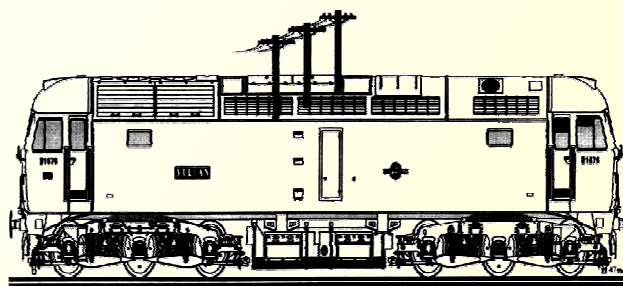




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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS



HANDBOOK ON GENERAL MAINTENANCE SCHEDULE FOR 8 WHEELER DIESEL HYDRAULIC TOWER WAGON

CAMTECH\2003\E\8-TW\1.0

MARCH 2003

**Centre
for
Advanced
Maintenance
TECHnology**



Maharajpur, GWALIOR - 474 020

FOREWORD

Indian Railways uses large number of Tower wagons for maintenance of overhead equipment in electrified section. The proper maintenance of tower wagon is vital to ensure its availability and reliability.

CAMTECH has prepared this handbook to cover all essential aspects of tower wagon maintenance.

This handbook describes various maintenance schedules and trouble shooting instructions. It also covers operating instructions for OHE car driver.

I am sure the book will prove to be very useful to our field personnel to carry out their work more effectively and efficiently.

CAMTECH, GWALIOR
Date: 14th March, 2003

C.B.MIDDHA
EXECUTIVE DIRECTOR

PREFACE

Tower Wagon is an important vehicle for regular inspection and attending breakdown of O.H.E. Therefore proper maintenance of tower wagon is necessary to ensure the reliability and availability of tower wagon in emergency and for regular maintenance of OHE. This handbook on "General Maintenance Schedule for 8 Wheeler Tower Wagon" has been prepared by CAMTECH with the objective of making our maintenance personnel aware to correct maintenance and maintenance techniques adopted in field

It is clarified that this handbook does not supersede any provisions laid down by RDSO or Railway Board and it is not a statutory document.

I am sincerely thankful to Director(TI)/RDSO/LKO for his valuable suggestions and comments. I am also thankful to all field personnel who helped us in preparing this handbook.

Technological upgradation and learning is a continuous process. Hence feel free to write to us for any addition/ modification in this handbook. We shall highly appreciate your contribution in this direction.

***CAMTECH, GWALIOR
DATE: 14th March, 2003
DIRECTOR/ELECTRICAL***

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ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

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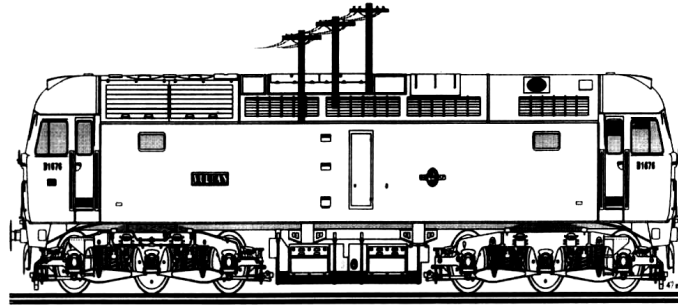
Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

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CHAPTER 1

INTRODUCTION



8 Wheeler Tower Wagon is self propelled 4 axle vehicle used for periodical inspection, patrolling and maintenance of traction over head equipment. It is also used for attending break- downs, restoration of damaged OHE etc. It is also required to erect small length of catenary and contact wires.

It is powered by 2 x 285 HP underslung, horizontal engines. Hydraulic transmission and final drive units are employed to provide high and smooth acceleration. Safety devices of electrical and electro-pneumatic control system is provided to protect the engine and transmission from operational hazards. The OHE car include a roof top elevating platform, engine cooling system, air brake system and driving cabs at both ends. Elevating platform with swivelling capability of 90 degree on each side provides access to the OHE.

The satisfactory up keep of tower wagon is of utmost importance. It is the direct responsibility of tower wagon in charge to ensure that the tower wagon is maintained satisfactorily and is available always for attending OHE maintenance and for use in the event of OHE breakdown.

This handbook is meant for OHE staff and deals with only those aspects of maintenance, which are required to be carried out by OHE depot staff. Maintenance details given in this handbook are generally pertaining to 8 wheeler diesel hydraulic tower wagons manufactured by M/s SAN Engg. & Locomotive Co. Ltd., Bangalore.

POH facilities are not available in OHE depots and therefore POH of complete tower wagon including engine, running gear arrangement, brake system, wheel and axle, roller bearing, pneumatic system, lifting and swiveling platform, hydraulic transmission, axle drive, bogie, electrical equipment and all under frame equipment shall be carried out at an interval of three years in an EMU shop/ Electric Loco shed/ Electric Loco workshop as decided by CEE. This handbook does not include details of work to be carried during POH of tower wagon. Similarly work to be carried out by TXR examination as per IRCA Part IV is not included in this handbook. Frequency of TXR examination to be decided by the Owning Railway on the basis of utilisation of Tower Wagon but should not be more than one month. This handbook is intended for the staff of OHE depots only.

1.1 SALIENT FEATURES OF 8 Wheeler OHE car

S.No	Name	Specification/ Description
1.	Type	8 Wheeler OHE car.
2.	Specification	RDSO's specification No. ETI/OHE/59/(7/93)
3.	Layout diagram	M/s ICF's Drg. No. DHTC-9-0-001 Rev.'E'
4.	Type of bogie	All coil ICF bogie
5.	Track Gauge	1676 mm Gauge (B.G.)
6.	Service	a) Periodical inspection traction patrolling and maintenance of OHE. b) Attending to site of break down and restoration of damaged OHE. c) Erection of small length of OHE.
7.	Engine	NT 855 R of Cummins India Ltd, Pune.
8.	Transmission	SAN CRTUP 102 (using HM CRT5633)
9.	Coupling	Kussel 3 K 045152 1121.
10.	Carden shaft	
10.1	Transmission to final drive	
	Kussel Part No.	P0013-1367.1094.1065
	San Part No.	12301770
10.2	Engine to transmission	
	Kussel Part No.	P0011-4369.1085.0540
	San Part No.	12301560
11.	Axle drive	SAN (Gear Ratio 3.824:1)
12.	Axle capacity	20 T
13.	Brake System	Compressed air brakes of RPIL, Hosur, Drg. No. 35819100. Alt. Nil
14.	Suspension	Two stage helical springs with shock absorber
15.	Wheel tread diameter	952 mm (New)
16.	Number of axles	Four (Two powered and two non powered)
17.	Axle box bearing	FAG 22928 self aligning roller type
18.	Draw and buffer gears	Draw gear arrangement to RDSO Sk. No. 79061, Side buffer arrangement to RDSO Sk. No. 79046 and screw coupling arrangement to RDSO Sk. No. 79067 as per IRS R-10.

S.No	Name	Specification/ Description
19.	Flooring	3 mm thick aluminum chequered plate on 12 thick approved quality plywood over the corrugated floor.
20.	Thermal insulation	25 to 50 thick glass wool (side wall, end wall and roof)
21.	Paneling	
	1. Roof	a) 1 mm thick IS:1079-1988, MS plates b) 1.5 mm thick natural fiber composite material with thermoset resin to RDSO specification No. C-9511.
	2. Side wall and partitions	a) 1.0 & 1.6 mm, IS:1079-1988, MS plate b) 3 mm L.P. sheet to RDSO Spec. C-8625
22.	Max. operating speed	110 kmph
23.	Alternator	24V/30A- Lucas TVS make 110/4.5 KW, KEL make
24.	Generator set	230 V single Phase, 2.1/2.4 KVA of Shriram Honda
25.	Lifting and swivelling platform	Model: TPS-01, to drg. No. J-15/96-00-00, Alt : nil, Make : M/s Bemco
26.	Pantograph	Type: AM 12 of M/s Stone India, to Drg. No. 22110201 with foot insulators and actuating mechanism
27.	Tare weight	56.8 tonnes
28.	OHE sensing device (make)	Rail Power, UK

CHAPTER 2

TECHNICAL DETAILS

2.1 ENGINE

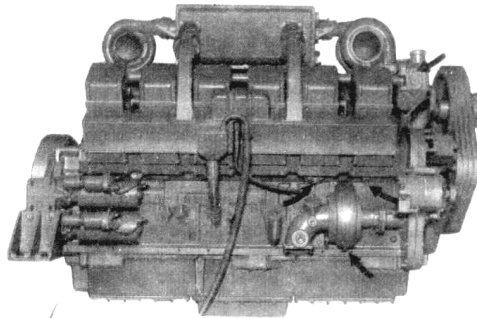


FIGURE 2.1

Engine and Cooling System

DIESEL ENGINE

Type	NT 855 R of Cummins India Ltd, 6 cylinder, 4 stroke, Turbocharged, horizontal, inline & water cooled.
Bore & Stroke	142 mm x 152mm
Power	285 hp @ 2100 rpm
Idle rpm	700 rpm
Rating	Continuous
Compression Ratio	14.1 : 1
The engine is supplied with engine mounted compressor (13.2 cfm @ 7kg/sqcm) driven by engine. The air inlet is from intake manifold of engine.	
Cooling	Cooling system is roof-mounted radiator with hydrostatic fan drives.

2.2 TRANSMISSION

Transmission is used for transmit the power from engine to wheel through carden shaft and axle drive

Make/Type

Hindustan motors, model CRTUP102. It is modified version of CRT 5633, with TC 580 torque converter and planetary type gear box .

Max. input power 320 kw (430 hp)
 Max. input torque 900 lb-ft (1220 N-m)
 Output rpm
 (at Max. input power) 2290
 Gear ratios FWD 3.040:1, 1.510:1, 0.760:1
 REV 3.162:1, 1.570:1, 0.790:1

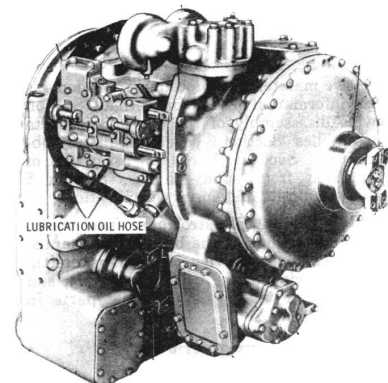
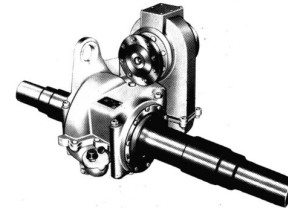


FIGURE 2.2
TRANSMISSION

2.3 AXLE DRIVE

Technical Details

Make	:	M/s. SAN
Model	:	2625
Reduction Ratio	:	3:824:1
Weight of axle drive with axle and wheel including oil	:	2350 kg.
Sump capacity	:	App. 32 ltr
Type of oil	:	EP 90 or HP 90



**FIGURE 2.3
AXLE DRIVE**

2.4 LIFTING AND SWIVELLING PLATFORM

Technical specification for Hydraulic lifting & swivelling platforms

1.	Make	M/s BEMCO JACKS
2.	Lifting platform model	TPS-01
3.	Lifting platform assy. Drg. No.	J-15/96-00-00
4.	Cylinder unit Assy. Drg. No.	J-15/96-03-00/R1
5.	SAN Engg. References drg. No.	35812012
6.	Lifting capacity	0.5T uniformly distributed
7.	Total collapsed height of platform from coach floor	2955mm
8.	Max. platform height from coach floor	4955mm
9.	Height of collapsible railings	800mm
10.	Working platform (basket) size (lxb)	5700mm x 1500mm
11.	Max overhang from centre line	4200 mm
12.	Size of outer tele structure (boom)	350mm square
13.	Rotation of platform	$\pm 90^\circ$
14.	Motor for swivelling	0.37 kW(0.5 HP), 750 rpm 3 phase, 50HZ, 440V
15.	Lifting time to max. height	45 sec.
16.	Swivel time from 0° to $\pm 90^\circ$	18 sec.
17.	Lifting boom arrangement	2 stage telescopic

2.5 CARDEN SHAFT AND FLEXIBLE COUPLING

Carden Shaft

Carden shaft is used between engine and transmission and between transmission and final drive.

Flexible coupling is connects engine flywheel & transmission through carden shaft.

1	Manufacturer	M/s Kusel Antriebe, Germany
2	Max. torque (T Kmax)	6300 Nm
3	Dynamic torsional strength (T Dyn)	9433 Nm/rad
4	Share hardness	50°
5	Mating carden shaft	SAN code No. 12301240 (Kusel - make)
5.1	Flange diameter	180 mm
5.2	No. of Holes	8
5.3	Pitch circle dia	155.5 mm
5.4	Hole diameter	14 C 12mm
5.5	Pilot bore diameter	110mm
6	Fly wheel butting surface	
6.1	Outer diameter	466.725mm
6.2	No. of holes	8
6.3	Pitch circle dia	438.2± 0.2
6.4	Hole diameter	14mm
7	Width	89mm
8	Qty per powerpack	1 No
9	Weight	31.7 Kgs

2.6 BATTERY

- I. 3 x 8V, 290 AH
- II. 110 V, 120 AH

2.7 ALTERNATOR

- I. 24 Volt, 30 Amp.
- II. 110 Volt, 4.5 kW.

2.8 GENERATOR

8 KVA, 415 Volt, 3 Phase, 50 Hz.

CHAPTER 3

MAINTENANCE OF ENGINE

‘A’ CHECK EVERY DAY

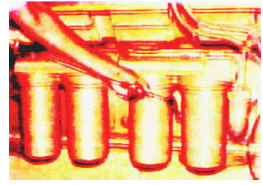
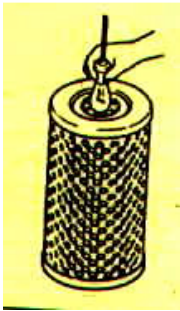
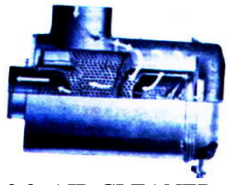
S. No	Maintenance Steps	Remarks
1.	Check previous day's engine logbook.	Correct as required.
2.	Drain water and sediment from fuel filter through drain cock.	Before starting the engine.
3.	Check engine oil level and top up if necessary.	 <p>Must be slightly less than or equal to 'H' mark on dip stick when engine is stopped and has stood for 20 minutes or more (must be measured after all oil is drained back into oil pan).</p>
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 overheating of the coolant. Check engine radiator water level.
6.	Check air cleaner oil level and change oil, if required (If oil bath type). Clean dustpan and pre-cleaner of dry type air cleaner.	Use clean engine oil.
7.	Check airline connections 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 then close the drain cock.	
10.	Clean crankcase 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)


FIGURE 3.1 CHECKING OF OIL LEVEL




S. No	Maintenance Steps	Remarks
12.	Start the engine and note the oil pressure both at idling and maximum speed.	If there is a change in oil pressure from that recorded in the log book on earlier occasion then stop engine and check through trouble shooting technique the cause for oil pressure change and correct if necessary (for assistance in diagnosing the change in oil pressure call your service representative if necessary.
13.	Record oil pressure.	Refer operation and maintenance manual for lub 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 end of the day allowing diesel to settle. Drain sediment from fuel filter water separator bowl.

‘B’ CHECK EVERY 300 HOURS or 6 MONTHS WHICH EVER IS EARLIER

S.No	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.
4.	<p>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.</p>  <p>FIG. 3.3 ELEMENT CHECKING WITH ELECTRIC BULB</p>	<p>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.</p>  <p>FIG. 3.2 AIR CLEANER</p> <p>Caution : Excess air pressure will damage paper. Air nozzle must be kept at least 20.32 cm from the element. Must not be used if even one pin hole exists. Discard element if punctured and also change gasket along with element.</p>

S. No	Maintenance Steps	Remarks
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.	(i) Check coolant PH value/ concentration of DCA/chromate concentration (3500 PPM). (ii) Borex base CAC used as coolant- (a) Check coolant for CAC with test strip. Add CAC if PH value less than 0.6. (b) (i) If coolant is pink, the PH is within limit (8.5 – 10.0) (ii) If colourless, add CAC to maintain concentration.	Change corrosion resistor element if PH value is below normal range 8.5 – 10.5. . Check chromate concentration at 3500 PPM.
9.	Check magnesium plate in assembly corrosion resistor. Change water filter element.	Check magnesium plate for pitting or being eaten away. Change if more than 50% of area is lost. Use DCA service element or chromate element bags AR 95679 if concentration is low.
10.	Change fuel filter element washer and 'O' ring on mounting bolt.	Clean shell fuel filter. Change element when restriction exceeds vacuum 8" of mercury.
11.	Check oil in aneroid control, If equipped.	Use same oil as used in oil pan.
12.	Check and adjust belts. New belts will stretch within one hour of use. They must be readjusted.	Tighten belt tension (use ST – 1293)  FIG. 3.4 CHECK BELT TENSION
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.	-----

‘C’ CHECK EVERY 1500 HOURS or 1 YEAR WHICH EVER IS EARLIER

S.No	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of checks ‘A’ & ‘B’.	----
2.	Check thermostat operation.	It should start opening and open fully within range 73.9°C and 79.5°C or 76.6°C and 85° C. Discard and fit new thermostat if operation is not satisfactory.
3.	Check fan hub and drive.	Check mounting bolts and 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.
7.	Check inlet air restriction.	Check after cleaning dry type air cleaner element . If restriction 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.	Readings 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.(Reverse flushing operation)
16.	Check air compressor	Check shaft and clearance.
17.	Adjust injectors and valves. 	Clean fuel inlet connection screens. Final adjustments must be carried out with engine hot and with correct torque as specified (Refer O & M manual).
18.	Change hydraulic governor oil/aneroid oil.	Use engine lubricating oil.

S.No	Maintenance Steps	Remarks
19.	Check vibration damper.	Check wobble and eccentricity/alignment marks on rubber type. Discard damper if misalignment is more than .16 cm.

‘D’ CHECK EVERY 6000 HOURS or 2 YEARS WHICH EVER IS EARLIER

S.No	Maintenance Steps	Remarks
1.	Repeat all maintenance steps of checks ‘A’, ‘B’ & ‘C’.	--
2.	Check exhaust and inlet manifold nuts and capscrews.	--
3.	Tighten all mounting bolts and nuts.	--
4.	Clean turbocharger diffuser and impeller and check end float.	--
5.	Check turbocharger bearing clearances.	Only end float on semi floating bearing if in excess of limits, replace it.
6.	Check crankshaft end float.	If in excess of recommended limits, corrective action is indicated.
7.	Clean injector inlet screens	Must be done only if a performance deterioration is evident. Some of the indications for performance deterioration are. 1. Black smoke. 2. Change in fuel manifold pressure. 3. Loss of power. 4. Malfunction of aneroid. 5. Clean and calibrate all injectors. 6. Check fuel pump calibration. 7. Replace aneroid bellows and calibrate
11.	Replace fuel pump filter screen and magnet.	--
12.	Steam clean engine.	If steam is not available, then use clean soap water solution as outlined in ‘C’ check item – 11.

‘E’ CHECK -

Overhauling Of Engine After Two 'D' Check.

CHAPTER 4

MAINTENANCE OF TRANSMISSION

4.1 INTRODUCTION

Basically the transmission model CRTUP 102 is a modified model of CRT 5633 of M/s Allison transmission. The output shaft drives a bi-direction secondary pump through gears to lubricate the transmission while towing. The secondary pump, in normal operation, (that is when engine is running) sucks the oil from sump and delivers back to sump. Further when engine is not working and car is in motion, the oil is diverted for lubrication of transmission. This is achieved by means of hydraulic valve which is mounted on the transmission.

The following daily checks to be done before starting the tower wagon

i. 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.

ii. 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. Oil level with dip stick is also to be checked.

iii. Hot Oil 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. Oil level with dipstick is also to be checked.

4.2 OIL 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.

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.

Filling Transmission

At temperature above -23.4°C, pour hydraulic transmission fluid type C-4 into filler opening. At temperature below -23.4°C, an auxiliary preheat is required to raise the temperature in the sump. Use only C-2 fluids from approved manufacturers.

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.

4.3 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.

4.4 MAINTENANCE OF CARDEN SHAFT

1. Observe the performance of coupling for smooth engagement.
2. If necessary, dismantle the coupling & physically check the components for any damage.
3. Tighten the bolts evenly with suitable spanner till the surfaces butt each other.
4. Check the torque tightening values.
5. Release completely the bolt connection. Check the surface for deformations. If the contact surface of the bolts heads are found to be in order, tighten the bolts finally.

CHAPTER 5

MAINTENANCE OF AXLE DRIVE

MAINTENANCE

a.	Daily	Check oil level with dipstick. The oil level must be between the maximum and minimum limits marks on the dipstick. The oil level to be topped up if necessary.
b.	Weekly	Clean the Axle drives to check for any leakage from the pipe joints and other places and correct them.
c.	Monthly (15000 Kms which ever is earlier)	Tighten all the fasteners (external) including the fasteners for carden shafts, torque arm and if there is any excessive loosening, investigate for the reason. Clean the breather and refit. Test the oil sample for impurities. If water is found mixed with oil, drain the oil, drain the oil completely and charge it with fresh oil.
d.	Half yearly for (approximately 90000 Kms which ever is earlier)	Change the oil.
e.	Three years or (app. 3,00,000 Kms whichever is earlier)	Remove the final drivers from the car disassemble the gears, shafts & sub-assys. Inspect the gears and bearing. The defective components must be replaced before re-assembly.

CHAPTER 6

MAINTENANCE OF LIFTING AND SWIVELING PLATFORM

6.1 INTRODUCTION

Lifting and swiveling platform measuring with in the permissible limits is mounted on the one end of the roof for raising its height and rotating it by 90° on both side. The arrangement is such that when the maintenance staff has to work near the structure , the platform can be rotated so that it reaches the structure and facilitates the working of the staff. Similarly height of the platform can be adjusted to suit the working spot on overhead equipment.

6.2 OPERATING PROCEDURE

1. Switch on the isolator switch on main control panel fixed on the outer boom. "Mains On" lamp blows. Lock the door of the control panel when platform is to be operated from top the working platform.
2. Enter on to the platform and pull up each segment of telescopic railing till you hear the clicking of the locking pin.
3. Take push button pendent out of storage case below platform and hook on to the railing at convenient place.
4. Press 'CONTROLS ON' push button to energise control circuit.
5. Press 'UP' button for going up. Solenoid gets energised. Keep the button pressed till the required height it reached. When the push button is released the lifting stops and so does the motor and pump.
6. To swivel the platform to the right or left side, press 'RIGHT' or 'LEFT' button respectively. When basket rotates to about 90⁰ the limit switch gets actuated and rotation stops automatically. From this position basket can be rotated only in opposite direction by pressing the other slewing button.
7. To come down, press 'DOWN' button. The pump continues to operate to open the pilot operated check valve till button is released.
8. In case platform motion continues even after releasing any button, press the 'EMERGENCY STOP' button.
9. To operate platform again, release the Emergency stop button by turning it. Press 'CONTROLS ON' button to start next operation.

Emergency Lowering

In case the platform does not come down in spite of pressing 'DOWN' button due to any reason, such as power failure, fault in the hydraulic or electrical circuit etc. proceed as follows:

- (a) Open the shut-off valve fitted between the cylinder outlet and hand pump.
- (b) Open the release valve on hand-pump. Oil from the cylinder returns back to reservoir through hand pump while ram lowers by gravity.

Emergency Lifting

- (a) Open the shut-off valve fitted between the cylinder outlet and hand-pump.
- (b) Close release valve on the hand pump.
- (c) Operate the hand-pump. Ram moves up very slowly to raise the platform in loaded condition as well.

Emergency Swivelling

In case there is any fault in the system when platform is raised and swivelled out, proceed as follows :

- (a) Lower the platform (as explained above) such that the pinion fitted on the gear box comes within the reach of the person standing on the roof.
- (b) Unscrew hex bolt and grub screw fitted with pinion assembly. Remove the pinion from gear box shaft.
- (c) Now the platform is free to rotate in any direction. Manually rotate the working platform to normal position.
- (d) Lower it completely to bring to its normal retracted position.

Preventive Maintenance

Routine preventive maintenance of various components is mandatory in order to ensure safety of the equipment and people working on and around it. The following guide lines if followed properly will go a long way in keeping the equipment defect free. A proper log of maintenance carried out must be kept.

6.3 MAINTENANCE SCHEDULE

Sr. No.	Nature of work	Frequency
1	Check hydraulic oil level and top up if necessary. Use recommended oil only.	Weekly
2	Clean the suction strainer if the equipment is in regular use.	Quarterly
3	Replace suction strainer.	Yearly
4	Clean return line filter element if in regular use.	Quarterly
5	Replace return line filter element.	Yearly
6	Drain oil tank, clean it and change oil.	Yearly
7	Apply grease on all Nylon pads.	Weekly

Sr. No.	Nature of work	Frequency
8	Apply grease on gear & pinion after cleaning the teeth and surface.	Weekly
9	Lubricate bearing housing.	Monthly
10	Check oil level in gear box. Top up if required.	Weekly
11	Check and tighten if necessary all holding bolts of outer telescopic structure, cylinder flange, tilting head, gear ring, pinion, bearing housing, gear box, slewing motor, bearing housing supports etc.	Monthly
12	Clean telescopic railing square pipes and apply light film of grease/oil for smooth up and down motion. Also check railing locking arrangement for smooth functioning. Oil if necessary.	Monthly
13	Check electrical cable insulation.	Monthly
14	In case OHE car is not in use for long time, check platform for all operations ten times.	Weekly
15	Replace seals of hydraulic cylinder.	2 Years
16	Replace guiding pads between telescopic structures.	2 Years

Major Overhaul

Replacing guiding pads between telescopic structures and replacing seals of hydraulic cylinder constitute a part of major overhaul. This can be carried out only in an engineering work shop having overhead crane facility.

CHAPTER 7

MAINTENANCE OF PANTOGRAPH

Pantograph is similar to that used for AC loco .It is mounted on the centre line along the roof of the tower wagon at the other end. The height of the panto is adjusted suitably to meet the requirement of overhead equipment

On panto pan the marking of stagger is done which facilitates recording of the stagger

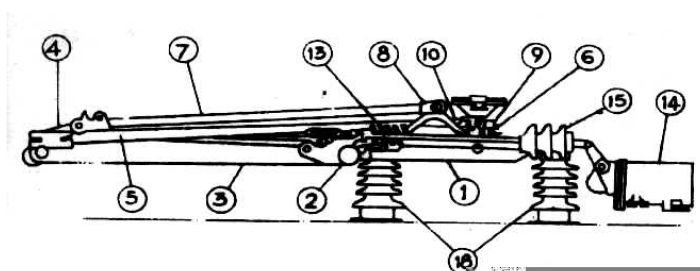


FIGURE 7.1 PANTOGRAPH LOWERED CONDITION

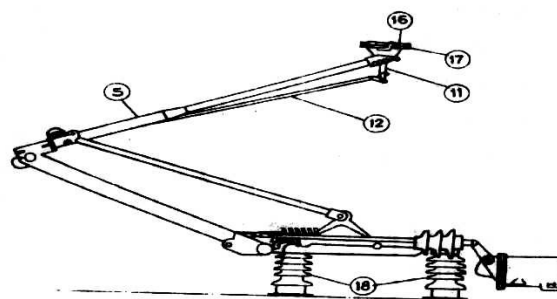


FIGURE 7.2 PANTOGRAPH RAISED CONDITION

Details of figure 7.1 and 7.2

S.No.	Details	S.No.	Details
1.	Base	10.	Joint of upper tube
2.	Horizontal Spindle	11.	Spring Box
3.	Lower Arm	12.	Positioning Link
4.	Yoke	13.	Lifting Spring
5.	Tube	14.	Servo Motor
6.	Upper Tube	15.	Tie rod insulator horn
7.	Thrust Rod	16.	Collector
8.	Pivot point	17.	Insulated Horn
9.	Transverse Tube	18.	Support Insulator

7.1 FORTNIGHTLY INSPECTION SCHEDULE

(After the tower wagon is brought under isolated section of OHE, the following parts should be checked.

7.1.1 Pan

Clean and check for copper deposition, grooves or any other abnormality. Renew the grease if necessary.

7.1.2 Insulators

Check for cracks and flash marks, clean.

7.1.3 Main Springs

Check for breakage.

7.1.4 Raising and Lowering

Check the raising and lowering of pantograph. It should gradually rise and slow down before touching the contact wire and should not rebound. While towering, it should be fast in the beginning and slow down as it reaches the collapsed position.

7.1.5 Verify that there is no foreign material on pantograph.

7.2 IA SCHEDULE

7.2.1 Wearing Strips

Remove excess grease and any particle of copper. Check for any groove on the surface or breakage. The permissible depth of groove is 1 mm. If it exceeds, replace the strips, check whether the strip fixing screws are projecting beyond the strip surface. Tighten loose screws. It must be verified that no screw is missing. Measure the thickness of strip, if it below 3.5mm replace the strip. Check the strip for sharp edges and projecting particles round the edges with a file, if strip has to be replaced, use correct material, as per specification.

7.2.2. Copper Shunts

Check for damage or loose connection. Replace if necessary, While replacing a shunt, care should be taken that in the bimetallic plate, aluminium touches the aluminium alloy part and copper side touches the shunt. Contact surface of aluminium alloy must be rubbed clean with a metallic brush and then covered with conducting grease or natural vaseline mixed with zinc powder.

7.2.3 Main Springs

Visual checking for cracks etc.

7.2.4 Plungers

Check the bow plunger for free sliding while pressing. In case of jamming, loosen the sleeves fixing the spring boxes and turn them round their vertical axis until jamming is removed. For a weight of 7 kg. on collector the collar must come down by at least 10mm.

7.2.5 Insulators

Clean the foot insulators and operating rod insulator with spirit and wipe by dry cloth. Check the insulator and arc horns for flashes and verify that the setting of arc horns is at 200mm.

7.2.6 Roof Bars

Check for breakage, loose connection etc. special care must be taken with aluminium bars.

7.2.7 Lubrication

Check the graphite grease on the pan. If it is burnt, blackened or hardened, remove the grease and apply new grease (the quantity of grease required is 750 grams per pan on a modified pan to pan assembly). Otherwise, add a small quantity of grease and wipe the surface by a straight edge touching the strip and the edge of the grease supporting plate, thus forming a triangular section of the grease.

7.2.8 Raising and Lowering Times

After supplying the graphite grease check the raising and lowering time of pantograph. The time to reach a height of 1.5 metres from the moment the pantograph is fed with compressed air must be between 6 and 10 seconds. The lowering time from the moment the pantograph operating valve is de-energised till the pantograph rests on its stops must be less than 10 seconds. The raising and lowering times can be adjusted by the throttle valve.

7.3 IB SCHEDULE

The works carried out in IA Schedule should be repeated in IB Schedule. In addition, the following works should be carried out.

7.3.1 Pan

Oil the spring boxes of pan and check the tension of springs.

7.3.2 Nuts and bolts

Check and tighten all nuts and bolts.

7.4 IC SCHEDULE

The work carried out in IB Schedule should be repeated in IC Schedule. In addition, the following works should be done.

7.4.1 Mechanical Parts

Verify operation. Check visually the frame for distortion or any other damage.

7.4.2 Throttle Valve

Check the working, Clean and lubricate with vaseline.

7.4.3 Servomotor

If servomotor is giving abnormal sound during operation, drain the cylinder by unscrewing the cap of drain plug. Check for air leakage.

7.4.4 Lubrication

Lubricate all articulation pin bearing and plungers.

7.4.5 Pan

Check for uniform wear of strip and horizontality of pan.

7.4.6 Contact Pressure

The thrust exerted upwards by pantograph on the contact wire must be checked, after greasing the pan, by hanging a weight of 7 kg on the head and varying the height up to 2 metres. The thrust must be uniform. If the pressure exerted is above or below the limit, it can be adjusted by releasing or tensioning the main spring with the adjusting screw.

7.5 AOH SCHEDULE

All the works in IC to be repeated. The following are the additional works.

7.5.1 Servomotor

Overhaul and lubricate the cylinder walls by Alvania 3 grease. Check the piston packing for wear and damage. Measure the diameter of cylinder. The maximum diameter allowed is 205mm.

7.5.2 Lubrication

Clean the pin bearings and lubricate. Lubricate the ball bearings and articulations of thrust rod by Alvania 3 grease. The ball bearings I and II are not equipped with greasing nipples, so take off the cover and renew the grease.

7.5.3 Isolating Cocks

Operate all isolating cocks by hand and put back to the previous position.

7.5.4 Frame

Carry out the check for bent or distorted pan, frame etc.

7.5.5 End Strips

Check for wear. The minimum thickness required is 2.5mm. If there are grooves deeper than 2mm replace the strips.

7.5.6 Horns

Check for cracks etc.

7.6 OVERHAUL DURING IOH/ POH

During the overhaul the pantograph must be removed from the O.H.E.Car.

7.6.1 Bearings

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

7.6.2 Mechanical Parts

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

7.6.3 Throttle Valve

Dismantle and overhaul the throttle valve.

7.6.4 Painting

Scrape the old paint. Clean the surface and apply battle ship grey paint.

(a) Horizontality of pan:

If the thickness of strip differs by more than one mm at both the ends the horizontality of pan arms must be checked by a spirit level. The pan must remain horizontal when it is raised up to the full height of 1.5 metres. If the strip is having increased wear only on a particular portion of its length due to bent or distorted pins, it may be removed from pantograph, straightened and checked by jig.

While changing the strip, it may be checked whether the cross members of pan have bent. This can be done by placing a straight edge across the wearing strips and moving it along the whole length of the pan observing whether the straight edge is touching both strips over the entire width.

(b) Transverse Flexibility

Raise the pantograph to a height of 1.5 metres. Arrange to pull the pan transversely at the middle cross member with a force of 50 kg. Weight as checked by a spring balance or by a system of weight suspended on the rope passing over a pulley. The displacement of pan at the middle cross member should be $36 \pm 5\text{mm}$.

(c) Jigs and Fixtures

During overhauling and after repair the connecting tubes of pantograph must be checked by jigs. A rod of 25mm diameter passing freely through the guide holes and bearing housing ensures that there is no bending inside the bearing housing. The upper articulation tubes passing freely through the grooves indicate that there is no checking the condition of cross member.

Sitting of pantograph on four bolts indicates that the base is alright. The distortion of pan and vertical raising can be checked by the rod which fixed to the frame. The stand can be used as a support during repair of spring etc.

7.7 PERIODICITY OF SCHEDULES

Fortnightly Schedule	15 days
IA Schedule	45 days
IB Schedule	90 days
IC Schedule	135 days
AOH	18 months
IOH	4 ½ years
POH	9 years

CHAPTER 8

MAINTENANCE OF ELECTRICAL SYSTEM

8.1 ELECTRICAL ITEMS (OTHER THAN BATTERIES)

8.1.1 Trip Schedule

Condition - Diesel Engine Running **General Examination**

- a. Check for high temperature, unusual sound and odour of the following:
 - Alternator
 - Lube oil pump
 - Engine tachometer
 - Starting equipment
- b. Ensure the working of hour meter and battery charging:

Condition - Diesel Engine Stopped

General Examination

Make visual examination of junction boxes, distributors, electrical control equipment and instruction for dirt, flashover, overheating, loose covers and screws, leads and wiring connections for tightness, presence of moisture and incipient damage due to rubbing and other defects.

Lights

Check operation of:

- a. Head and buffer lights
- b. Cab lights
- c. Gauge lights
- d. Warning and indicating lights
- e. Inspection lights
- f. Dimmer lights
- g. Flasher lights

8.1.2 Fortnightly Schedule

Condition - Diesel Engine Stopped

- Check insulation resistance of reversible protected type plugs and ensure for earthing.
- Check the condition and ensure proper working of all relays, pressure and tumbler switches, rectifiers and contactors etc. Adjust if required.
- Clean and inspect contacts of engine starting press keys.

8.1.3 Monthly Schedule

Condition - Diesel Engine Stopped

- Open cabinet doors of pneumatic and electrical control and blow out with clean and dry compressed air. Ensure that the equipment is dry and clean.
- Check starter motor, alternator and engine tachometer. Blow off dirt with compressed air. Inspect carbon brushes, holders and commutators. Check brush pigtail.

8.1.4 Quarterly Schedule

Condition - Diesel Engine Running

- Check and adjust alternator
- Check engine tachometer with a master tachometer for correct and accurate operation.

Condition Diesel Stopped

- Check the complete circuit and wiring and rectify as required.
- The alternator and self starter may be removed and inspected, connections checked and their working may also be checked.

8.1.5 Half Yearly Schedule

Condition - Diesel Engine Stopped

Remove and repair alternator if condition warrants.

8.1.6 Yearly Schedule

Condition - Diesel Engine Stopped

Remove and overhaul the following electrical machines

- Self starter
- Alternator
- Engine tachometer generator

CHAPTER 9

MAINTENANCE OF BATTERY

Maintenance of battery can be divided into two schedules

1. Weekly Schedule
2. Monthly Schedule

i. Weekly Schedule

- Check the level of electrolyte in all the cells and top up distilled water if necessary.
- Check the specific gravity and voltage of 4-pilot cells.
- Check the inter cell connection for looseness and crack in container. Rectify if necessary.
- Check the tap of cells and arrange for cleaning of dust etc by wet cloth.
- In case of sulphation of terminals remove the connections, clean, put back and apply petroleum jelly.

ii. Monthly Schedule

In addition to the weekly schedule following are also to be attended.

- Check specific gravity and voltage of all cells.
- Remove inter cell connections, take out the cells, clean thoroughly the cells, inter cell and end cell connections and fit back in the TW. Apply petroleum jelly.
- Check vent plugs. Provide ceramic vent plug if not provided. Tighten if necessary and replace if missing.
- Check the cells by cell tester. Replace defective cells.

Hydrometer Reading And Battery Condition

Hydrometer reading Correct at 27° C	Battery Condition
1.250 ± 0.005	Fully Charged
1.170 ± 0.005	75 % Charged
1.120 ± 0.005	50 % charged
1.100 or below	must be recharged

CHAPTER 10

MAINTENANCE OF BRAKE SYSTEM

10.1 TESTING OF THE AIR BRAKE SYSTEM

10.1.1 Preparation of OHE Car to Ensure Proper Function of The Air Brake.

- i. Ensure that all the cut-off cocks (C.O.C.) are open.
- ii. Ensure cut off angle cock at either ends are closed and hose coupling ends kept with dummy.
- iii. Check for free handle movement of all driver's brake valves and place their handle in release position.
- iv. Drain cocks of after-cooler, main reservoir, Aux. Reservoir, J-filter and centrifugal dirt collector present in the pneumatic system are kept in closed position, after a few operations, in order to drain the condensate.
- v. Keep the dead man's pedal in pressed condition.
- vi. Maintain the required gap between the brake block and wheel tread on all the wheels. Adjust the slag adjuster if necessary to achieve the required gap.
- vii. Non-operative control stand.
 - a. Place Driver's brake valve isolating C.O.C. in closed position.
 - b. Parking brake application C.O.C. in closed position.
- viii. Operative control stand
 - a. Driver's brake valve isolating C.O.C. in open position.
 - b. Parking brake application C.O.C. in open position.

10.1.2 Air Brake Charging System

10.1.2.1 Reservoir Charging Time

Close brake pipe charging C.O.C. Isolate electro pneumatic compressor governor. Start the engine. Move throttle handle to full throttle position and note the following.

Test Result	Specified
Time required for MR pressure built up from 0 to 8 kg/cm ² =	6 minutes.

10.1.2.2 Compressor Governor Setting

Bring the engine to idle condition. Reduce the MR pressure by opening the MR2 drain cock upto 6 kg/cm^2 . To check compressor governor setting EPG should be in 'ON' position.

Now allow the MR pressure to rise and note down the pressure at which the compressor cuts out. At the same time also note the automatic drain valve opening time. As compressor is in unloading condition, MR pressure will start to drop. Note the pressure at which compressor is again loaded.

Test Result		Specified
a. Compressor cut out	-	$8.0 \pm 0.1 \text{ kg/cm}^2$
b. Compressor cut in	-	$7.0 \pm 0.1 \text{ kg/cm}^2$
c. Autodrain valve opening time-		6-9 sec.

10.1.2.3 J-1 Safety Valve

Check the working of J-1 safety valve with engine running at higher throttle position. Isolate EPG compressor governor. Note the pressure at which safety valve blows and closes.

Test result	
a. Safety valve blow at	$8.5 \pm 0.1 \text{ kg/cm}^2$
b. Safety valve close at	7.5 to 7.8 kg/cm^2

10.1.3 Air Brake System Leakage Test

10.1.3.1 MR Line Leakage Test

- Bring EPG in 'ON' position.
- Maintain MR pressure at 6 kg/cm^2 . Stop the engine and note pressure drop in MR pressure gauge for a period of 5 minutes.

Test result	Specified
Maximum permissible drop in MR pressure in 5 min	- 0.7 kg/cm^2 .

10.1.3.2 BC Line Leakage Test

- Charge the system fully.
- Move SA—9 independent brake valve handle to application position. Adjust the knob of the SA-9 brake valve to get brake cylinder pressure 1.5 kg/cm^2 max.
- Close cut off cocks provided on port no. 5 of A-9 and port no. 30 of SA-9 in operative cab.
- Note pressure drop in BC gauge for 5 minutes.

Test result	Specified
Maximum permissible drop in 5 minutes	- 0.7 kg/cm^2 .

10.1.3.3 B.P. Line Leakage Test

- Open brake pipe charging C.O.C. provided between BP charging C2 relay valve and brake pipe. Charge the system fully. Allow sufficient time to charge the distributor valve control reservoir.
- Now make 0.6 kg/cm^2 reduction in BP pressure by partially applying A9 auto brake valve. Close BP charging C.O.C. and note pressure drop in BP pressure gauge for 5 minutes.

Test result

Specified

- a. Pressure drop in BP pressure in 5 minutes - 0.7 kg/cm^2 .

10.1.3.4 Check Valve Test

- Charge the system and then shut down the engine. Close cut off cock provided just after the MR-2.
- Drain MR-1 and note the pressure drop in MR pressure gauge to be provided in drain hole of MR-2.

Test result

Specified

- Maximum permissible MR pressure drop in 5 min. - 0.4 kg/cm^2 .

10.1.4 Setting of N-1 Reducing Valve

10.1.4.1 N-1 Reducing Valve Provided Between MR2 & Aux. Reservoir.

The reducing valve should be set at $6 \pm 1 \text{ kg/cm}^2$ and the pressure will be checked on the gauge to be provided in drain hole of aux. Reservoir.

10.1.4.2 N-1 Reducing Valve Provided in Distributor Valve Delivery Line

Apply full brake through A-9 auto brake valve and note that the BC pressure should not increased from $1.5 \pm 0.1 \text{ kg/cm}^2$.

10.1.5 SA-9 Independent Brake Valve Test

- Bringing the engine to idle condition, check SA-9 for gradual application and release with handle movement.
- Move the handle of the SA-9 independent brake valve to full application position in operative cab.
- Record max. BC pressure and time taken for BC pressure to built up.
- Move handle of the SA-9 to release position and note time taken for the drop in BC pressure.

Test result		Specified
a. Max. BC pressure	-	$1.5 \pm 0.1 \text{ kg/cm}^2$
b. BC pressure development time (0 to 1.5 kg/cm^2)-		4-6 seconds
c. BC pressure drop time (1.5 to 0.0 kg/cm^2)	-	10-15 seconds

10.1.6 A-9 Automatic Brake Valve Test

- Keeping the brake valve handle in release position note that the brake pipe (BP) pressure rises to and remain steady at $5.0 \pm 0.1 \text{ kg/cm}^2$.
- Move A-9 automatic brake valve handle quickly from release to emergency position. Check that BP pressure falls to zero within 1 to 2 seconds.
- Move A-9 brake valve handle to release position.

10.1.6.1 Full Service Application

- Move the handle of the automatic brake valve to full application position.
- Record BP pressure drop, time taken in drop, BC developed and time for BC pressure development.

Test result		Specified
a. BP stabilising pressure	-	3.2 to 3.4 kg/cm^2 .
b. Time for BP pressure stabilising	-	3-5 seconds.
c. Time for BC development (from 0 to 1.5 kg/cm^2)-		4-6 seconds.
d. Max. BC pressure	-	$1.5 \pm 0.1 \text{ kg/cm}^2$.

Release from full service application

- Move the handle of A-9 in release position and record the following

Test result		Specified
a. Time for BP to charge upto 5.0 kg/cm^2	-	2-4 seconds
b. Time for BC pressure to drop from 1.5 to 0 kg/cm^2 -		10-15 seconds.

10.1.6.2 Emergency Application

- Make emergency application by A-9 automatic brake valve and note the following:

Test result		Specified
a. Time for BP pressure to drop from 5.0 kg/cm^2 to zero	-	1 to 2 seconds.
b. Time for BC pressure to built 0 to $1.5 \pm 0.1 \text{ kg/cm}^2$	-	4-6 seconds.
c. Max. BC pressure	-	$1.5 \pm 0.1 \text{ kg/cm}^2$

- Move A-9 brake valve to release position and note:

Test result		Specified
a. Time for BP charging upto 5.0 kg/cm ²	-	3-6 seconds.
b. Time for BC pressure to drop to zero	-	15-20 seconds.

10.1.7 Distribution Valve Testing

- Set N-1 reducing valve provided in BC line to 3.8 ± 0.1 kg/cm² (Temporary)

10.1.7.1 Proportionality of C3W Distributor Valve (DV)

- Move handle of A-9 auto brake valve from release to application and then to release position and note the BC pressure correspondent to BP pressure in steps.

Test results

BP pressure in kg/cm ²	Brake Cylinder Pressure in kg/cm ²	
	Application	Release
5.0		
4.5		
4.0		
3.5		

10.1.7.2 Leakage in Control Reservoir of DV

- Move A-9 automatic brake valve handle to emergency position. Note BC (3.8 ± 0.1 kg/cm² temporarily). Observe for drop in BC pressure gauge for 10 minutes.

Test result	Specified
▪ Permissible max. drop in BC pressure gauge in 10 minutes	- 0.0 kg/cm ²
▪ Re-set N-1 reducing valve to 1.5 ± 0.1 kg/cm ²	

10.1.8 Emergency Brake Valve Test

- Placing A-9 auto brake valve in release position charge the system and run the engine at higher throttle position.
- Move the operating lever of emergency brake valve to open position quickly and record the following parameters.

Test result	Specified
a. Time for BP for pressure to drop from 5 to 2.5 kg/cm ²	- 2-4 seconds
b. Time for BC pressure to built from 0 to 1.5 ± 0.1 kg/cm ²	- 4-6 seconds.
c. Max. BC pressure	- 1.5 ± 1.0 kg/cm ²

10.1.9 Parking Brake Valve

- Close parking brake circuit C.O.C. in operative cab.
- Brake should apply on 4 wheels where the brake cylinder is connected to the spring brake chamber. There should be no pressure built up in the BC pressure gauge.
- Open the cut off cock of the parking brake circuit in the operative cab.
- Brake should release on all the wheels. Ensure that the brake blocks are free from the wheel tread.
- Record the cut in and out pressure for parking brake indication lamp.

Test result		Specified
▪ Cut in	—	4 kg/cm ²
▪ Cut out	—	5.5 kg/cm ²
▪ Again close cut off cock of the parking brake in operative cab.		
▪ Pull the lever on the quick release mechanism, the brake should release on all wheels. Ensure that brake blocks are free from the wheel tread.		

10.1.10 Deadman's Feature Test

- Placing A-9 & SA-9 brake valve handle in release position charge the system.
- Release the deadman's pedal. Brake should get applied and power should come to idle.
- Press the deadman's pedal brake should get released.

10.1.11 Power Cut Off Test

- Ensure that engine comes to idle on application of brake through A-9 SA-9 & emergency brake valve.

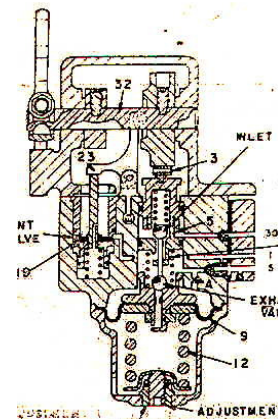
Test result	Specified
Power should come to idle at	0.7 kg/cm ² BC pressure.

- All the tests should be conducted by making one cab operative another non-operative and vice-versa.

10.2 MAINTENANCE OF IMPORTANT VALVES

10.2.1 A-9 Automatic Brake Valve

The A-9 automatic brake valve is a compact self-lapping, pressure maintaining brake valve which is capable of graduating the application or release of OHE car air brakes. It has five positions, namely release, minimum reduction, full service, over reduction and emergency.



10.2.1.1 Maintenance Schedule

Monthly Schedule

- Check for leak tightness at inlet ,outlet and exhaust port on the pipe bracket.
- Check the operating handle movement ; it should be free of undue resistance.
- The pressure setting must be checked and reset, if necessary.
- Check the five position movement of the handle and the pressure in each position.
- Check the emergency position repeatedly for complete and instant operation.

Half yearly schedule

- The A-9 automatic brake valve should be dismantled from the OHE car cabin and overhauled as per procedure.

Yearly schedule

- Replace all rubber components, in addition to overhauling.

10.2.2 SA-9 Independent Brake Valve

The SA-9 independent brake valve is a compact, self-lapping pressure maintaining straight air brake valve which performs the function of graduating the application or release of the OHE CAR air brakes.

10.2.2.1 Maintenance Schedule

Monthly Schedule

- Check the operating handle movement; it should be smooth and without any undue resistance.
- The pressure setting must be checked and reset, if necessary.
- Check the two position movement of the handle.
- Check for air pressure leakage in the valve.

Half yearly schedule

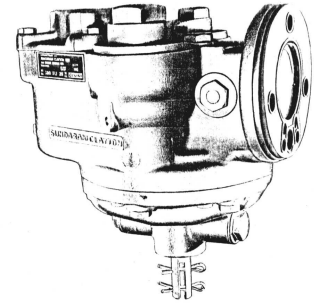
- The SA-9 independent brake valve should be dismantled from the OHE CAR and overhauled as per procedure.

Yearly Schedule

- Replace all rubber components, if found damaged in addition to overhauling.

10.2.3 C3W Distributor Valve

The C3W distributor valve is a diaphragm operated, self-lapping valve that functions to supply and exhaust compressed air in proportion to the control air pressure in the signal port.



10.2.3.1 Maintenance Schedule

Monthly Schedule

- Test the sensitivity of the relay valve functioning for the changes in control, by checking the delivery pressure for different control pressures.
- Ensure that there is no leakage in the valve.

Half Yearly Schedule

- The C3W distributor valve should be dismantled from the OHE CAR and overhauled as per procedure

Yearly Schedule

- Replace all rubber components, if found damaged in addition to overhauling.

10.2.4 D-1 Auto Drain Valve

The D-1 automatic drain valve automatically discharges condensate and moisture from a reservoir with each opening cycle of the compressor control device.

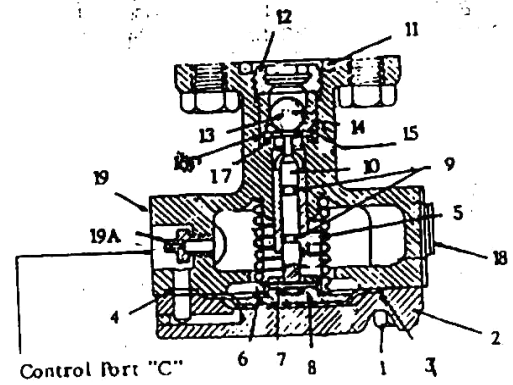


FIGURE-1

10.2.4.1 Maintenance Schedule

Monthly Schedule

- No separate maintenance schedule is required to check the performance of the valve. However, the valve can be actuated manually by pressing the manual over-ride feature provided on the magnet valve for compressor governing pressure switch.

Half Yearly Schedule

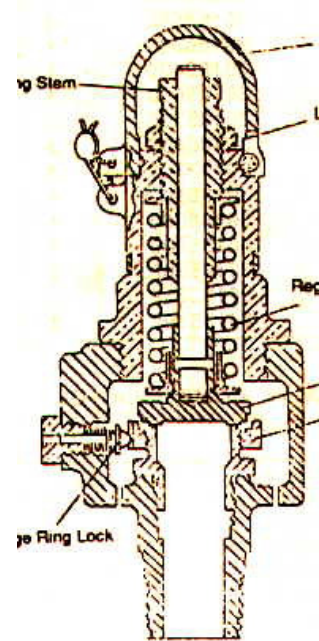
- The D-1 auto drain valve should be dismantled from the OHE CAR and overhauled as per procedure

Yearly Schedule

- Replace all rubber components, in addition to overhauling.

10.2.5 J-1 Safety Valve

The J-1 safety valve, when properly installed in the main reservoir piping, functions to prevent the excessive build up of main reservoir pressure by venting the excess pressure to atmosphere as soon as the pressure reaches the predetermined setting.



10.2.5.1 Maintenance Schedule

Monthly Schedule

- Check the leakage in the safety valve.
- Check the set-up pressure and if necessary re-adjust the pressure setting.

Half Yearly Schedule

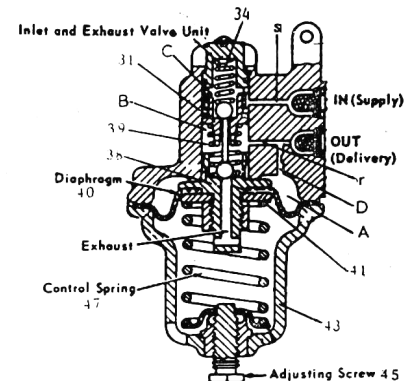
- The J-1 safety valve should be dismantled from the OHE CAR and overhauled as per procedure.

Yearly Schedule

- Replace all rubber components, in addition to overhauling.

10.2.6 N-1 Reducing Valve

- The N-1 reducing valve is a small capacity, self-lapping diaphragm operated type regulating valve and functions to reduce an air supply pressure, to that of a lower delivery pressure.



10.2.6.1 Maintenance Schedule

Monthly Schedule

- There is no specific maintenance procedure called to ensure the proper functioning of this valve, other ensuring whether the maximum brake cylinder pressure limited to whatever level set on the N-1 reducing valve.

Half Yearly Schedule

- The N-1 reducing valve should be dismantled from OHE CAR and overhauled as per procedure

Yearly Schedule

- Replace all rubber components in addition overhauling.

10.2.7 Double Check Valve

It is a simple device with three port and very few components in the assembly. When two independent signal pressures are required to actuate the same control port of another device one a time, double check valve is used.

10.2.7.1 Maintenance schedule

Monthly schedule

With the system fully charged, move the handle of SA-9 independent brake valve to minimum service position and allow the brake cylinder pressure to stabilise. Then make a full service application with the graduated hand control valve and observe that the brake cylinder pressure increase to whatever is allowed by the later. Release brakes at the graduated hand control valve fully. The brake cylinder pressure will drop down and again stabilise at the value corresponding to the pressure due to the minimum service position of the independent brake valve. Move the independent brake valve handle to release position and observe that the brake cylinder pressure reduces to zero completely.

Half yearly schedule

The double check valve should be dismantled from the OHE car and overhauled as per procedure

Yearly schedule

Replace all rubber components, in addition to overhauling.

CHAPTER 11

TROUBLE SHOOTING

11.1 TROUBLE SHOOTING OF DIESEL ENGINE

11.1.1 *Hard starting or failure to start*

- Improper use of starter aid/air temperature
- Out of fuel or fuel shut off closed
- Poor quality of fuel / grade fuel
- Air leaks in suction lines
- Restricted fuel lines
- Broke fuel pump drive shaft
- Scored gear pump or worn gears
- Cracked injector body or cup
- Water in fuel and/or waxing
- AFC calibration incorrect
- Long idle periods
- Gasket blow by or leakage
- Valve leakage / adjustment bad
- Broken or worn piston rings
- Engine due for overhaul
- Incorrect valve and injection timing.

11.1.2 *Engine Misses*

- Poor quality of fuel / grade fuel
- Air leaks in suction lines
- Restricted fuel lines
- Plugged injector spray holes
- Cracked injector body or cup
- Damaged injector O-ring
- Water in fuel water/or waxing
- Injector flow incorrect
- Long idle periods
- Gasket blow -by or leakage
- Valve leakage / adjustment bad
- Broken or worn piston rings
- Injectors valve and injection timing

11.1.3 Excessive black smoke at ideal

- Struck drain valve
- Restricted fuel lines
- Plugged injector spray holes
- Wrong injector cups
- Cracked injector body or cup
- Faulty cylinder oil control
- Long idle periods
- Gasket blow by or leakage
- Broken or worn piston rings
- Worn or scored liners or pistons
- Broken/bent push rod or cam box

11.1.4 Low power or loss of power

- Restricted air intake
- High exhaust back pressure
- Thin air in hot weather or high attitude
- Air leaks between cleaner and engine
- Dirty turbocharger compressor
- Poor quality of fuel / grade fuel
- Air leaks in suction lines
- Restricted fuel lines
- Plugged injector spray holes
- Scored gear pump or worn gears
- Wrong injector cups
- Cracked injector body or cup
- Damaged injector O-ring
- Throttle linkage or adjustment
- High speed Governor set too low
- AFC calibration incorrect
- Fuel pump calibration incorrect
- Injector flow incorrect
- AFC air leak, bellows
- Oil level too high
- Dirty filters/screens/breather
- Long idle periods

- Engine overloaded
- Gasket blow by or leakage
- Valve leakage / adjustment bad
- Broken or worn piston rings
- Incorrect bearing clearance
- Engine due for overhaul
- Incorrect valve and injection timing
- Worn or scored liners or pistons
- Injectors need adjustment

11.1.5 *Low air output*

- Restricted air intake
- Thin air in hot weather or high attitude
- Air leaks between cleaner and engine
- Dirty turbocharger compressor

11.1.6 *Low oil pressure*

- External and internal oil leaks
- Dirty oil filter
- Clogged oil drillings
- Oil suction line restriction
- Faulty oil pressure regulator
- Crankcase low or out of oil
- Wrong grade oil for weather conditions

11.1.7 *Coolant temperature too low*

- Faulty thermostats
- Coolant temperature low
- Long idle periods

11.1.8 *Coolant temperature too high*

- Crank case low or out of oil
- Insufficient coolant/worn pump
- Faulty thermostats
- Damaged hose/loose belts
- Exterior leaks/air in system
- Low coolant capacity/dirty radiator
- Engine exterior dirty

11.1.9 Oil temperature too high

- Crank case low or out of oil
- Oil level too high
- Insufficient coolant/worn pump
- Faulty thermostats
- Damaged hose/loose belts
- Clogged oil cooler or water passages
- Exterior leaks/air in system
- Low coolant capacity/dirty radiator
- Engine exterior dirty

11.2 TROUBLE SHOOTING OF TRANSMISSION

TROUBLE SHOOTING FOR CRT 5633

S.No	CAUSE	REMEDY
I. LOW CONVERTER OUT PRESSURE		
1	Low oil level	Add oil to proper level
2	Oil line leakage	Check for leaks
3	Clogged oil strainer	Clean oil strainer
4	Defective oil pump	Rebuild oil pump assembly
5	Aerated oil	Leaks in suction passages
II. HIGH OIL TEMPERATURE		
1	Low Or High Oil Level	Restore oil to proper level
2	Low Coolant Level	Add coolant. Check for leaks
3	Low Convertor out pressure	Refer "A"
4	Cooler line kinked or clogged	Clean or replace cooler lines
5	Operating in too high for eqpt. Speed	Downshift to lower range
6	Torque convertor starter locked	Check converter components
7	Engine overheating	Refer engine manual
III. HIGH STALL SPEED		
1	Oil level low	Add oil to proper level
2	Low conv. Out pressure	Refer to "A"
3	High oil temperature	Refer to "B"
4	Clutch slipping	Overhaul transmission
IV. LOW STALL SPEED		
1	Low engine output	Refer engine manual
2	Broken convertor parts	Replace convertor assembly
3	Stator reversed or rollers	Assembly stator correctly

S.No	CAUSE	REMEDY
V. LOSS OF TORQUE AT TRANSMISSION OUTPUT		
1	Stator reversed or rollers not installed	Assemble stator correctly
2	Low conv. Out pressure	Refer to "A"
3	Low engine power	Refer to "D"
4	Clutch slippage	Refer to "G"
5	Linkage not adjusted installed.	Adjust linkage
VI. NO POWER AT TRANSMISSION OUTPUT		
1	Linkage Not Adjusted	Adjust linkage
2	Low Clutch Pressure	Refer to "G"
3	Mechanical Failure	Overhaul transmission
VII. LOW CLUTCH PRESSURE		
1	Low oil level	Add oil to proper level
2	Aerated oil	Refer to "A-5"
3	Oil leakage	Check for leakage
4	Main pressure regulator valve defective	Overhaul valve assembly
5	Defective oil pump assy.	Rebuild oil pump assembly
6	Linkage not adjusted	Adjust linkage
VIII. NO POWER TRANSMITTED IN ONE GEAR RANGE		
1	Range clutch failed	Overhaul transmission
IX. HIGH CONVERTOR OUT PRESSURE		
1	Restricted cooler line	Check cooler circuit for blockage
2	Lubrication regulator valve sticking	Inspect valve components correct fault
X. VEHICLE OPERATES IN LOW RANGE FORWARD OR REVERSE BUT STALLS IN OTHER RANGES		
1.	Failed low range clutch	Overhaul transmission
XI. VEHICLE OPERATED IN INTERMEDIATE RANGE FORWARD OR REVERSE BUT STALLS IN OTHER RANGES.		
1.	Failed int. range clutch	Overhaul transmission
XII. VEHICLE OPERATES IN HIGH RANGE FORWARD OR REVERSE BUT STALLS IN OTHER RANGES		
1.	Failed high range clutch	Overhaul transmission
XIV. VEHICLE OPERATES IN FORWARD BUT STALLS IN REVERSE		
1.	Failed forward clutch	Overhaul transmission
XV. VEHICLE OPERATES IN REVERSE BUT STALLS IN FORWARD		
1	Failed reverse clutch	Overhaul transmission

11.3 TROUBLE SHOOTING OF THE ELECTRICAL SYSTEMS

11.3.1 Trouble Shooting of the Starter Motor

Failure of the engine to start may be attributed (treated) not only to the faulty starter motor but also to other system faults such as battery, switches, wiring connections, ignition systems or fuel supply etc.

Make sure that the trouble does not lie elsewhere before attempting to test the starter motor.

The following are some useful hints for dealing with trouble limited to starter motor, such as

Defect 1: When starter motor is operated its shaft fails to rotate or rotates slowly and the starter motor does not crank the engine through pinion has engaged with ring gear.	
Cause	Action - Remedy
a) Discharge/defective battery.	Recharge battery/substitute a fully charged battery.
b) Defective/loose connections.	Tighten all connections.
c) Dirty, oily or badly burnt commutator	Remove the starter for further inspection.
d) Starter terminal or brush box having an earth fault.	- do -
e) Defective, solenoid switch.	- do -
f) Defective armature field coils.	- do -

Defect 2: Armature rotates but pinion fails to engage.	
Cause	Action - Remedy
a) Improper pinion engagement	Clean it.
b) Burr formation on pinion or ring gear	Deburr it by filing
c) Defective auxiliary coil.	Change auxiliary coil.
d) Loose mounting.	Tighten mounting/units
e) Worn commutator end/drive end bush	Change the bush
f) Commutator bearing pin loose.	Check the tightness of bearing pin fixing screw.

Defect 3: Starter motor continuous running after release of ENGINE START switch.	
Cause	Action - Remedy
a) Sticky starting switch.	Open starter motor isolating knife switch immediately and repair/replace switch.
b) Short in wiring harness	Replace faulty wiring.
c) Dry-drive end bush	Trace cause and lubricate
d) Sticky solenoid switch contacts.	Remove the starter for solenoid inspection.
e) Bush in pinion seized on shaft.	Remove the starter for inspection.
f) Pinion/ring gear fouled or damage.	Clean thoroughly, deburring of pinion and ring gear by filing.

Defect 4: Pinion engage but starter motor does not crank the engine (whining noise is heard)	
Cause	Action - Remedy
a) In sufficiently charged battery/corroded terminals.	Recharge the battery/clean terminal and smear petroleum jelly.
b) In sufficient pressure on carbon brushes or worn out brushes.	Change the brush springs/brushes.
c) Shorted/earthing armature	Change armature
d) Slipping clutch assembly	Change clutch assembly.
e) Partially earthing field coil.	Change starter motor
f) Solenoid contact bad.	Re-set solenoid and replace spring.

Defect 5: Engine is not cranking	
Cause	Action - Remedy
a) Weakened battery	Check the voltage of the battery charge it if required.
b) Inoperative ENGINE START switch	Check and replace if necessary.
c) Faulty fuel solenoid	Check and replace if necessary.
d) Faulty magnetic switch	Check and replace if necessary.
e) Faulty starting motor solenoid	Check and replace if necessary.
f) Faulty starter motor	Check and replace if necessary.
g) Faulty ER1 (ER2) relay or Faulty FSR relay	Check and replace if necessary.

Using the Starter Motor

The following points should be strongly observed while starting the engine-

- 1) Make sure that all engine controls are correctly adjusted.
- 2) Press the FUEL SOLENOID PUSH BUTTON and turn the ENGINE START/STOP switch in to "1" (2") position firmly and release it soon after the engine fires.
- 3) If the engine does not fire at once, allow it to come to rest before another attempt to start.
- 4) Do not run the battery down by repeated operations when engine refuses to start. Ascertain the causes of failure to start.
- 5) On no account should the starter motor be operated when engine is running, otherwise serious damage would occur both to starter motor and to flywheel teeth. However built in safety is provided to safe guard the starter motor is limited to avoid continuous long cranking.

CAUTION: Do not operate the starter motor more than 10 seconds. If any of above defects found, system needs thorough inspection.

Defect 6: RELAYS ER1/ER2/TRC/FSR DOES NOT OPERATE.	
Cause	Action - Remedy
a) Low control voltage	Check the control voltage
b) Large voltage drop	Check the loose connection
c) Control circuit incorrectly wired.	Check and correct the control circuit and coil connection. Check the marking of cables and connect accordingly.

Defect 7: RELAY CHATTERS ER1/ER2/TRC\FSR	
Cause	Action - Remedy
a) Low control voltage	Check the control voltage
b) Large voltage drop	Check the loose connections. Clean the contact tips of main and auxiliary contacts.
c) Broken shading ring on the magnet pole.	The mechanical life of contactor is over.

Defect 8: HUMMING OF IRON CORE OR NOISE MAGNET	
Cause	Action - Remedy
a) Rust or dust or other substance is on contacting surface of iron core.	Rub off rust with fine emery paper or clean the surface with cloth.
b) Broken shading rings	Mechanical life of contactor is over.
c) Magnet faces not mating	Mechanical life of contactor is over.
d) Dirt or rust on magnet faces	Clean lightly with fine emery paper or dry cloth or use compressor air.

Defect 9: RELAY FAILURE TO PICKUP AND CLOSE ER1/ER2/TRC/FSR	
Cause	Action - Remedy
a) Low voltage	Check control voltage
b) Coil open shorted	Replace the coil
c) Mechanical obstruction	Clean and check the free movement of contact assembly.

Defect 10: RELAY FAILURE TO DROP OUT (OPEN) ER1/ER2/TRC/FSR	
Cause	Action - Remedy
a) Coil not disconnect from supply.	Check wiring of the coil circuit
b) Worn or rusted parts causing binding	Replace such parts.
c) Residual magnetism due to lack of air gap in magnet path	The mechanical life of relay is over.

Defect 11: OVERHEATING OF COIL	
Cause	Action - Remedy
a) Over voltage or under voltage	Check and correct the control voltage.
b) Inter turns short circuit caused by mechanical damage in coil.	Replace coil
c) Dirt or rust on pole faces increasing the air gap.	Clean pole faces with very fine emery paper or dry cloth.

Defect 12: OVERCHARGING BATTERY GASES	
Cause	Action - Remedy
a) Sensing lost	Check circuitry and restore sensing connections.
b) Faulty regulator	Check the regulator, replace if necessary.
c) Rotor shorted to earth on negative side.	Rectify and replace rotor assembly

Defect 13: ENGINE DOES NOT STOP	
Cause	Action - Remedy
a) Faulty ENGINE/START-STOP switch	Check and replace if necessary.

Defect 14: EVEN THOUGH LUB OIL PRESSURE IS MORE, ENGINE DOES NOT SUSTAIN (STOPS AFTER RELEASING THE START PUSH BUTTON)	
Cause	Action - Remedy
a) Faulty low water level switch	Check and replace if necessary.
b) Faulty low water level relay	Check and replace if necessary
c) Faulty over speed switch	Check and replace if necessary.
d) Faulty lub oil pressure relay	Check and replace if necessary
e) Faulty low hydraulic oil level	Check and replace if necessary.
f) Faulty HLR relay	Check and replace if necessary

Defect 15: ENGINE THROTTLES IN HIGH RANGE BUT CAR DOES NOT MOVE (TRANSMISSION DO NOT ENGAGE)	
Probable Cause	Remedy
a) Defective timer relay TCE1	Check and replace.
b) Defective clutch cut off valve	Check and replace

Defect 16: BRAKE APPLIED INDICATION DOES NOT EXTINGUISH EVEN AFTER ALL THE BRAKES ARE RELEASED.	
Probable Cause	Remedy
a) Defective service brake pressure switch	Check and replace
b) Defective parking brake pressure switch	Check and replace
c) Disturbed pressure settings in pressure switch	Check and verify for proper settings.

Defect 17: EMERGENCY RAISE OF ENGINE DOES NOT TAKE PLACE I.E. ENGINE REMAINS IDLE WHEN EMERGENCY RAISE PUSH BUTTON IS RAISED.	
Probable Cause	Remedy
a) Defective push button switch	Check and replace
b) Defective ERR relay	Check and replace

Defect 18: ENGINE THROTTLE DOES NOT TAKE PLACE EVEN AFTER THE THROTTLE HANDLE IS MOVED TO DIFFERENT NOTCH POSITIONS	
Probable Cause	Remedy
a) Defective ET1 (ET2) relay	Check and replace
b) Defective timer relay TCE2	Check and replace
c) Defective MUTC solenoid	Check and replace
d) Defective speed relays (NRA-NRD)	Check and replace

Defect 19: CAR DOES NOT MOVE WHEN SELECTED "LO" IN THE "RANGE SELECTOR" EVEN AFTER DIRECTION ENGAGED INDICATION IS CONFIRMED	
Probable Cause	Remedy
a) Defective LRR relay	Check and replace
b) Defective TCE1 timer relay	Check and replace
c) Defective GEAR1 solenoid	Check and replace
d) Defective clutch cut off valves	Check and replace

Defect 20: FORWARD/REVERSE SOLENOID FAILS TO GET ENERGISED EVEN AFTER DIRECTION IS SELECTED.	
Probable Cause	Remedy
a) Defective ADD ON block CT1 (CT2) power contactor.	Check and replace
b) Check 02R relay for its operation. Power to this relay comes from signal converter.	Check and replace
c) Defective SIGNAL CONVERTER	Check and replace
d) Defective FORWARD/REVERSE solenoid	Check and replace

Defect 21: CABIN DOES NOT GET INITIALISED	
Probable Cause	Remedy
a) Defective RESET AND INITIALISATION push button.	Check and replace
b) Defective cabin relay - CR1 - CABIN1 CR2 - CABIN2	a) Check and replace. b) Use stand by relay by switching on cabin BY-PASS switches in control cubicle.
c) Defective DRIVERS KEY SWITCH	Check and replace

Defect 22: HEAD LIGHT DOES NOT GLOW	
Probable Cause	Remedy
a) Defective head light switch	Check and replace
b) Defective diode stack unit	Check and replace diode in that particular fault line.
c) Defective relay contact	Check and replace relay/and on block.

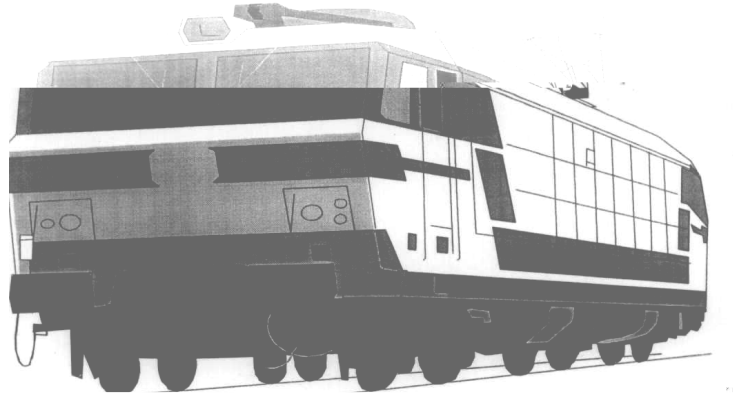
11.4 TROUBLE SHOOTING OF LIFTING AND SWIVELLING PLATFORM

Sr. No.	Trouble	Solution
1	Electrical motor not running.	a) Check whether all the 3 phases are 'ON'. b) If the 'MAIN ON' lamp does not blow, check the voltage after the transformer and bridge rectifier. Repair or replace transformer or bridge, if found faulty. c) Check the working of electrical contacts of contractors as per the electrical circuit. Replace the contractors, if found faulty to ensure motor running. d) Check the fuses and replace if burnt. e) Check the settings of overload relays. Reset depending on motor capacity if required.

Sr. No	Trouble	Solution
2	Oil not delivered.	a) Check direction of rotation of pump and correct it to clockwise when seen from motor non-drive end. b) Check oil level & top up if required. c) Check suction strainer & clean if clogged. d) If oil flow is not observed, open the DC valve, clean the spool and re-assemble the valve. e) Keep the respective push button pressed and check oil flow from outlets. f) If there is no oil flow, check the contractor. If the contractor is working, check solenoid coil. If burnt replaced new coil.
3	Cylinder upward motion jerky, takes more than 45 to 48 seconds to complete stroke. Cylinder not lifting the load and power pack not building the pressure.	a) Check the setting of relief valve fitted on manifold block and if required rotate the set screw in clockwise direction to increase the pressure and in anticlockwise direction to decrease the pressure. Tighten the check nut and replace rubber cap as it was. b) Remove the air lock from the pump. Remove the air bleeding screw or delivery line coupling and run the pump till the flow of oil is continuous and smooth. c) Tighten (close) shut off valve and release valve of handpump. d) Piston seals wornout. Replaced them.
4	Power pack (motor) stops.	Check the pressure (load) indicated by the pressure gauge. If the load is more, the overload relay trips and motor gets switched off automatically. Reduce the pressure by rotating the relief valve set screw anti-clockwise. Reduce the load on the platform. Overload relay is self setting type which will automatically reset.
5	Platform lowers with jerks. Takes more than 65 seconds to lower completely.	Increase the setting of relief valve provided in the return line. This increases the pilot pressure.
6	Platform not swivelling.	a) If motor is not running, check electrical contactors. Replace whichever is faulty. b) Check the gap between the flanges of electro-magnetic clutch & adjust it to 3 mm approx., when the platform is not loaded. It should be min. 0.5 mm when the platform is loaded uniformly with additional tip load. c) Coil burnt. Replace the coil or clutch.

CHAPTER 12

DEPOT EXAMINATION



A general inspection of under frame, under slung equipment, bogie and its components, brake system, wheel and axle, draft gear etc. to be done by depot staff before going on trip.

A general inspection of underframe, under slung equipment, bogies and its components for cracks, operation of brakes, brake gear fittings, condition of wheel and axle, axle box, draft gear etc. should be done by C & W staff and there should not be any rejectable defects as laid down in Rules of Chapter IV of IRCA Part IV” Guidance may be taken from RDSO Maintenance Manual NO CMI-K001 for bogie maintenance”.

CHAPTER 13

DRIVER SEQUENCE OF OPERATION

13.1 CABIN INITIALIZATION

- Ensure all switches/ driver/s controls are in "OFF"/"O"/"STOP" position.
- Insert driver's key and turn "ON" driver's key switch.
- Press reset and initialisation push button, hooter beeps and stops after 5 seconds. "Control supply ON" indication glows on the driver's desk.
- Press "LAMP TEST" switch to ensure healthy condition of indication lamps.
- Ensure all driver's brake valves handles are in release and running position.
- Check for the functioning of "HEAD LIGHT", "TAIL LIGHT", "MARKER LIGHT" and "FLASHER LIGHT" from both driver's cabins of the car.
- Ensure " forward/reverse" switch in "stop" position.
- Ensure "range selector" switch in "HI" position.

13.2 STARTING OF ENGINE

- Press deadman's foot pedal (the foot pedal should be pressed continuously for all the remaining sequences).
- Ensure "ENGINE THROTTLE" handle in "0" (Zero) position, ensure "FORWARD/ REVERSE" switch in "STOP" position and ensure "RANGE SELECTOR" switch in "HI" position.
- Press fuel solenoid push button and simultaneously turn "ENGINE START/ STOP" switch to position 1 (position 2) to start pantograph end engine (radiator end engine) and release "ENGINE START/STOP" switch after engine sustains to run.
- Release fuel solenoid push button after "ENGINE STOP" indication extinguishes

13.3 CHARGING OF RESERVOIRS

- Ensure throttle handle in "0" Zero position, ensure "forward / reverse" switch in "stop" position, ensure "range selector" switch in "HI" position and continuously press the deadman's foot pedal.

- If MR pressure is less than 8 kg/sqcm then the running engines can be raised to high idle (2200 rpm of engine) by pressing "Emergency Engine Raise" push button (push button should be kept pressed continuously during this process) till the desired pressure is reached.
- After the MR pressure reaches 7.5 kg/sqcm, release the "Emergency engine raise" push button.
- Open the following isolating cocks:
 - a) MR LINE
 - b) BP LINE
 - c) BPC LINE
 - d) HORN LINE in the active driver's cabin.
- If BP pressure is less than 5 kg/sqcm or MR pressure less than 7.5 kg/sqcm repeat procedure 3.

13.4 SELECTION OF DIRECTION

Note:-Selection of direction possible only in stand still condition (0- 2KMPH) of the vehicle.

- Ensure all driver's brake valve's handles are in release and running position.
- Ensure M.R. pressure 7.5 kg/sq.cm. and B.P. pressure 5 kg/sq.cm.
- BC1 & BC2 to be 'ZERO', if not pull the manual release of distributor valve for a short while, till the pressures BC1 & BC2 read 'ZERO'.
- Ensure working of horn & wipers.
- Ensure throttle handle in "0" (Zero) position, ensure "range selector" switch in "HI" position and continuously press the dead-man's foot pedal.
- Select "FORWARD" or "REVERSE" direction using "FORWARD" or "REVERSE" switch and ensure "DIRECTOR ENGAGED" indication glow.
- Change of direction during the movement of the car is not possible. However it can be done only in standstill condition of the vehicle (0-2 kmph) repeating above two steps.

13.5 HIGH RANGE

- Ensure the lifting platform is lowered and locked condition (for high speed only), direction selection to FORWARD.
- Release parking brake (open the parking brake isolating cock) "BRAKES APPLIED" indication extinguishes.
- Ensure the "RANGE SELECTOR" position in "HI".
- Move the "ENGINE THROTTLE" handle to different positions of the throttle switch. Car moves with speed depending upon the position of the throttle handle.
- Movement of car in reverse direction is not possible in "HI" range.

13.6 LOW RANGE

- Ensure parking brake isolating cock is in "Open condition", thereby "BRAKES APPLIED" indication extinguishes.
- Select FORWARD or REVERSE as desired for low speed operation, select "LO" range in the RANGE SELECTOR switch. The vehicle starts moving immediately with the engine's idle power only. ("ENGINE THROTTLE" is inactive in this range).
- "LO" range selection gives the option of moving the car both in forward and reverse direction at a maximum vehicle speed for 08 kmph.

13.7 CHANGE OF RANGE DURING MOVEMENT OF CAR

- "HI" to "LO".
- Ensure vehicle speed below 10 kmph.
- Bring the "ENGINE THROTTLE" handle to "0" (ZERO) position.
- Select "LO" in the "RANGE SELECTOR", the car continues to move in the same direction, but now in "LO" range mode and throttle gets disabled.

13.8 "LO-FORWARD" to "HI-REVERS".

- Bring "FORWARD / REVERSE" switch to "STOP" position.
- Select "HI" in range selector.
- Ensure "Engine THROTTLE" handle in "0" (ZERO) throttle.
- Select "FORWARD" in "FORWARD / REVERSE" switch.
- Move the "Engine THROTTLE" handle to different positions as desired. Car starts moving.

13.9 "LO-REVERSE" to "HI-FORWARD"

- ENSURE STANDSTILL CONDITION OF THE VEHICLE.
- Ensure throttle handle in "0" (ZERO) position, ensure "range selector" switch in "high" position and continuously press the deadman's foot pedal.
- Select "FORWARD" direction using " FORWARD/REVERSE" switch and ensure "DIRECTION ENGAGED" indication glows.

13.10 BRINGING ENGINES TO IDLE

- Bring the engine Throttle handle to "0" (zero) position. One or both the engines come to low idle.

CAUTION : Do not raise the lifting platform in the "HI" Range mode. If raised, the engines comes to low idle.

13.11 SHUTTING OFF THE ENGINES

- Individual shutting off the engine while the vehicle is in standstill/running;
- Ensure :ENGINE THROTTLE" handle in "0" (zero) position.
- Ensure "Forward/reverse" switch in "stop" position.
- Ensure "Range selector" in "HI" position.
- Turn the "Engine start/stop" switch to position 1 or position 2 to put off the corresponding engine.
- "Engine stop" visual indication of the corresponding power pack is seen on the drivers desk, simultaneously hooter hoots as an audio indication.
- Emergency engine stop;
- Emergency stop of both the engines can be done by pressing the "Emergency Engine Stop" push button in any operating condition of the the vehicle.
- "Engine Stop" visual indication of the corresponding power pack is seen on the driver's desk, simultaneously hooter as an audio indication.

13.12 STOPPING THE CAR (standstill condition)

- Apply the brakes (service/ standby) the vehicle comes to a halt with in a duration the emergency upon the speed. "BRAKES APPLIED" indication glows.
- In case of emergency or in the event of the failure of service/ standby brake, the emergency brake can be applied which results in faster application of brake. "Brakes Applied" indication glows.

CHAPTER 14

DAILY CHECK BY DRIVERS

In addition to testing of air break system as described in chepter10 , following daily checks are also to be carried out by driver. If any deficiencies/ defects are noticed during inspection, same should be reported to depot in charge to take remedial action immediately to rectify the deficiencies/defects.

Before/After Starting The Engine

S.No.	Details
1.	Check Fuel oil level and leakage if any.
2.	Check engine lub oil level and leakage if any.
3.	Check transmission oil level and leakage if any.
4.	Check axle drive oil level and leakage if any.
5.	Check compressor oil and level and leakage if any.
6.	Check radiator water level and leakage if any.
7.	Check battery voltage 24 V
8.	Check electrolyte level 20 mm above the safe guard
9.	Check belt condition
10.	Check dynamo
11.	Check water pump belt
12.	Check radiator fan
13.	Check alternator

Under slung equipment examination

S.No.	Details
1.	Check engine base securing bolt & nut
2.	Check transmission joint bolt & nut
3.	Check carden shaft joint bolt & nut
4.	Check axle box cover fixing bolt & nut
5.	Check axle drive housing fixing bolt & nut
6.	Check palm pull rod cotter pins
7.	Check hanger pin & split pins
8.	Check compressor base bolt and nut
9.	Check cattle guard fixing bolt & nut
10.	Check buffer fixing bolt & nut
11.	Check brake cylinder fixing bolt & nut
12.	Check all pneumatic pipe lines & oil pipe line connections for any leakage.
13.	Check helical spring

Check Working Condition Of The Following

S.No.	Details
1.	Brake valve A9
2.	Distributor valve C3
3.	Parking brake
4.	Brake cylinders
5.	Parking brake cylinder
6.	Pressure gauges
7.	Horn
8.	Wiper
9.	Pantograph
10.	Swivelling Platform
11.	Automatic drain valve
12.	J-1 safety valve

Check Operation Of Following

S.No.	Details
1	Head light
2	Parking light
3	Tail light
4	Lights and fans
5	Panel board's indication light
6	Throttle switch
7	Forward /reverse switch
8	RPM meter
9	Speedo meter
10	Pressure and temperature gauges

ANNEXURE- A

RECOMMENDED OILS / LUBRICANTS

ENGINE

Make/Model NT - 855R

Oil Grade/Make	1) IOCL	:	SERVO PREMIUM CF4 15 W - 40
	2) BPCL	:	MAK CF4 15 W40
	3) HPCL	:	HYLUBE Milcy Power
Qty per Eqpt		:	40 lts

TRANSMISSION

Make/ Model : (CRT UP 102)
Oil Grade/make

Manufacture	Brand Name	Type
1) HPCL	Power Clide	C3-SAE 10 C3-SAE 10
2) IOC	SERVO transmission	C3 or C4 SAE 10 C3 or C4 SAE 30
3) TIDE water oil Co.	TIDE WATER TRANS GEAR	C3 - SAE 10 C3 - SAE 30
4) HPCL	HYDRAULIC TRANSMISSION FLUID	C3 - SAE 10 C3 - SAE 30
5) CEHVRON PETROLEUM	CHAMPLIN S-3 Motor Oil	C3 - SAE 10 C3 - SAE 30
6) SHELL INTERNATIONAL	SHELL OIL	S-9400
7) CALTEX PETROLEUM	CALTEX TEXMATIC FLUID	DEXRON IID 21588
8) CHEMOLEUM	TRANSMISSION FLUID	C4-SAE 10 C4-SAE 30

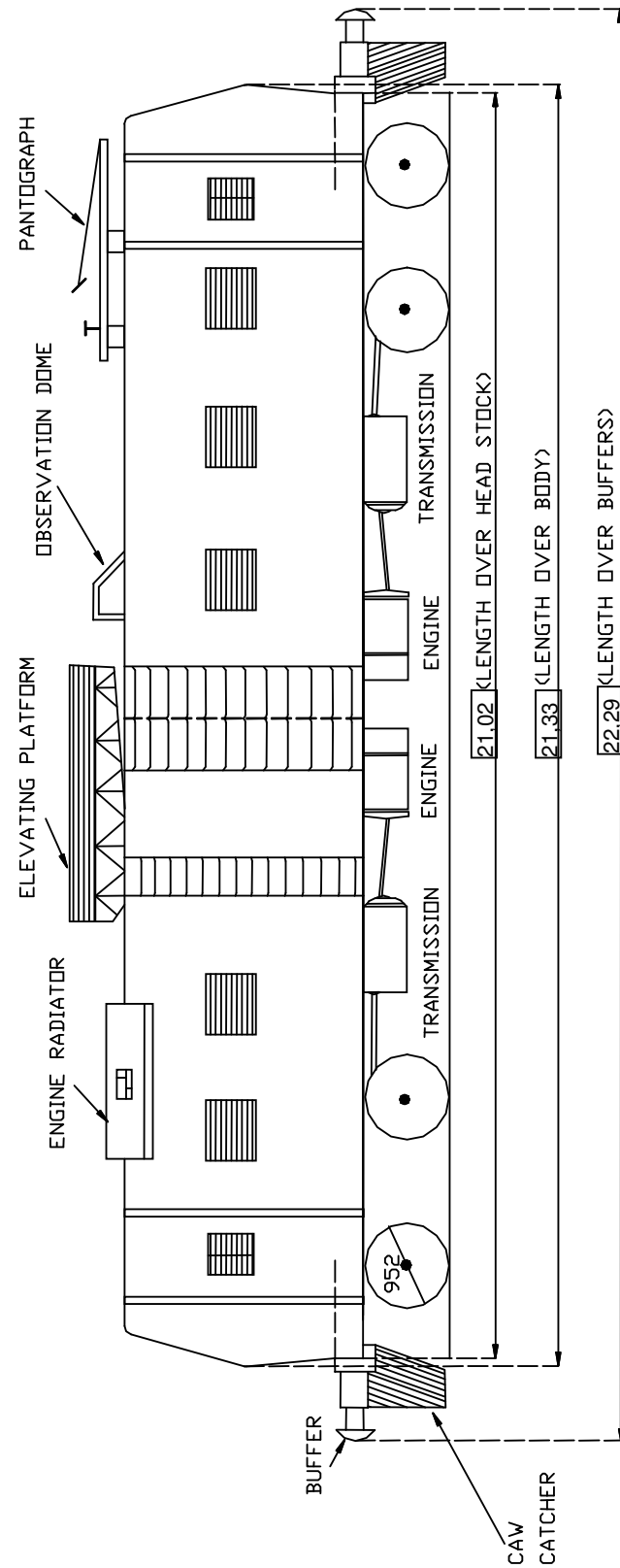
Qty per equipment : Initial fill 49.2 lts
Refil 42.6 lts.

FINAL DRIVE

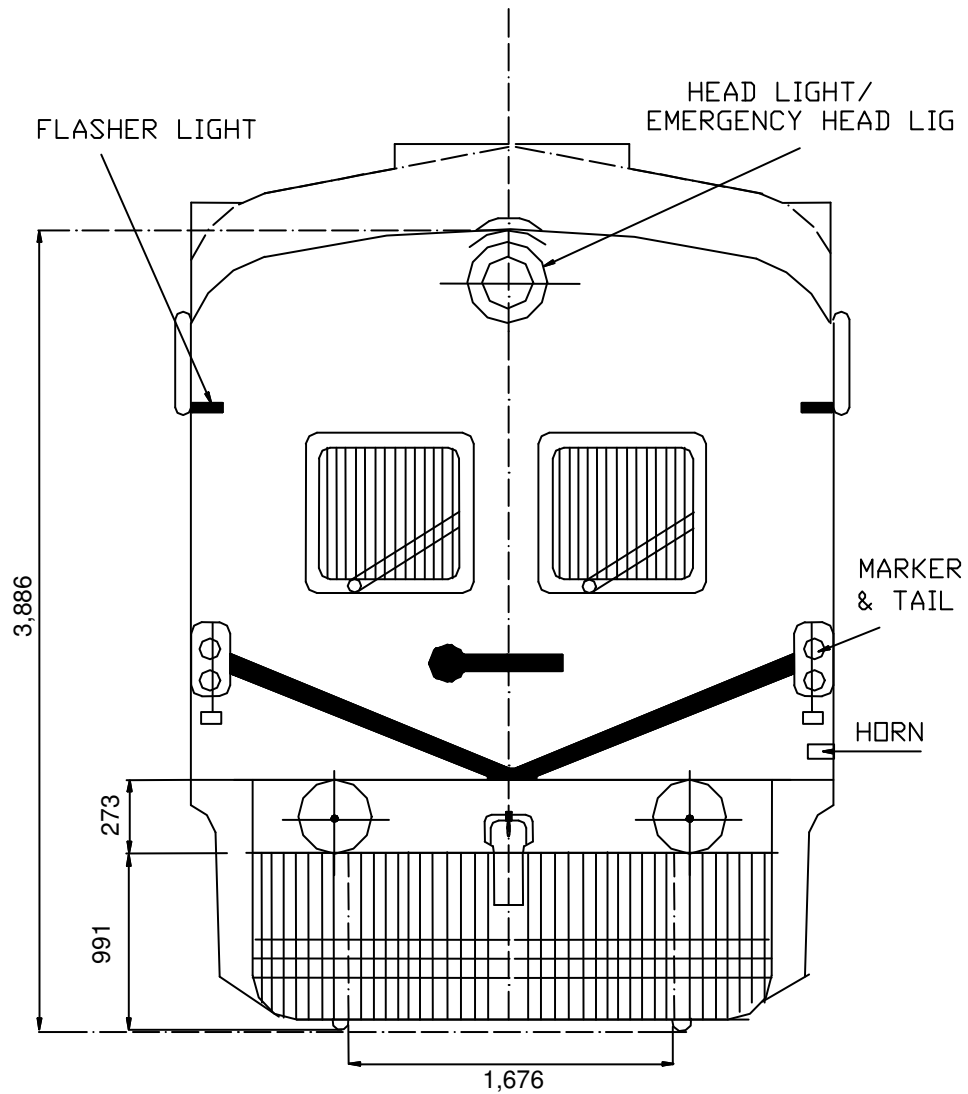
Make/Model	:	SAN
Oil Grade/ Make	:	1) IOCL : SERVO Gear HP 90
		2) BPCL : BHARAT SPIROL 90
		3) HPCL : HP Gear oil EP - 90
Qty per Eqp	:	Initial fill 25 lts
		Refill 18 lts

COOLING SYSTEM

Make/ Model	:	Cummins India Ltd
Oil grade/ Make	:	SERVO 68
Qty per equipment	:	250 lts.



MAIN DIMENSIONS OF O.H.E. CAR (8-WHEELER) SIDE ELEVATION
 All dimensions are in mm)



MAIN DIMENSIONS OF O.H.E. CAR (8 WHEELER) FRONT ELEVATION
(All dimensions are in mm)

REFERENCE

1. Operation and maintenance manual (bulletin No 3243773 - 02) of M/s Cummins India Ltd
2. Manual on Transmission CRT 5633 Series of M/s *Hindustan Motors*.
3. Instruction, operation and maintenance manual for 8 wheeler O.H.E. car of M/s SAN Engineering and locomotive company Ltd. Bangalore.
4. Railway Products (India)Ltd.Drg no 35819100 Alt.Nil for"Air brake system for SAN make 8 wheeler OHE car"
5. Papers presented during the seminar at CAMTECH on "Maintenance of 8 Wheeler Tower Wagon"

OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity, performance of all Railway assets and manpower which inter-alia would cover reliability, availability, utilisation and efficiency.

If you have any suggestions and any specific Comments please write to us.

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