken not to damage the circlip groove of the guide cap.

(e) For re-welding of axle guide:-

- Locate new guide with the aid of setting gauges with reference to other guides. Two gauges, one giving the longitudinal and other diagonal location in relation to other guides are sufficient to locate it. However, a third gauge be used as a counter-check. Tack weld the guide to underframe.
- Remove the gauge and complete the welding.
- Allow the frame to cool off.
- Check the dimension of the guide in relation to others with

the aid of master gauges.

- Check also the height of the guide in relation to other guides with a straight edge.
- Use low hydrogen electrodes of approved brand for welding (Electrodes under IRS Class A3/A4 may be used).
- Important dimensions to be checked after rectification.
- The crown clearance between the rubber pad and the axle box shall be as per following table.

| BEML | VENTRA | BHEL | PHOOLTAS | JAMALPUR | |
|---|---|---|---|---|---|
| | | | | Mark-III | Mark-IV |
| 125 +0/-5mm. | 130 +0/-5mm | 50 +0/-5mm | 92 ± 5mm | NA | 110 +0/-5mm |

The rubber pad is to be adjusted every time the timber packing are inserted between the lower spring seat and the lower rubber washer to compensate tyre wear, so as to obtain the prescribed clearance between axle box crown and the rubber pad.

3.3 WHEELS AND AXLES (For all Tower Cars)

(i) The leading dimensions of powered wheels and axles set should be checked as per respective drawings of different manufacturers as mentioned in Annexure III These wheels are clearly marked with their axle capacity and should not be interchanged with other wheels under any circumstances

(ii) The wheel profile should be checked to RDSO SK. No.91146 Alt.3 profile Fig. 2 If the profile is found worn out, it should be re turned.

(iii) Variation in the tread diameter of the wheel on the same axle should not exceed 0.5mm. Large variation in wheel diameter will lead to biased flange wear. The variation in wheel diameter between one pair of wheels and the other should not exceed 13mm.

(iv) Wheel gauge should be within the tolerance of +/-1mm.

(v) Under no circumstances, wheels, which have reached the condemning, limit, as indicated by grooves on the wheel rim/tyre should be used.

(vi) In case any wheel is de-wheeled and repressed on, the pressing on pressure and the wheel gauge tolerance shown in as per respective drawings of different manufacturers as mentioned in Annexure III should be strictly adhered to and a record of wheel pressing on pressure maintained.

(vii) Weld reclamation of Axle should never be done.

3.4 ROLLER BEARINGS (For all 4 W Tower Cars)

Axle boxes are fitted with roller bearing as per Drawing mentioned in Annexure III.

(a) LUBRICATION OF ROLLER BEARINGS

The quantity of grease required to be filled in axle box during renewal is given below:
SKF bearing – 2 kg
FAG bearing – 1.5 kg

The list of approved brands of grease is given below:-

| Supplier | Type of bearing | |
|---|---|---|
| | SKF | FAG |
| IOCL | Servogem 3 | Servogem 3 |
| HPCL | - | Lithon 3 |
| BPCL | - | Polypak 3 |

Different types of grease should not be mixed together.

(b) INSPECTION OF ROLLER BEARING (For all 4 W Tower Cars)

(i) Thoroughly clean the exterior of axle box and then remove the front cover from the body casting.

(ii) Examine the grease, if it is discoloured fully, bearing should be dismounted and thoroughly inspected. If the grease is in good condition, bearing need not be dismounted, but be washed and cleaned in position with petrol or white spirit.

(iii) When dismounted, scoop out all accessible grease by the hand and by using a rubber scraper take out all grease. Wash the bearing with spirit or petrol.
Ensure that tracks, rollers and cages of bearing are free from damage. Measure the bearing clearance using a feeler, if the roller and tracks are not pitted or flaked and cage is not worn, In case of Spherical roller Bearing check that rollers do not fall out when the outer ring is swiveled at an angle, bearing is in good condition. The following bearing clearances for new as well as in service self-aligned spherical roller bearing for BG Tower Cars may be followed:-

| Bearing Make | Radial Clearance in un-mounted condition (mm) | | Radial Clearance in mounted condition (mm) | |
|---|---|---|---|---|
| | New Bearings | In service bearings | New Bearings | In service bearings |
| FAG/NORMA | 0.145 - 0.190 | 0.270 Max. | 0.080 - 0.160 | 0.220 Max |
| NEI/NBC | 0.145 ~ 0.190 | 0.295 Max. | 0.080 ~ 0.160 | 0.245 Max |

(c) DISMANTLING

Roller bearing can be dismounted as described below:

(i) Straighten the folded tabs of the triangular locking plate, unscrew the hexagon and screws holding the securing cup. Remove the securing cup. Then push the injector adapter ring on the journal against the bearing and clamp it firmly against the bearing inner ring. Connect the oil injection pump capable of developing a minimum pressure of 740kg/sq.cm to the adaptor ring and pump in thick cylinder oil, so that a film of oil is formed between the bearing and the axle journal. Remove the adapter ring as soon as the oil firm is formed. Fit the withdrawal tool over the bearing outer ring, then push the locking ring forward, so that the claws of the sleeve engage the inside face of the bearing outer ring. Due to oil film between the journal and inner ring the bearing can be easily dismounted by turning the withdrawal screw.

(ii) After removing the bearing, remove the rear cover and the sealing ring.

(iii) Wash and examine the bearing and other components.

(d) FELT SEALING RING

The felt sealing ring should be examined and if found damaged, replace it. However, it is advisable that every alternate POH, the felt ring is renewed.

(e) MOUNTING OF ROLLER BEARING AND AXLE BOX

(i) Soak felt ring in cylinder oil to IS:1589-60 Type-I Gr-3 heated to 40$^{o}$C - 50 $^{o}$C for 30 minutes and fit in the groove in rear cover.

(ii) Clean and examine journal and ensure that threaded holes for locking screw are perfect.

(iii) The collar may be shrunk fitted on axle journal after heating the collar in a neutral oil bath or by an Induction heater, with the help of a mounting sleeve. Make sure that the collar firmly butts against

journal shoulder.

(iv) Fit the rear cover with four bolts alongwith rubber 'O' ring and felt sealing ring in position. Fill in the 'V' grooves and the cavity in the rear cover upto the face of the ring with approved brand of grease.

(v) Heat the roller bearing in a hot oil bath or an Induction heater and slide it over the journal carefully with the help of a mounting tool. Push the bearing forward till it firmly butts against the ring. The stamped face of the bearing should be kept outwards while fitting the bearing so that the stamping can be seen during inspection. After the bearing cools off, pack the bearing with grease.

(vi) Assemble the required securing cup and lock plate with hexagon screw The securing screw is locked by bending over the tabs provided in the locking plate against flat of bolt heads.

(vii) Liberally, smear inside of axle box with grease and fit it over the bearing. Put the required front cover with sealing rings and tighten up bolts and lock the nuts with split pins.

(viii) Check if the axle box can be rotated freely by hand.

The working space for mounting and dismounting of roller bearing must be absolutely clean and the table on which roller bearings are cleaned must be free from iron filings, dust, etc. Kerosene oil may be used for cleaning the roller bearing and journals. The cleaning bath should be changed every time to keep it free from dust and foreign matter. Steel trays with lids should be used for cleaning roller bearing.

## 3.5 AXLE BOX HOUSING

Roller bearings are housed in accurately machined cast steel axle boxes. The axle boxes are also provided with cast iron Front cover and light alloy back covers secured by four bolts. Axle boxes and covers should be thoroughly cleaned and checked for cracks particularly at the bolt holes of the covers, which have shown proneness to failures. The bolts should be examined for worn threads, straightness etc. before reuse and should be well tightened and locked by spring washers and split pins to ensure that the covers and the axle box housing form a water-tight assembly and protect bearing from dust and moisture.

## 3.6 AXLE BOX SPRINGS (Except Mark –III)

Axle box springs are as per respective drawings of different manufacturers as mentioned in Annexure III manufactured as per RDSO spec. WD-01-HLS-Latest Revision/Amendment. It is necessary to check

these springs for cracks and measure their free height to ensure that they meet the design requirements.

All the springs shall be grouped in categories and used on bogies as per instructions detailed in RDSO technical pamphlet no.C-8419 (latest revision/amendment).

Top and bottom faces of these springs should be ground parallel if necessary as both ends bear against flat surfaces and the inclination in vertical axis corrected to fall within the tolerances specified on their respective drawings

3.7 LOWER SPRING SEAT (Except Mark –III)

Lower spring seat on axle box wing in which guide bush moves up and down does not normally wear in service. If the surface is worn more than 0.4mm in diameter or if the surface is scored or other wise damaged, the lower spring seat should be replaced. The lower spring seats should be carefully checked for cracks before reuse. During POH clean the inner surface of lower spring seat and smear all-round the honed face with Axle box roller bearing grease.

3.8 AXLE GUIDE ASSEMBLIES (Except Mark –III)

Axle box set guides are accurately machined and welded to the underframe to ensure that the wheel set are guided in parallel, these guides are fitted with bushes at the lower end to guide the wheel set both in lateral and longitudinal direction.

Following components which form the axle guide assembly should be thoroughly examined and renewed as indicated:

| | | |
|---|---|---|
| 1. | Guide | Circlip groove is damaged. |
| 2. | Upper spring | Damaged, dented or seat or protective tube cracked |
| 3. | Dust shield | Distorted or broken spring or otherwise defective |
| 4. | Dust shield | Examine at every POH change if required |
| 5. | Guide ring | Cracked broken or worn |
| 6. | Circlip | Replace if bent or worn-out |
| 7. | Guide bush | Worn out more than 1.2mm in diameter |
| 8. | Lower rubber | Distorted or damaged |
| 9. | Upper rubber | Distorted or damaged washer |

In case of the total diametric clearance is more than 1.6mm between the guide and the lower spring seat based on maximum bore diameter

and minimum bush diameter the component worn out should be replaced.

l) SHOCK ABSORBERS (Except Mark –III)

Hydraulic shock absorbers are set to offer resistance as per following table. Shock absorbers are fitted to work in parallel with axle springs. These shock absorbers normally give trouble-free service and require no attention in between two POHs

| BEML | VENTRA | BHEL | PHOOLTAS | JAMALPUR | |
|---|---|---|---|---|---|
| | | | | Mark-III | Mark-IV |
| 250 kg / 10cm/sec | 275 Kg/ 10cm/sec | 475 kg /10cm/sec | 250 kg /10cm/sec | NA | 250kg/10cm/sec |

However, a shock absorber, which is found either leaking or physically damaged, should be renewed. As the resistance of these shock absorbers is likely to deteriorate in service, it is necessary to attend to them. The shock absorbers can be got overhauled from their respective manufacturers, tested and renewed as and when required.

3.10 ACTION TO BE TAKEN BEFORE REASSEMBLING THE SUSPENSION (Except Mark III)

After attending to the various components as detailed above the suspension may be reassembled taking into consideration the following aspects.

(i) The two wheel and axle sets selected for the 4-Wheeler Tower car should not have variation of more than 13mm on tread diameter
(ii) The two pairs of axle box springs selected for each axle should not vary in their tare height by more than +/-3 mm and their load deflection characteristics should be as per RDSO specification WD-01-HLS (Latest revision/Amendment).
(iii) Packing rings of requisite thickness to be selected for use on lower spring seat for taking up the wheel wear.
(iv) Top and bottom rubber pads on the axle box spring should not be used again if they are not in good condition.

## 3.11 SEQUENCE OF REASSEMBLING THE SUSPENSION (Except Mark –III)

(i) Assemble the roller bearing and axle boxes and ensure that the bearing is effectively secured.
(ii) Smear the honed surface of lower spring seat with roller bearing grease. Place the lower rubber washer on axle box wing and insert the helical spring on the lower springs seats with rubber ring and compensating ring. Wooden packing to be added if required to compensate for wheel wear.
(iii) Insert upper rubber washer, top spring seat, dust shield spring, dust shield, guide ring and guide bush on the axle box guide and lock the bush in the position with circlip.
(iv) Lower the 4-W Tower car body on the wheel and axle sets taking care to ensure that all the 8 guide bushes engage lower spring seat and the body is set evenly on the 4 axle boxes.
(v) Assemble propeller shaft coupling connecting with axle drive.
(vi) Assemble torque arm connecting axle drive with underframe.
(vii) Connect speedometer cable and standstill detector.
(viii) Engage all axle box straps.
(ix) Shock absorbers connecting axle box and underframe to be bolted.
(x) Connect brake tie members and brake block hanger bracket with pins.
(xi) Touch up the paint on the suspension with one coat of anti-corrosive black paint.
(xii) Connect TM cable in case of Diesel Electric Tower Cars.

## 4.0 RUNNING CLEARANCES (Except Mark –III)

After assembling suspension and lowering 4-W Tower car body, the clearances between the 3.2) above & to be maintained accordingly. Suitable packing shall be used to maintain dimension when wooden packing is given on axle box to compensate for wheel wear.

## 5.0 ATTENTION REQUIRED FOR SUSPENSIONS ON OPEN LINES AT DEPOTS.

(i) Lifting the body off the suspension, instruction contained in para 3.1 above should be strictly adhered to while lifting the body off the suspension.
(ii) Sick lines should not try to weld a damaged axle box guide or replace the same. The 4-Wheeler Tower car should be sent to workshops for welding the guide and checking the alignment of guides.

(iii) The instructions contained in Conference Rules, Part IV for the examination of wheel profile, axle should be strictly adhered to. Wheel sets showing biased flange wear, i.e. one flange wearing faster than the other should be with drawn from service and sent to shops for examination and rectification. 4-W Tower car have been provided with 16 tonnes wheel and axle sets, which are marked clearly on the wheels. It is important that these wheels are not mixed up with the 13 tonnes axle wheel assembly, which is used on other stocks.

Note: Max. permissible flat on wheels of these coaches should be limited to 50mm.

(iv) Roller bearing should not be attended to in sicklines. All that would be necessary in service is to feel the axle boxes at train examining stations for any tendencies on their part to get overheated. If any axle box shows a tendency to run hot, the 4-Wheeler Tower car should be sent to shops for attention.

(v) Four bolts securing the rear and front cover of the axle box shall be examined to ensure correct assembly with spring washer and split pins.

(vi) Whenever a spring is to be replaced, it should be ensured that the variation in the height of the spring with respect to the other springs forming the suspension already on the 4-W Tower car should not be more than 6 mm. Difference upto 6mm should be made by insertion of suitable steel packing.

(vii) For this purpose, it is necessary that the sicklines should have an imprest of axle box springs duly tested and certified to conform to the instructions contained in para 3.10).

(viii) If hydraulic shock absorbers used on suspension show any sign oil leakage or other damages, the same should be replaced with shock absorber completely overhauled. For this purpose, tl sicklines should maintain 'imprest' for use as unit chan assemblies. Leaking shock absorbers should be sent to tl workshop for overhauling. The shock absorbers should be check to ensure that the bolts securing it are properly tight and locked.

(ix) The brake blocks should be replaced when worn out to a thickness of 20mm For BEML.

(x) Straps for the axle boxes, should be checked for proper securing arrangement and for adequate running clearances.

(xi) If hard wooden packing are required to be used on lower spring seats for taking up the wheel wear, the packing of proper thickness should be used.

(xii) Under no circumstances wheels, which have reached the condemning limit, indicated by the grooves on the wheel

rims/tyres should be used.

(xiii) Tower car should not be allowed to run in service with a broken axle guide or broken spring. 4-W Tower car should be immediately sent to shops for replacing the broken axle guides or broken springs.

## 6.0 MAINTENANCE OF GUIDE LINES FOR SUSPENSION OF 4 WHEELER TOWER CAR (Mark III)

(a) As Mark III Tower Car is fitted with laminated bearing spring unlike other tower cars. Therefore, the inspection and maintenance of the suspension system should be done as per following procedure.

| S.No. | Description of item | Inspection criteria |
|---|---|---|
| 1 | Shackle | Visually examine the shackle, check the dimension for inner gap 357x62, wear limit is 1 mm for both sides. |
| 2 | Horn cheek | Visually examine the horn cheek. Check the horn gap (285mm). The wear limit of rubbing surface is 1mm. |
| 3 | Shackle pin | Visually examine the shackle pin, check the dia. of pin (Ø 35mm), wear limit is 0.5mm. |
| 4 | Suspension arrangement | The axle box housing clearance from axle guard horn is 10mm at either sides and lateral clearance is 20mm (either side) |

b. LEAF SPRING REPAIR

Following procedure should be adopted for leaf spring repair of Mark - III Tower car.

(i) Physically examine whether any spring plate/buckle and spring clip are broken. The springs are tested by scragging.
(ii) Check camber and free camber whether it is within limits or not.
(iii) If any plate spring clip and buckle is found broken the same is to be replaced.
(iv) If Camber and free camber are not within limits it is to corrected.
(v) The spring is debuckled and is checked by scragging. Then spring is to be buckled. After clipping the spring is to be riveted.
(vi) Load test is to be done.
(vii) The Free camber is 146 +6 mm.

## 7.0 BRAKE GEAR

(i) Maximum radial clearance of 1mm between the brake gear pins and bushes is permitted. If the clearance is more, the worn out part should be replaced and the standard clearance maintained

(ii) Brake block should be replaced when they wear out to the specified thickness. For BEML the thickness is of 20mm.

(iii) An adjusting palm pull rod with holes at regular intervals is provided in the brake rigging to take up slack in the rigging due to wheel wear. Adjustment should be done by relocating the pin in different holes on the palm pull rod.

## 8.0 WIND SCREEN WIPER

(i) Windscreen wipers should be checked for its operation only on the wet windscreen. If wiping is not proper the wiper blade has to be replaced.

(ii) The wiper arm and blade assembly shall be to RDSO Specification No, C-K306 (Latest revision).

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Annexure III

LIST OF THE REFERENCE DRAWINGS

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

1 Drawing no. of M/s BEML's 4 Wheeler Tower Car.

| SN | Description | Drawing no. |
|---|---|---|
| (i) | Powered wheel and axle | BEML drg. No.907-81009 |
| (ii) | Non-powered wheel and axle | BEML drg. No.907-81010 |
| (iii) | Axle box springs | BEML drg. No. 907-81105 |
| (iv) | Guide | 907-81002 |
| (v) | Upper spring | 907-81007 |
| (vi) | Dust shield | 903-81110 |
| (vii) | Dust shield | 411-81114 |
| (viii) | Guide ring | 903-81156 |
| (ix) | Circlip | 411-81160 |
| (x) | Guide bush | 411-81161 |
| (xi) | Lower rubber | 903-81139-P.2 |
| (xii) | Upper rubber | 903-81140 |
| (xiii) | Bearing | SKF no.22328C/C3 |
| (xiv) | Felt | ICF/M/D/SPEC-001 |

2 Drawing no. of M/s Phooltas Harsco Rail Solution Wheeler Tower Car.

| SN | Description | Drawing no. |
|---|---|---|
| (i) | Power pack Arrangement | OHE-4 0200/00 Rev 02 |
| (ii) | Axle Drive Gear Box | OHE-4 01 03/00 Rev.01 |
| (iii) | Torque Arm Assembly | OHE-4 02-05/00 Rev.01 |
| (iv) | Layout of Tower Car | OHE-4 00 02/00 Rev.02 |
| (v) | Axle (Powered) | OHE-4 01 00/02 Rev.01 |
| (vi) | Axle (Non Powered) | OHE-4 01 00/01 Rev. 0 |
| (vii) | Helical Coil Spring | OHE-4 03 01/00 Rev.0 |
| (viii) | Brake Rigging Diagram | OHE-4 07 00/00 Rev.0 |
| (ix) | Wheel & Axle | OHE-4 01 01/00 Rev.0 |
| (x) | Suspension Arrangement | OHE-4 03 00/00 Rev.01 |
| (xi) | Axle Box Guide Arrangement | OHE-4 04 00/00 Rev.01 |

3.0 Drawing no. of M/s Ventra Locomotives Ltd., 4 Wheeler Tower Car

| SN | Description | Drawing no. |
|---|---|---|
| (i) | Axle box assembly drawing no. | ABS 0076 |
| (ii) | Suspension cum axle box guide arrangement | SGM 0090 |
| (iii) | Lower spring seat and Guide | SGP 0532 & 0533 |
| (iv) | Coil spring | SGP 0482 |
| (v) | Brake rigging arrangement | BGM 0132 |
| (vi) | Wheel and axles Powered | WAS 0103 |
| (vii) | Non-powered | WAS 0104 |

4.0 Drawing no. of Jamalpur Workshop's 4-Wheeler Tower Car Mark III

| SN | Description | Drawing no. |
|---|---|---|
| (i) | Suspension arrangement | SKETCH –89068 |
| (ii) | Wheel and axle | JMP drg. No. OHE/M3/RG-02 |
| (iii) | Axle box bearing | No.4000/22 (item 9) |
| (iv) | Axle box Arrangement | 4000/22,4000/23,4000/24 |
| (v) | Laminated bearing spring | SKETCH-89069 |

5.0 Drawing no. of Jamalpur Workshop's 4-Wheeler OHE Car Mark-IV

| SN | Description | Drawing no. |
|---|---|---|
| (i) | Details of running gear arrangement | K1016 |
| (ii) | Running gear arrangement | RDSO/SK-K0042 |
| (iii) | Helical spring | SK-K1016 (item 1) |
| (iv) | Lower rubber washer | EMU/M-0-1-008 |
| (v) | Guide bush | ICF/SK-0-1-182 (item 2) |
| (vi) | Circlip | ICF/SK-0-1-182 (item 3) |
| (vii) | Dust shield | T-0-1-619 |
| (viii) | Dust shield spring | T-0-1-667 |
| (ix) | Upper rubber washer | EMU-0-1-005 |
| (x) | Wheel and axle set powered | SK-K1017 (item 1&2) |
| (xi) | Wheel and axle set non-powered | SK-K1017 (item 1&3) |

## 6.0 Drawing no. of BHEL's 4 Wheeler Tower Car

| SN | Description | Drawing no. |
|---|---|---|
| (i) | Wheel and axle | 1 720 11 03 000 |
| (ii) | Wheel Ø 952 | EMU/M-0-1-027 |
| (iii) | Cartridge bearing | 0 718 88 01 000 |
| (iv) | Axle box guide arrangement | 1 72016 03 001 |
| (v) | Roller bearing | 1 720 16 03 002 |
| (vi) | Lower rubber washer | EMU/M-0-1-008 |
| (vii) | Guide bush | EMU/M-0-1-023 |
| (viii) | Helical spring | 2 720 15 03 001 |
| (ix) | Dust shield | 3 720 16 03 002 |
| (x) | Dust shield spring | T-0-1-012 |
| (xi) | Guide ring | T-0-1-640 |
| (xii) | Rubber packing ring | T-0-1-632 |
| (xiii) | Circlip | 115x4N IS: 3075-86 Part-I |

Annexure-IV

FORMAT FOR SCHEDULE OF STANDARD EXAMINATION OF 4-WHEELER OHE CAR

(Daily Check)

4-WHEELER Tower CAR: Cumulative km.:

Date :

| No. | Details of work to be carried out | Condition/Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | 4 WHEELER TOWER CAR | | | |
| 1.1 | Drain condensate from automatic drain valves of brake system. | | | |
| 1.2 | Drain the moisture manually on daily basis. | | | |
| 1.3 | Check the leakage of air pressure, if any, rectify the same. | | | |
| 1.4 | Check the brake application and relieving before leaving the depot. | | | |
| 1.5 | Check the working of horns during starting. | | | |
| 1.6 | Check the oil level of axle drive, if found less, add upto maximum mark. | | | |
| 1.7 | Check the Transmission oil level in the oil tank , if found less, add upto maximum mark. | | | |
| 1.8 | Ensure correct level of radiator water, lube oil in ADGB & fuel in tanks | | | |

# SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Car body, Under frame, Brake Rigging etc.)

Weekly Schedule

4-WHEELER Tower Car No. Cumulative km.:

Date :

| No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | 4 WHEELER TOWER CAR | | | |
| 1.1 | Repeat all Daily checks | | | |
| 2.0 | Car Body | | | |
| 2.1 | Car body should be washed both from outside and inside. | | | |
| 3.0 | Shell | | | |
| 3.1 | Visually check body panels/ walls for damages. | | | |
| 3.2 | Visually inspect window bars for damage/missing. | | | |
| 3.3 | Examine body side doors for proper working/damages. | | | |
| 3.4 | Inspect door handles for damages/missing. | | | |
| 4.0 | Under frame | | | |
| 4.1 | Check condition of head stock/sole bar/cross members. | | | |
| 4.2 | Inspect brake hanger brackets for damages. | | | |
| 4.3 | Inspect safety brackets for brake hanger pins. | | | |
| 5.0 | Suspension | | | |
| 5.1 | Examine rubber stopper/stop screw of axle box crown for damage/ missing/ looseness. | | | |
| 5.2 | Inspect axle box safety straps/loops for damage/breakage/missing. | | | |
| 5.3 | Visually examine axle box springs for breakage/damage. | | | |

| | | | | |
|---|---|---|---|---|
| 5.4 | Visually examine dashpot oil filling special screw for deficiency. | | | |
| 5.5 | Check oil leakages in dashpot through defective seals/vent screws. | | | |
| 5.6 | Visually examine axle box clearance. | | | |
| 5.7 | Examine vertical shock absorbers for damages. | | | |
| 6.0 | *Brake rigging* | | | |
| 6.1 | Check brake-rigging arrangement for any defects/deficiencies. | | | |
| 6.2 | Examine brake beams breakages/ damages. | | | |
| 6.3 | Check and attend brake beam safety wire ropes/safety straps. | | | |
| 6.4 | Check and attend brake shoe head and key and replace if necessary. | | | |
| 6.5 | Check and replace worn brake blocks. | | | |
| 6.6 | Visually inspect brake hangers, brake gear pins and cotters/split pins and replace if necessary. | | | |
| 6.7 | Visually inspect damaged/ missing brake gear bushes and replace if necessary. | | | |
| 6.8 | Examine lever hanger pins. | | | |
| 7.0 | *Draw gear* | | | |
| 7.1 | Check and replace damaged/ missing split pins/cotter/ rivets. | | | |
| 7.2 | Examine draw hook, draw bars and rubber pads for damages. | | | |
| 7.3 | Check conditions of the screw coupling and its components and replace if required. | | | |
| 7.4 | Check condition of draw beam and locating pins on it. | | | |
| 7.5 | Examine visually draft key locking pins. | | | |
| 8.0 | *Buffing gear* | | | |

| | | | | |
|---|---|---|---|---|
| 8.1 | Visually examine buffer plungers for damage/drooping/stroke length. | | | |
| 8.2 | Examine buffer mounting bolts and attend if necessary. | | | |
| 8.3 | Examine visually buffer casing for cracks/damages. | | | |
| 9.0 | *Running gear* | | | |
| 9.1 | Examine visually axle box for grease oozing out, warm axle box if any. | | | |
| 9.2 | Visually examine wheel tyre profile and thickness of tyre and check with tyre profile gauge if they appear to be near condemning limit. | | | |
| 9.3 | Visually inspect axle box covers. | | | |
| 9.4 | Inspect wheel tread for shattered rim, spread rim, shelled tread, thermal cracks, heat checks. | | | |
| 9.5 | Check the oil level of axle drive, if found less, add upto maximum mark. | | | |
| 10.0 | Seats | | | |
| 10.1 | Examine the holding/securing brackets for seats and attend if necessary. | | | |
| 10.2 | Examine and repair damaged upholstery cushions | | | |
| 10.4 | Seats and frames should be cleaned. | | | |
| 10.5 | Cushion should be cleaned with duster. Oil or head stain and dirty spots if any should be cleaned with mild soap solutions and wipe dry. | | | |
| 11.0 | Doors | | | |
| 11.1 | Examine doors for proper functioning and securing with hinge pivots. Doors should not graze with floor or doorsill | | | |

| | | | | |
|---|---|---|---|---|
| | plates. | | | |
| 11.2 | Examine door locks, latches firmly secured with correct sized screws and properly/ smoothly engaging in their slot. The tongue of gravity type latch should be in proper alignment with its slot plate. | | | |
| 11.3 | Visually examine window shutters for smooth working and proper locking. | | | |
| 12.0 | Windows | | | |
| 12.1 | Check window-balancing mechanism for proper functioning. | | | |
| 12.2 | Examine window safety catches for proper engagement in their slots. | | | |
| 12.3 | Window bars should be provided and fixed in prescribed manner and replaced if damaged. | | | |
| 13.0 | Interior fittings | | | |
| 13.1 | Examine laminated panels and mouldings for damage/cracks. | | | |
| 13.2 | Examine tower bolts of backrests for proper working. | | | |
| 13.3 | Examine ventilation grills for damages. | | | |
| 14.0 | Wash Basin fittings | | | |
| 14.1 | Examine push cock for proper function | | | |
| 14.2 | Check and attend leakage in pipe, pipe fittings. | | | |
| 14.3 | Clean drain grills and drain holes of wash basin if found chocked | | | |
| 14.4 | Check and replace damaged/ missing mirrors / shelves / soap dishes | | | |

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR
(Car body, Under frame, Brake Rigging etc.)

MONTHLY SCHEDULE

4-Wheeler Tower Car No. Cumulative km.:

Date :

| S No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | Repeat all items of Weekly Schedule | | | |
| 2.1 | *Suspension* | | | |
| 2.1.1 | Add specified grade of oil in dashpot. | | | |
| 3.0 | *Brake System* | | | |
| 3.1 | Externally clean the brake system pneumatic pipes and check for leakages. If required tighten the end fittings.<br>Check the mounting fasteners of Air reservoir/ Distributor valve/ relay valve magnet valve and other brake system equipments | | | |
| 3.2 | Check and attend brake block adjuster. | | | |
| 3.3 | Examine and attend brake levers. | | | |
| 3.4 | Examine and attend brake hanger lever brackets. | | | |

SCHEDULE OF STANDARD EXAMINATION OF4 WHEELER TOWER CAR
(Coach body, Under frame, Brake Rigging etc.)

QUARTERLY SCHEDULE

4 WHEELER TOWER Car No. Cumulative km.:

Date :

| S No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | Repeat all items of Monthly Schedule | | | |
| 2.0 | Intensive cleaning of Tower Car | | | |
| 3.0 | Under frame | | | |
| 3.1 | Examine trough floor and other under frame members from underneath for corrosion. | | | |
| 4.0 | *Secondary Suspension* | | | |
| 4.1 | Check Axle Box Crown clearance. | | | |

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR
(Coach body, Under frame, Brake Rigging etc.)
Six Monthly Schedule

4-WHEELER TOWER Car no. Cumulative km.:

Date :

| No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | Repeat all items of Quarterly Schedule | | | |
| 2.0 | Shell | | | |
| 2.1 | Thoroughly clean and remove dust, rust accumulated at underframe and pillars with coir brush and compressed air. | | | |
| 2.2 | Examine for corrosion of sole bar and other under frame members with torch light or inspection lamp. | | | |
| 2.3 | Touch up damaged paint both inside and outside. | | | |
| 2.4 | Check roof ventilator for damages. | | | |
| 3.0 | Suspension | | | |
| 3.1 | Check and attend axle guide assembly if necessary. | | | |
| 3.1.1 | Check axle box clearance with gauge. | | | |
| 4.0 | *Draw gear* | | | |
| 4.1 | Ensure that wear on screw coupling shackle pins, trunion pins, shackle/link holes and draw hook holes should not exceed 3mm. | | | |
| 4.2 | Ensure that wear at any section on draw hook should not exceed 10mm. | | | |
| 5.0 | *Buffing gear* | | | |
| 5.1 | Ensure the length is within 584-635mm. | | | |

| No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 5.2 | Inspect buffer plunger false plate for wear and profile. | | | |
| 6.0 | *Running gear* | | | |
| 6.1 | Check with wheel distance gauge for loose or tight wheel. | | | |
| 7.0 | Flooring | | | |
| 7.1 | Inspect and attend damaged/cracked flooring. | | | |
| 7.2 | Examine and attend opened joints. | | | |
| 7.3 | Examine Drain holes in trough floor for accumulation of water due to clogging if noticed. Inspect affected area for corrosion. | | | |

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

(Coach body, Underframe, Brake rigging etc.)

Yearly Schedule

4 WHEELER TOWER Car no.

Cumulative km.:

Date :

| No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | Repeat all items of Six-monthly Schedule | | | |
| 2.0 | Thorough flushing of water tanks | | | |
| 3.0 | Overhaul all brake equipments, except brake cylinder. | | | |
| 4.0 | Replace rubber kits during yearly repairing of pneumatic valves. | | | |
| 5.0 | Ultrasonic Testing of wheel set. | | | |

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

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

Twenty Four Months

3 WHEELER TOWER Car no.

Cumulative km.:

Date :

| No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | Repeat all items of Yearly Schedule | | | |
| 2.1 | Run out the Wheels/Axles and attend all the items as mentioned in Annexure-II | | | |

SCHEDULE OF STANDARD EXAMINATION OF 4 WHEELER TOWER CAR

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

Thirty six Months

4 WHEELER TOWER Car no.

Cumulative km.:

Date :

| No. | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1.0 | Repeat all items of yearly Schedule | | | |
| 2.0 | Brake | | | |
| 2.1 | Overhaul the safety switch. | | | |
| 2.2 | Clean the chokes, exhaust plugs, mesh filters in the distributor valves and check proper functioning of all sub-assemblies. | | | |
| 2.3 | Overhaul the drivers brake valve. Replace all the rubber items, clean filters. | | | |
| 2.4 | Check for proper functioning of relay valves and replace the damaged/ worn out items. | | | |
| 2.5 | Replace rubber-sealing washer of air brake hose coupling. | | | |
| 2.6 | Check all the hose assemblies of brake system for damage or over ageing replace if required. | | | |
| 2.7 | Remove the brake cylinder and over haul 100% rubber parts replacement. | | | |
| 2.8 | Overhaul all valve magnets, speed cylinders, direction cylinders and gear cylinders by replacing 100% rubber parts. | | | |

SCHEDULE OF STANDARD EXAMINATION OF4 WHEELER TOWER CAR

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

Periodical Overhaul (seventy two months)

5 WHEELER TOWER Car no.

Cumulative km.:

Date:

| SN | Details of work to be carried out | Condition/ Action | Sign. | Remarks |
|---|---|---|---|---|
| 1. | The following sequence of work should be generally followed during POH of Tower Car | | | |
| 2. | Verification of deficiencies. | | | |
| 3. | Pre-inspection and Lifting of Tower Car body | | | |
| 4. | Stripping | | | |
| 5. | Body repair. | | | |
| 6. | Fitting of Water Tank, Plumbing & Leakage testing | | | |
| 7. | Repair of internal panels | | | |
| 8. | Fitment of shutters | | | |
| 9. | Fitment of doors | | | |
| 10. | Fitment of seats | | | |
| 11. | Repair, maintenance & fitment of screw coupling. | | | |
| 12. | Painting and finishing | | | |
| 13. | Repair and maintenance of Axle Box Guide Arrangement as per Annexure II. | | | |
| 14. | Repair and maintenance of brake system including overhauling of Distributor valve. | | | |
| 15. | Repair and maintenance of rolling gear | | | |
| 16 | Lowering of Tower Car body on Wheels/ Axles. | | | |
| 17. | Brake Testing | | | |
| 18. | Testing of branch wiring | | | |

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

ANNEXURE-V

(A) Spares for Carriage

Must change items (with dash pot type of guide arrangement) during POH

| SN | Description | Qty |
|---|---|---|
| 1 | Roller bearing grease | 1.52 to 2.0 kg/ bearing when opened |
| 2 | Locking plat | 4 nos (when opened) |
| 3 | Rubber sealing ring of axle front & rear cover | 4 front, 4 rear (when opened) |
| 4 | Rubber packing arrangement | 8 nos |
| 5 | Guide ring (Acetal) | 8 nos |
| 6 | Guide bush (Acetal) | 8 nos |
| 7 | Circlip for dash pot guide bush | 8 nos |
| 8 | Dash pot oil | 2 lts approx./dash pot |
| 9 | Brake gear bush (as a set) | All |
| 10 | Brake shoe key | 8 nos |
| 11 | Shoe adjuster assembly & nut and bolt with split pin | 8 nos |
| 12 | Brake beam bush collored | 8 nos |
| 13 | All bulb type cotters | All when opened |
| 14 | Sealing washer for air vent screw | 8 nos |
| 15 | Rubber stopper and crown bolt | 4 nos |
| 16 | Air brake house pipes | 2 nos |
| 17 | Dirt collector filters | All |
| 18 | Felt sealing ring (for axle box) | 4 nos |
| 19 | Wiper blades | 4 nos |
| 20 | Lower and upper rubber washers (IRSR-64/98) | 8 lower & 8 upper |

Spares to be kept in the inventory at POH shop/shed.

| SN | Description | Qty |
|---|---|---|
| 1 | Shock absorbers | 2 nos |
| 2 | Suspension springs | 2 nos |
| 3 | Brake blocks | 16 nos |
| 4 | Brake head shoe key | 4 nos |
| 5 | Brake gear pins & bushes | 1 complete set for 1-tower car |
| 6 | Brake beams | 2 nos |
| 7 | Felt sealing rings | 4 nos |

| | | |
|---|---|---|
| 8 | Locking plats | 4 nos |
| 9 | Wipers arm and blade assembly & wiper motor | 2 assemblies |
| 10 | Horns | 2 nos |
| 11 | Upper & lower spring seat | 2 nos each |
| 12 | Flexible hose connection for brake cylinder | 4 nos |
| 13 | Air brake hose assembly | 2 nos |
| 14 | Roller bearing grease | 5 kg approx. |
| 15 | Rubber sealing rings of axle box front and rear cover | 4 nos |
| 16 | Rubber packing rings | 8 nos |
| 17 | Guide ring (Acetal) | 4 nos |
| 18 | Guide bush (Acetal) | 4 nos |
| 19 | Circlip for dash pot guide bush | 4 nos |
| 20 | Dash pot oil | 50 lt approx. |
| 21 | Shoe adjuster assembly | 4 nos |
| 22 | Split pins & cottors | Sufficient |
| 23 | Sealing washers for air vent screw | 8 nos |
| 24 | Rubber stopper and crown bolts | 4 nos |
| 25 | Dirt collector filters | 1 no. each |
| 26 | Buffer bolts | 8 nos |
| 27 | Glass wind screen | 2 nos |
| 28 | Suspension safety straps | 4 nos |
| 29 | Brake beam safety strap/loop | 4 nos |
| 30 | Glass shutters with equalizing device | 2 assemblies |
| 31 | Louver shutters | 2 assemblies |
| 32 | Air brake hose pipe assembly | 2 nos |
| 33 | Isolating and cut off cocks | 1 no. of each type |
| 34 | Fans | 2 nos |
| 35 | Brake cylinders (with its spares like piston packing ring, dust excluders etc) | 2 nos |
| 36 | Brake gear levers | 1 complete set for a Tower car |
| 37 | Lower & upper rubber washer (IRSR-64/98) | 4 lower & 4 upper |
| 38 | Driving axle alongwith axle drive with torque arm for each type of tower Car. | 1No |
| 39 | Non-driving axle for each type of tower Car. | 1No |
| 40 | Valve Magnet –for speed gear and direction. | 04 Nos |
| 41 | A-9 Valve, distributor valve, C3W valve, C2W relay valve | 1 each |

(B) Transmission System

Must change parts for transmission for CRT-5633 ( Avtec)

| S N | PART NO | DESCRIPTION | Qty |
|---|---|---|---|
| Mandatory Changes | | | |
| 1 | 80000561 | Element ( every 250 hours | 2 |
| 2 | Transmission Oil | C4 SAE 30 Transmission Oil ( Every 1000 r hours) | App 55 Litres |
| Overhaul Parts list ( App 8000 Hours ) | | | |
| 1 | 6884505 | SEAL & GASKET KIT | 1 |
| 2 | 9409058 | BOLT | 12 |
| 3 | 23041915 | BEARING ROLLER | 2 |
| 4 | 6838403 | EXT SNAP RING | 1 |
| 5 | 6774184 | INT SNAP RING | 1 |
| 6 | 6703059 | RING,EXT SNAP | 1 |
| 7 | 6774708 | NUT LOCK | 1 |
| 8 | 6758485 | WASHER THRUST | 1 |
| 9 | 6773088 | CUP | 24 |
| 10 | 6770302 | Roller needle | 12 |
| 11 | 6769276 | Spring | 12 |
| 12 | 6770574 | Roller needle | 12 |
| 13 | 6774710 | Plate Stator backing | 1 |
| 14 | 6770578 | Retainer | 2 |
| 15 | 23047054 | Sleeve Converter ground | 1 |
| 16 | 23048010 | Bearing | 1 |
| 17 | 6769319 | Snap ring | 1 |
| 18 | 23048012 | Bearing | 1 |
| 19 | 6882657 | Hose Assy | 1 |
| 20 | 23047967 | Bearing | 1 |
| 21 | 6753304 | Snap ring | 1 |
| 22 | 6750025 | Snap ring | 1 |
| 23 | 6768469 | Thrust Washer | 1 |
| 24 | 23047964 | Bearing | 1 |
| 25 | 6756042 | Belleville Spring | 1 |
| 26 | 6756041 | Snap Ring | 1 |
| 27 | 6884212 | Washer Thrust | 1 |
| 28 | 6880157 | Hose lube feed | 1 |
| 29 | 23045626 | Tube Jumper | 1 |
| 30 | 6754835 | Snap ring | 1 |
| 31 | 6769721 | Ring Compression | 1 |
| 32 | 23018736 | Hub | 1 |
| 33 | 23047970 | Bearing | 2 |
| 34 | 6756338 | Spacer | 1 |

| | | | |
|---|---|---|---|
| 35 | 6753487 | Snap ring | 1 |
| 36 | 23041450 | Bearing | 1 |
| 37 | 8892840 | Snap ring | 1 |
| 38 | 23018418 | Pump Assy | 1 |
| 39 | 6776451 | Screen Assy | 1 |

Recommended spares for each transmission CRT 5633 transmission for 2 years.

| SN | Description | Qty |
|---|---|---|
| 1. | FILTER ELEMENT | 10 |
| 2. | SEAL AND GASKET KIT | 2 |
| 3. | GASKET | 5 |
| 4. | GASKET | 5 |
| 5. | HOSE ASSEMBLY | 2 |
| 6. | Ring external snap | 1 |
| 7. | Turbine | 1 |
| 8. | Nut. Lock | 1 |
| 9. | Washer Thurst | 1 |
| 10. | Race | 1 |
| 11. | Stator | 1 |
| 12. | Cup | 24 |
| 13. | Roller, Needle | 12 |
| 14. | Spring, Needle Roller | 12 |
| 15. | Roller, Stator Freewheel | 12 |
| 16. | Plate, Stator Backing | 1 |
| 17. | Bolt | 12 |
| 18. | Strip, Locking | 6 |
| 19. | Pump, Torque TC 580 | 1 |
| 20. | Bearing, Ball | 1 |
| 21. | Gear, Accessory Drive Inp. | 1 |
| 22. | Washer | 36 |
| 23. | Bolt | 36 |
| 24. | Ground Sleeve | 1 |
| 25. | Bolt | 5 |

(C) Engine:

Must change items for engine NTA-855 of Cummins India Ltd, Pune

| SN | Parts | Qty |
|---|---|---|
| 1. | SHELL,MAIN BEARING | 1 |
| 2. | RING,LINER SEAL | 6 |
| 3. | LINER,CYLINDER | 6 |

| | | |
|---|---|---|
| 4. | SEAL,OIL | 1 |
| 5. | SEAL,OIL | 1 |
| 6. | PICKUP,MAGNETIC | 1 |
| 7. | PISTON & CONN ROD | 6 |
| 8. | VALVE,SOLENDID | 1 |
| 9. | SEAL,O RING | 1 |
| 10. | RING,RETAINING | 1 |
| 11. | VIBRATION DAMPER | 1 |
| 12. | GASKET,CAM FOL HOUSING | 3 |
| 13. | GASKET,CAM FOL HOUSING | 3 |
| 14. | GASKET,CAM FOL HOUSING | 3 |
| 15. | ROD,PUSH | 12 |
| 16. | ROD,PUSH | 6 |
| 17. | CAP,FILLER | 1 |
| 18. | THERMOSTAT | 1 |
| 19. | COOLER LUB OIL | 1 |
| 20. | NOZZLE,PISTON COOLING | 6 |
| 21. | BREATHER,CRANKCASE | 1 |
| 22. | MANIFOLD,EXHAUST | 1 |
| 23. | MANIFOLD,EXHAUST | 1 |
| 24. | MANIFOLD,EXHAUST | 1 |
| 25. | MTG EXHAUST MANIFOLD | 1 |
| 26. | SHIELD,HEAT | 1 |
| 27. | HOSE OIL SUPPY | 1 |
| 28. | INTERCOOLER AIR | 1 |
| 29. | V-BELT | 1 |
| 30. | PICKUP MAGNETIC | 1 |
| 31. | FILTER,LUB OIL | 1 |
| 32. | FILTER,FUEL | 1 |
| 33. | FILTER,OIL BYPASS | 1 |
| 34. | HOSE,FLEXIBLE | 1 |
| 35. | HOSE,FLEXIBLE | 1 |
| 36. | BUSHING | 1 |
| 37. | CLIP | 3 |
| 38. | BLANKET,TURBOCHARGER HEAT | 1 |
| 39. | CONTROL,SAFETY | 1 |
| 40. | SWITCH,PRESSURE | 1 |
| 41. | BUSHING | 1 |
| 42. | SWITCH,PRESSURE | 1 |
| 43. | HOSE,FLEXIBLE | 1 |
| 44. | SENSOR,TEMPERATURE | 2 |
| 45. | SENSOR,PRESSURE | 1 |

| | | |
|---|---|---|
| 46. | V-BELT, RIBBED | 2 |
| 47. | SWITCH,OVERSPEED | 1 |
| 48. | HOSE,FLEXIBLE | 2 |
| 49. | HOSE,FLEXIBLE | 1 |
| 50. | HOSE,FLEXIBLE | 1 |
| 51. | HOSE,FLEXIBLE | 1 |
| 52. | HOSE,FLEXIBLE | 2 |
| 53. | KIT,VENT HOSES | 1 |
| 54. | INHIBITOR,CORROSION | 1 |
| 55. | SWITCH,RELAY | 6 |
| 56. | THERMATIC,VALVE | 1 |
| 57. | KIT, WASHER SEALING | 1 |
| 58. | KIT, WASHER SEALING | 1 |
| 59. | CLAMP,TUBE | 12 |
| 60. | CLAMP,TUBE | 3 |
| 61. | CLAMP,TUBE | 2 |
| 62. | SCREW,HEXAGON HEAD CAP | 24 |
| 63. | WASHER,LOCK | 56 |
| 64. | SCREW,HEXAGON HEAD CAP | 24 |
| 65. | SCREW,HEXAGON HEAD CAP | 16 |
| 66. | SCREW,HEXAGON HEAD CAP | 32 |
| 67. | SCREW,HEXAGON HEAD CAP | 32 |
| 68. | WASHER,LOCK | 80 |
| 69. | HOSE,FLEXIBLE | 2 |
| 70. | SCREW,HEXAGON HEAD CAP | 8 |
| 71. | WASHER,LOCK | 8 |
| 72. | SCREW,HEXAGON HEAD CAP | 4 |
| 73. | WASHER,LOCK | 4 |
| 74. | SCREW,HEXAGON HEAD CAP | 4 |
| 75. | WASHER,LOCK | 40 |
| 76. | SEAL,O RING | 14 |
| 77. | SEAL,O RING | 10 |
| 78. | SEAL,O RING | 16 |
| 79. | SEAL,O RING | 6 |
| 80. | WASHER,LOCK | 40 |
| 81. | INDICATOR,RESTRICTION | 1 |
| 82. | HOSE,ELBOW | 1 |
| 83. | CLAMP,T BOLT | 1 |
| 84. | HOSE,ELBOW | 7 |
| 85. | HOSE,ELBOW | 1 |
| 86. | CLAMP,T BOLT | 13 |
| 87. | CLAMP,T BOLT | 6 |

| | | |
|---|---|---|
| 88. | CLAMP,T BOLT | 2 |
| 89. | HOSE,HUMP | 1 |

Recommended spare of engine for six months

| SN | Description | Qty |
|---|---|---|
| 1. | Seal oil Acc Drive | 1 |
| 2. | Oil seal | 1 |
| 3. | Heat shield cover | 1 |
| 4. | Valve solenoid | 1 |
| 5. | Switch pressure | 1 |
| 6. | Switch temperature | 1 |
| 7. | Thermostat | 1 |
| 8. | Gauge oil level | 1 |
| 9. | Cap filter | 1 |
| 10. | Hose oil supply | 1 |
| 11. | Clip | 2 |
| 12. | Switch magnetic | 1 |
| 13. | Switch pressure | 1 |
| 14. | Wiring harness | 2 |
| 15. | Hose assembly | 1 |
| 16. | Sender | 2 |
| 17. | Transducer pressure | 2 |
| 18. | Hose flexible | 1 |
| 19. | Probe | 1 |
| 20. | Ammeter | 1 |
| 21. | Gauge water | 1 |
| 22. | Gauge lub. Oil | 2 |
| 23. | LO pressure gauge | 2 |
| 24. | Techno meter | 1 |
| 25. | Gauge Lub. Oil | 1 |
| 26. | Gauge water | 1 |
| 27. | Hose flexible | 2 |
| 28. | Hose assy | 1 |
| 29. | Hose assy. | 1 |
| 30. | Elbow | 12 |
| 31. | Hose assy. | 1 |
| 32. | Vaccum indicator | 1 |
| 33. | Elbow | 1 |
| 34. | Hose Air Cleaner | 2 |
| 35. | Elbow Hose | 1 |
| 36. | Clamp T.bolt | 1 |
| 37. | Clamp T.bolt | 2 |
| 38. | Hose hump | 2 |
| 39. | Clamp T.bolt | 2 |
| 40. | Hose Elbow | 2 |
| 41. | Clamp T.bolt | 4 |
| 42. | Clamp T.bolt | 1 |
| 43. | Kit Hyd.Filter & hoses | 1 |
| 44. | Ket Hyd. Hoses | 1 |

| | | |
|---|---|---|
| 45. | B Check ket (AR3238018) | 10 |
| 46. | Assy. Rotor screen | 2 |
| 47. | Gasket Rkr Hsg | 3 |
| 48. | O Ring Injector body | 6 |
| 49. | O Ring Injector body | 12 |
| 50. | Gasket breather cover | 4 |
| 51. | Element inner | 3 |
| 52. | Element outer | 3 |
| 53. | Belt WTR Pump | 1 |
| 54. | Belt alt. Fan (178473) | 1 |
| 55. | Coil assy.(3054610) | 1 |
| 56. | Total | |

Requirement of oil and lubricant for tower Car.

| SN | Description | Qty |
|---|---|---|
| 1 | Lube oil | 3 Litrs |
| 2 | Hydraulic drive for radiator | 54 Litrs |
| 3 | Transmission CRT-5633 (V) | 40 Litrs |
| 4 | Axle drive gear box | 25 Ltrs |
| 5 | Axle box | 2 Kg. |
| 6 | Cardan shaft | 100 gms |
| 7 | Brake rigging | As required |

(D) Recommended spares for 3-years normal maintenance for Traction Motor

| SN | Description | Qty |
|---|---|---|
| 1 | Axle BRG lubricator assembly | 4 |
| 2 | Half wiper of felt ASSY.COM | 4 |
| 3 | Brush holder complete (RH) | 6 |
| 4 | Brush holder complete (LH) | 6 |
| 5 | Cable bush PE side | 4 |
| 6 | Cable bush PE side CE side | 4 |
| 7 | Bellows | 2 |
| 8 | Rubber sandwitch unit | 2 |
| 9 | Carbon brush | 64 |
| 10 | Control gear equipment 72V | 01 |
| 11 | Magnet valve complete with coil | 01 |
| 12 | Contact for EP contactor | 01 |
| 13 | ARC box for EP contactor | 01 |
| 14 | Fixed contactor for master controller | 09 |

(E) Recommended spares for 3-years normal maintenance for lighting circuit

| | | |
|---|---|---|
| 1 | Twin beam Sealed assembly | 01 |
| 2 | Lamp holder for cab and hood light | 05 |
| 3 | Push button with element | 02 |
| 4 | Hood light switches | 10 |
| 5 | Head light switch | 01 |
| 6 | LED type flasher lamps | 01 |
| 7 | LED type marker lamps | 01 |

(F) Recommended spares for 3-years normal maintenance of traction alternator

| SN | DESCRIPTION | PART NO | UNIT |
|---|---|---|---|
| 1 | Wound stator frame | T9501 | 1 No |
| 2 | Wound main rotor | T9502 | 1 No |
| 3 | Wound exciter armature | T9503 | 1No |
| 4 | Wound exciter field | T9504 | 1No |
| 5 | Machined shaft with keys | T9505 | 1No |
| 6 | Aluminum fan | T9506 | 1No |
| 7 | Coupling hub | T9507 | 1No |
| 8 | Balancing disc | T9508 | 1No |
| 9 | Diode disc assembly | T9509 | 1No |
| 10 | Rotating diode 130A, 1600V (F) | T9510 | 3Nos |
| 11 | Rotating diode 130 A, 1600V (R) | T9511 | 3Nos |
| 12 | MOV (250V/14) | T9512 | 1No |
| 13 | NDE bracket | T9513 | 1No |
| 14 | DE bracket | T9514 | 1No |
| 15 | Bearing hub | T9515 | 1No |
| 16 | Outer bearing cap | T9516 | 1No |
| 17 | Inner bearing cap | T9517 | 1No |
| 18 | Stationary ring (grease) | T9518 | 1No |
| 19 | Mobile ring (grease) | T9519 | 1No |
| 20 | CGS plate | T9520 | 2No |
| 21 | Side cover with filter | T9521 | 2No |
| 22 | Top cover with filter | T9522 | 1No |
| 23 | Front cover | T9523 | 1No |
| 24 | Rear cover | T9524 | 1No |
| 25 | NDE cover | T9525 | 1No |
| 26 | DE cover with grid | T9526 | 1No |
| 27 | Tinned copper busbar (N) | T9527 | 1No |
| 28 | Tinned copper busbar (U) | T9528 | 1No |
| 29 | Tinned copper busbar (V) | T9529 | 1No |
| 30 | Tinned copper busbar (W) | T9530 | 1No |
| 31 | Deep groove ball bearing (6317/C3) | T9531 | 1No |
| 32 | Molded Insulator (10/36) | T9532 | 17No |
| 33 | Supporting clamp | T9533 | 2No |
| 34 | Flex plate 1.2mm Thick (SAE 0) | T9534 | 6No |

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