



भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS

केवल कार्यालयीन उपयोग हेतु
(For Official Use Only)

एसी ईएमयू/एमईएमयू के
रिवर्सर/वाईण्डिंग चेंन्ज ओवर स्विच
के
अनुरक्षण की लघु पुस्तिका

**MAINTENANCE HANDBOOK
ON
REVERSER/ WINDING CHANGE OVER
SWITCH OF AC EMU/MEMU**

**TARGET GROUP - TECHNICIANS OF AC EMU/MEMU
CAR SHEDS, WORKSHOPS**

केमटेक/ई/2006/रिव- ईएमयू/1.0
CAMTECH/E/2006/ REV- EMU / 1.0

जनवरी 2006
January 2006

**Centre
for
Advanced
Maintenance
TECHnology**



Excellence in Maintenance

महाराजपुर, ग्वालियर – 474 020
Maharajpur, GWALIOR - 474 020

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FOREWORD

With increasing passenger traffic in Metropolitans & their connected cities, reliability of AC EMU/MEMUs has become very important. Proper maintenance of Reverser/ Winding Change Over switch is vital to ensure trouble free operation of EMU/MEMUs.

CAMTECH has prepared this handbook to cover all essential aspects of maintenance and overhauling of Reverser/ Winding Change Over switch of AC EMU/MEMUs. It describes various maintenance schedules, overhauling procedure, common defects, causes and their remedies.

I am sure the handbook will prove to be very useful to our maintenance staff in EMU car sheds/ workshops.

CAMTECH, Gwalior
Date: 01-02-2006

R.N.MISRA
Executive Director

PREFACE

In AC EMU/ MEMU, electro pneumatically cam operated rotary switches are used as Reversers (K1 & K2) and Winding Change Over (WCO) switch. Proper maintenance of these equipments is necessary to ensure reliability of AC EMU/MEMUs in service.

This handbook on maintenance of Reverser/ Winding Change Over switch has been prepared by CAMTECH with the objective of making our maintenance personnel aware of correct maintenance and overhaul techniques to be adopted in field.

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

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

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

CAMTECH, Gwalior
Date: 30-01-2006

RANDHAWA SUHAG
DIRECTOR/ELECT

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CHAPTER 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

In AC EMU/ MEMU, electro pneumatically cam operated rotary switches are used as Reversers (K1 & K2) and Winding Change Over (WCO) switch.

Reverser is used for selection of the direction of the vehicle by reversing the direction of current in the traction motor field through its power contacts. Operation of the reverser is controlled by reverser key provided on master controller.



Figure 1.1 REVERSER

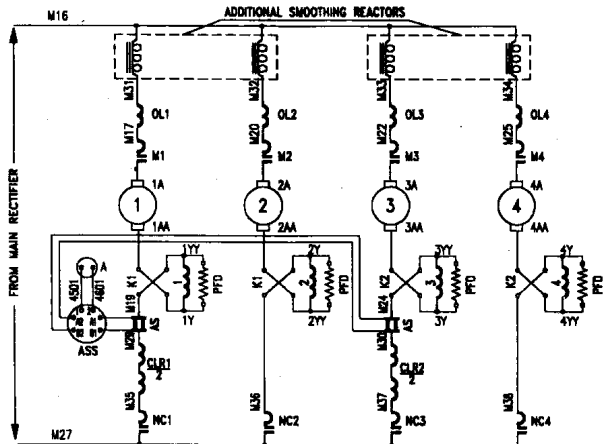


Figure 1.1A REVERSER POWER CIRCUIT

Reverser (K_1) power contacts are connected across the field windings of traction motor 1 & 2 and reverser K_2 power contacts are connected across the field windings of traction motors 3 & 4.

Winding change over switch is an electro pneumatic cam operated change over switch. It is provided to select one section of the transformer secondary winding or both sections in series by means of its contacts W1 & W2 and is operated on load. This switch operation is controlled by winding grouping relay (WGR).

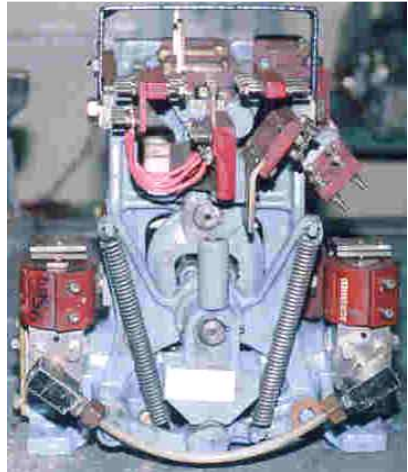


Figure 1.2 WCO SWITCH

Winding change over switch (WCO) power contact W1 closes initially and remains closed up to 12th notch. Before proceeding to notch 13, movement of the master controller handle beyond position 2, causes the WCO to throw from the LV to the HV position. This causes contacts W1 to open and W2 to close.

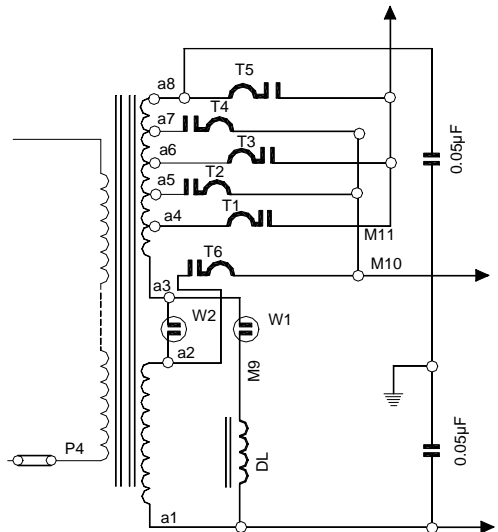


Figure 1.2A WCO POWER CIRCUIT

1.2 TECHNICAL DATA

Description	Reverser (K1 & K2)	Winding Change Over Switch (WCO)
Manufacturer	BHEL	BHEL
Type	29 RPS	29 RPS
Rated current	600 A	600 A
Rated voltage	1500 V	1500 V
Operating pressure		
Nominal	4.9 Kg/sq.cm	4.9 Kg/sq.cm
Minimum	3.15 Kg/sq.cm	3.15 Kg/sq.cm
Control voltage		
Nominal	110 V DC	110 V DC
Minimum	55 V DC	55 V DC
Main contact		
a. Contact gap	19.05± 1.6 mm	12.7 mm (min.)
b. Contact over travel	4.75 to 7.95 mm	4.75 to 7.95 mm
c. Contact pressure	7.7 to 17.2 kg	10.0 to 12.7 kg
d. Main cam to roller gap	1.59 mm	1.59 mm
Auxiliary contacts		
a. Contact gap	31.75mm min.	31.75mm min.
b. Contact over travel	2.4 mm to 6.35 mm	2.4 mm to 6.35 mm
c. Contact pressure	0.68 kg min.	0.68 kg min.

Description	Reverser (K1 & K2)	Winding Change Over Switch (WCO)
Auxiliary Bridge contacts		
a. Contact gap	-----	28.6 mm (min)
b. Contact over travel	-----	3.2 mm to 6.35 mm
c. Contact pressure	-----	0.34 kg min
Magnet valve type	30 MV	30 MV
Operating coil	ES 851137	ES 851137
Magnet valve coil resistance at 20 deg. C	957 ± 8% ohms	957 ± 8% ohms
Magnet valve ferrule bore	6 ± 0.1mm	6 ± 0.1mm
Valve travel	0.91/0.71mm	0.91/0.71mm
Air bolt bore	6.35 mm + 0.05	6.35 mm + 0.05
Height of valve stem above core when		
a. Magnet valve de-energised	2.03/ 1.93 mm	2.03/ 1.93 mm
b. Magnet valve energised	1.22/ 1.12 mm	1.22/ 1.12 mm
No. of Aux. Contacts	04	08

Description	Reverser (K1 & K2)	Winding Change Over Switch (WCO)
No. Bridge Contacts	--	04
Overall size	333 W x 435 lg X 365 ht	333 W x 435 lg X 365 ht
Weight	40 Kg (approx.)	40 Kg (approx.)
Terminal size	M 10 screw	M 10 screw
Fixing holes	4 holes of 16 mm dia	4 holes of 16 mm dia
Fixing centers	327 x 203.2 x 266.7 mm	327 x 203.2 x 266.7 mm

1.3 CONSTRUCTIONAL DETAILS

This mainly comprises of following sub assemblies namely.

- i. Cylinder assembly
- ii. Main shaft assembly
- iii. Finger assemblies
- iv. Main power contacts
- v. Interlock assembly
- vi. Magnet valve assembly

These main parts along with other components are mounted on an end frame. Cylinder and end frame are provided with fixing holes for mounting.

1.3.1 Cylinder Assembly

It comprises of a cylinder and bracket, auxiliary shaft, rack and pinion. On the auxiliary shaft is mounted the pinion and the ratchet. The pinion is fitted with two rollers. An operating lever which is fitted on the main shaft is given movement by the two rollers of the pinion on energisation of either of the magnet valves and the power contacts close or open.

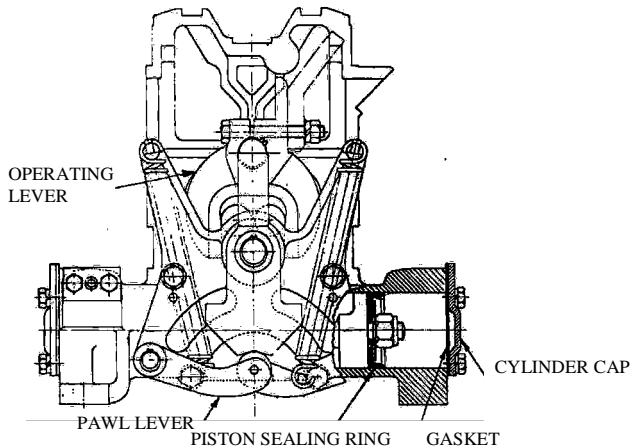
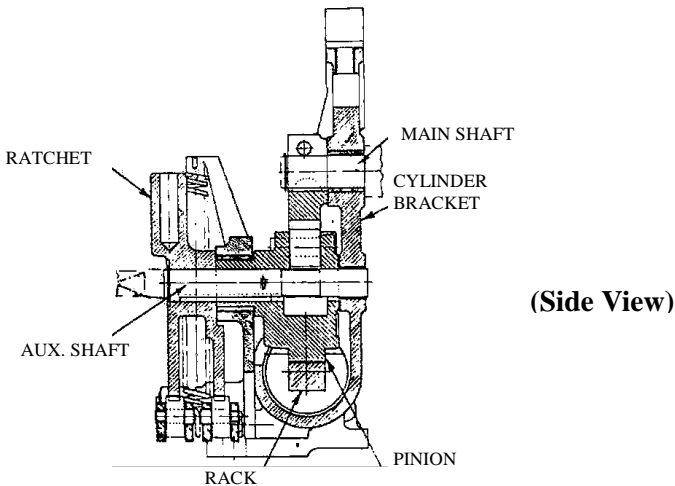


Figure 1.3 CYLINDER ASSEMBLY (Front View)



(Side View)

1.3.2 Main Shaft Assembly

The finger blocks are fitted on the main shaft. The power finger assemblies are fitted on the finger blocks. Main shaft is supported at the ends on oilite bearings.

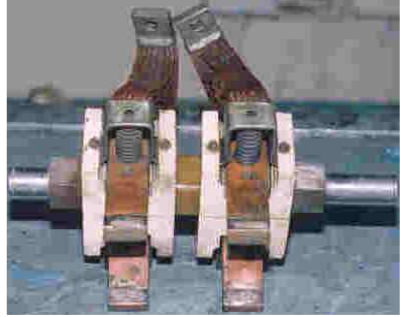


Figure 1.4

1.3.3 Finger Assemblies

The finger blocks are fitted on the main shaft which is supported at the ends on oilite bearings. The power finger assemblies are fitted on the finger blocks.

1.3.4 Main Power Contacts

Fixed contacts are fitted on the insulated terminal bar with nut & bolt.

Moving contacts are fitted on the power finger and finger blocks are fitted on the terminal bar. Copper braided shunts are fitted on the one end of the finger.

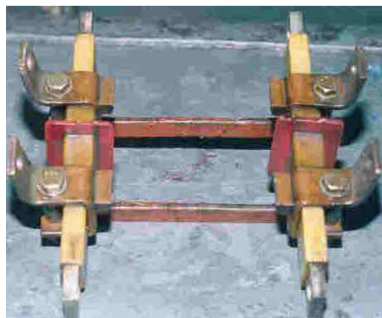


Figure 1.5

1.3.5 Interlock Assembly

This assembly is mounted on cylinder bracket, and on the operating lever. Both the fixed and moving contacts are fitted with silver tips. These are silver tipped butt type contacts. These auxiliary contacts are operated by operating lever. Auxiliary changeover contact and the auxiliary bridge contacts make after and break before the first closing main contacts.

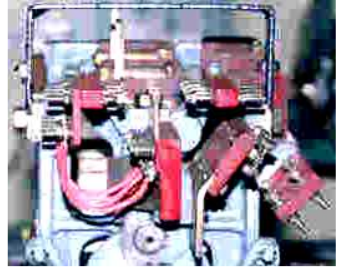


Figure 1.6

1.3.6 Magnet Valve Assembly

The type 30MV magnet valve, used in reverser/ winding change over switch, is an electro-pneumatically operated valve which controls the flow of compressed air to and from cylinder assembly.

The magnet valve consists of the following parts: Pole piece, Coil armature, valve body, valve stem, valve, valve plug, spring, core, armature stop and valve bolt. The valve and the lower face of the valve stem are provided with nitrile rubber inserts to form resilient seating faces.



Figure 1.7

The magnet valve is mounted on the apparatus with the help of two holes provided in the valve body at a centre distance of 27 mm.

1.4 WORKING PRINCIPLE

As shown in figure 1.8, an electro magnet valve is connected to cylinder assembly. When the coil of either of the magnet valves is energised, the armature is pulled down towards the core causing the valve stem to close the exhaust port and the valve to open the inlet port, thus admitting compressed air to the cylinder assembly and moves the piston in desired direction. As a result of movement of piston, auxiliary shaft, rack and pinion move. On the auxiliary shaft is mounted the pinion and the ratchet. The pinion is fitted with two rollers. These two rollers of the pinion gives movement to the operating lever which is fitted on the main shaft. And by the movement of main shaft, the power contact close or open.

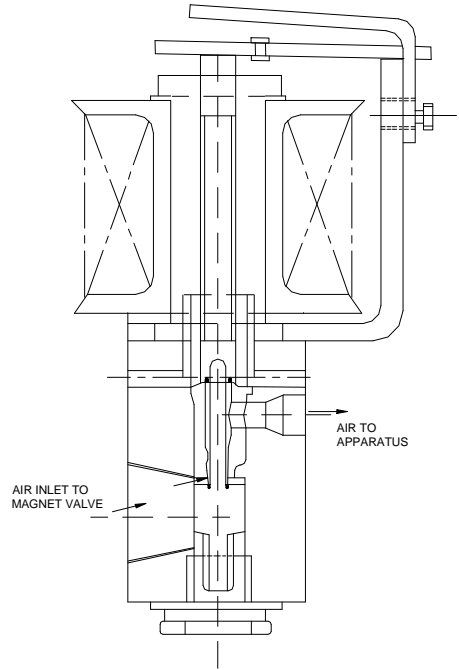


Figure 1.8

When the coil is de-energised. The valve, valve stem and armature are pushed up by the spring thereby closing the inlet port and opening the exhaust port enabling the compressed air from the apparatus to escape and apparatus return to its normal position.

CHAPTER 2

MAINTENANCE

Periodic maintenance of electropneumatic apparatus is essential to maintain them in sound condition and to prevent service failures. Maintenance schedules are given as under.

Schedule	Periodicity
Trip Inspection	10 days
IA Schedule	45 days
IB Schedule	90 days
IC Schedule	180 days
POH	18 months

Work to be carried out under different schedules is given as under.

2.1 TRIP INSPECTION

Carry out the following inspections.

S.No.	Inspection & Work to be done	Standard value
1.	Check K1, K2 & WCO visually for any abnormality.	No abnormality
2.	Check operation of K1, K2 & WCO by depressing the armature of the magnet valve manually for proper operation, air leakage etc. during L.T. testing.	OK/ No abnormality

2.2 IA SCHEDULE

Carry out the following inspections.

S.No.	Inspection & Work to be Carried out	Standard value
1.	Check K1, K2 & WCO visually for any abnormality.	No abnormality
2.	Check power contacts for flash marks, contact wear, contact pressure.	No abnormality
3.	Blow by dry compressed air thoroughly.	Blown
4.	Examine visually all flexible shunts, power connections for any over heating etc.	No abnormality
5.	Check all auxiliary contacts for any abnormality. Clean all auxiliary contacts by petrol and check their function.	No abnormality
6.	Check and ensure good condition of interlock shunts.	OK
7.	Check operation of K1, K2 & WCO by depressing the armature of the magnet valve manually for proper operation, air leakage etc. during L.T. testing.	OK/ No abnormality
8.	Check operation of K1, K2 & WCO electrically by switching "ON" 110 Volt D.C. control supply during L.T. testing.	Done
9.	Check and ensure tightness of terminal connections.	OK

2.3 IB SCHEDULE

Carry out the following inspections.

S.No.	Inspection & Work to be Carried out	Standard value
1.	Check K1, K2 & WCO visually for any abnormality.	No abnormality
2.	Check power contacts for flash marks, contact wear, contact pressure.	No abnormality
3.	Blow by dry compressed air thoroughly.	Blown
4.	Check air gap between main contacts. For K1, K2 For WCO	19.05 ±1.6mm 12.7mm(min.)
5.	Check air gap between auxiliary contacts, adjust the same if required. For K1, K2 and WCO auxiliary contacts. For WCO bridge contacts	31.75mm (min.) 28.6mm (min.)
6.	Check spring pressures of auxiliary contacts, change the spring if required. For K1, K2 and WCO auxiliary contacts. For WCO bridge contact.	0.68 Kg.(min.) 0.34 Kg. (min.)

S. No	Inspection & Work to be Carried out	Standard value
7.	Check and ensure good condition of interlock shunts.	OK
8.	Clean all insulating surfaces thoroughly and ensure no dust is collected on surface.	Clean
9.	Examine visually all flexible shunts, power connections for any overheating etc. Check the contacts for their bedding and all fixing bolts for tightness if over heating or discoloration is found. Provide new shunts if found badly frayed.	No abnormality
10	Check operation of K1, K2 & WCO by depressing the armature of the magnet valve manually for proper operation, air leakage etc. during L.T. testing.	OK/ No abnormality
11	Check operation of K1, K2 & WCO electrically by switching “ON” 110 Volt D.C. control supply during L.T. testing.	Done
12.	Check the gap between cam and roller. Main cam to roller gap	1.59 mm Min.

2.4 IC SCHEDULE

Carry out the following inspections.

S. No	Inspection & Work to be Carried out	Standard value
1.	Check K1, K2 & WCO visually for any abnormality.	No abnormality
2.	Check power contacts for flash marks, contact wear, contact pressure.	No abnormality
3.	Blow by dry compressed air thoroughly.	Blown
4.	Check air gap between main contacts. For K1, K2 For WCO	19.05 ±1.6mm 12.7mm(min.)
5.	Check main contact pressure For K1, K2 For WCO	7.7 to 17.2 Kg 10.0 to 12.7 Kg
6.	Check gap between cam and roller Main cam to roller gap	1.59mm(min.)
7.	Check air gap between auxiliary contacts adjust the same if required. For K1, K2 and WCO auxiliary contacts. For WCO bridge contact.	31.75mm (min.) 28.6mm (min.)
8.	Check spring pressures of auxiliary contacts, change the spring if required. For K1, K2 and WCO auxiliary contacts. For WCO bridge contact.	0.68 Kg.(min.) 0.34 Kg.(min.)

S.No.	Inspection & Work to be Carried out	Standard value
9.	Check and ensure good condition of interlock shunts	OK
10.	Clean all insulating surfaces thoroughly and ensure no dust is collected on surface.	Clean
11.	Clean power contacts, remove burrs, flash marks etc. if required.	Clean
12.	Tighten all the securing bolts of power contacts firmly by proper tool.	Tightened
13.	Examine visually all flexible shunts, power connections for fraying or discolorisation caused by heat or stiffness, replace the shunts if required.	No abnormality.
14.	Check tightness of all power connections by proper tool and tighten if required.	Tightened.
15.	Check operation of K1, K2 & WCO by depressing the armature of the magnet valve manually for proper operation, air leakage etc. during L.T. testing.	OK/ No abnormality

S. No.	Inspection & Work to be Carried out	Standard value
16.	Check operation of K1, K2 & WCO electrically by switching “ON” 110 Volt D.C. control supply during L.T. testing.	Done
17.	Lubricate rack, pinions and levers of K1, K2 & WCO with shell alvania 3 grease or 4 x grease or equivalent.	Lubricated
18.	Lubricate the shafts and cylinders of K1, K2 & WCO with grade SAE 30 oil, through nipples provided in cylinder walls. Ensure that before applying the lubricant, the piston is coincident with its nipple.	Lubricated

2.5 POH

Overhauling of reversers and winding change over switch to be carried out during every POH.

2.5.1 General

- Overhauling comprises repairing and reconditioning of the equipment i.e. dismantling, replacing worn or defective parts, repairing, re-assembling and testing.
- Cleanliness is essential to good maintenance and trouble free service. Therefore work of cleaning must be carried out thoroughly during overhauling.
- Remove both reversers and winding change over switch and bring them to repairing room.

2.5.2 Incoming Inspection

- Carry out visual inspection for any damage, defect and deficiency and note the same.
- Connect the magnet valve to 4.9 kg/ sq. cm air supply on test bench.
- Press armature of the magnet valve and observe the operation for any abnormality in both direction.
- Check the operation of apparatus electrically by connecting 110 V D.C. supply in both direction.
- Remove the apparatus from the test bench.

2.5.3 Dismantling

- Remove magnet valve assembly by unscrewing the mounting bolts.
- Remove the auxiliary contact and bridge contact assembly.
- Dismantle the parts of cylinder assembly, main springs, operating lever, pawl lever, ratchet and other parts.
- Remove the fixed contacts, finger block assembly, shunts etc.

2.5.4 Overhauling of Magnet Valve Assembly

Major parts of magnet valve assembly are shown in figure given below:

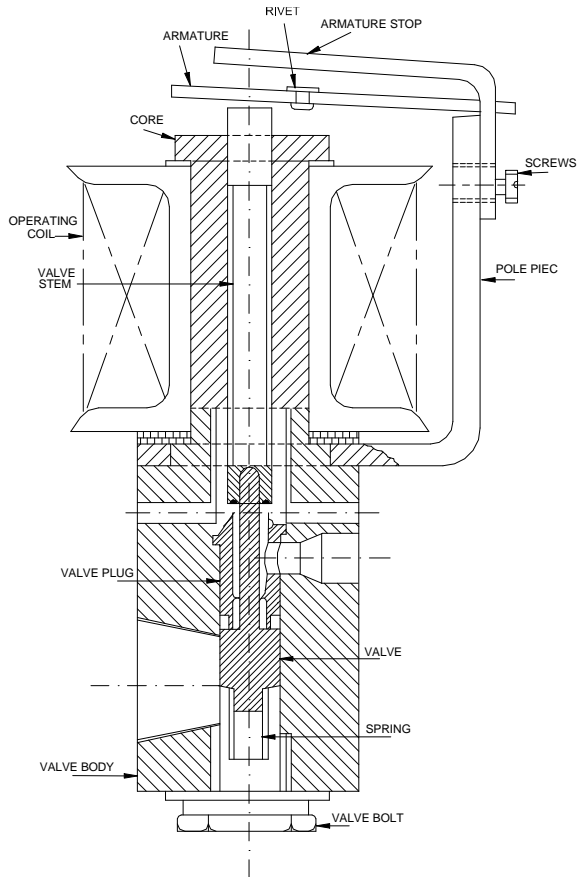


Figure 2.1 MAGNET VALVE ASSEMBLY

2.5.4.1 Dis-assembly

Dis-assemble the magnet valve as follow:

- Remove the valve bolt to release the valve and spring .
- Remove the armature stop and armature to release the valve stem.
- Remove the core and coil from the valve body using a suitable spanner.

2.5.4.2 Cleaning

- Thoroughly clean the upper and lower fixed metal seatings with a clean, soft and non-fluffy cloth.
- Clean the rubber seatings by using a soft brush and blow through filtered compressed air.
- Thoroughly clean the body of the valve stem and also the hole in the core through which the valve stem operates.
- Thoroughly clean other parts of magnet valve also.

2.5.4.3 Inspection of Different Parts

- Measure the ohmic value of the operating coil, it should be in line with the data.
Standard value at 20 deg. C. = $957 \pm 8\%$ ohms.
- Carry out the short turn test with the help of Shorted Turn Indicator as per RDSO SMI no. RDSO/ELRS/SMI/59 dt. 12.12.1979.

- Carry out the surge comparison test with the help of Surge Comparison Tester as per RDSO SMI no. RDSO/ELRS/SMI/157/ dt. 16.07.1993.
- Check valve and valve stem visually for any damage or defect, replace the same, if required.
- Check spring for any damage and replace if required.
- Check magnet valve ferrule visually for any damage and also check its bore size, it should be in line with the data ie. 6 ± 0.1 mm.

2.5.4.4 Re-assembly

Reassemble the magnet valve as follow:

- a. Install the valve, spring and valve bolt.
- b. Install the valve body and coil.
- c. Install the valve stem, the armature and armature stop.

Check the valve travel with the gauges as described in section 2.5.4.5 given below.

2.5.4.5 Inspection of Valve & Valve Stem

For judging the condemning limits of valve and valve stem follow the procedure given below.

- Mount the magnet valve on a bench vice and block the air outlet hole of the magnet valve with a gasket and gasket holding bracket.
- Take out armature stop by unscrewing screws and remove the armature.
- Connect compressed air supply of 4.9 Kg/cm^2 to the magnet valve.

- Depress the valve stem with the NOT LEAK section of the valve stem adjusting gauge shown below and see that the magnet valve is not leaking.

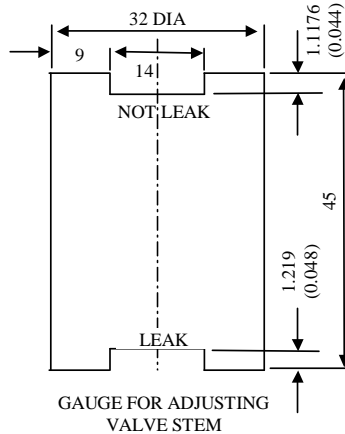


Figure 2.2

- If the magnet valve is leaking in the above position, it is an indication that the valve stem has worn out and it is to be replaced with a new valve stem.
- Depress the valve stem with LEAK section of the valve adjusting gauge shown below and see that magnet valve is leaking.

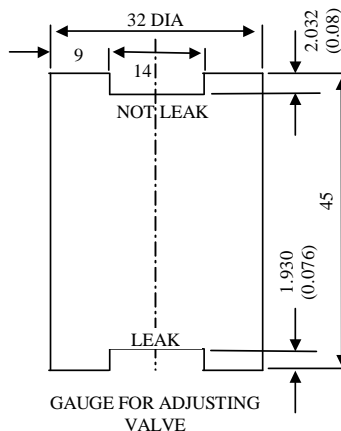


Figure 2.3

- If the magnet valve is not leaking in the above position, it indicates that the valve is worn out and it is to be replaced with a new one.

2.5.4.5.1 Replacement of Valve Stem

- Assemble a new valve stem in the magnet valve.

- Depress the valve stem with LEAK section of the valve stem adjusting gauge and if the magnet valve is not leaking. File the top of the valve stem slightly to make the magnet valve leaking when depressed as above.

- Care should be taken to see that the valve stem is not filed excessively.

- Now depress the valve stem with the NOT LEAK section of the valve stem adjusting gauge and see that the magnet valve is not leaking.

- Check the magnet valve with the LEAK and NOT LEAK sections of the valve adjusting gauge also and see that the valve is matching with the new valve stem and if necessary change the valve also as explained below in section 2.5.4.5.2.

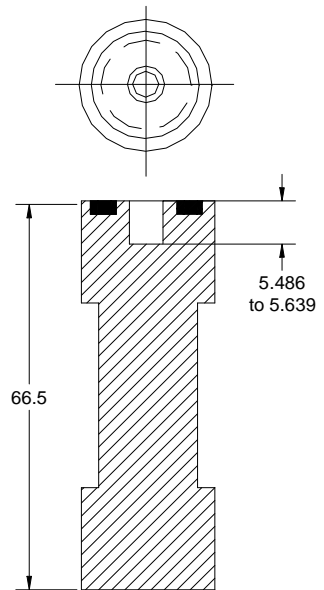


Figure 2.4 VALVE STEM

2.5.4.5.2 Replacement of Valve

- Assemble a new valve in the magnet valve.
- Depress the valve stem with the NOT LEAK section of the valve adjusting gauge and if the magnet valve is leaking. File the top of the valve slightly to make the magnet valve not leaking.
- Care should be taken to see that the valve is not filed excessively.
- Now depress the valve stem with the LEAK section of the valve adjusting gauge and ensure that the magnet valve is leaking.
- Check with the LEAK and NOT LEAK section of the valve stem adjusting gauge also and ensure that the magnet valve is working satisfactorily.

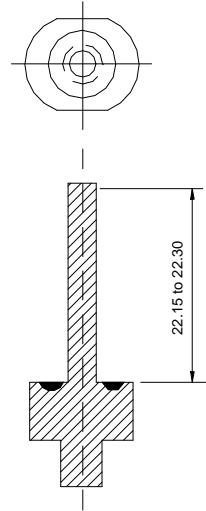
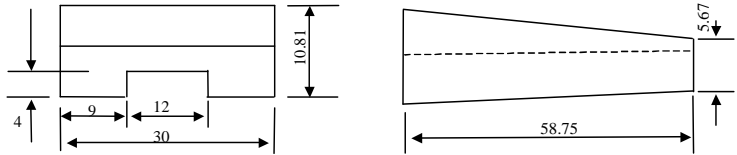


Figure 2.5 VALVE

2.5.4.5.3 Jumping Out of Valve Stem From Its Seat

Ensure that the valve stem is not jumping out of its seat and causing obstruction to the normal working of the magnet valve as follows.

- Fit the armature stop without the armature and slide the gauge as shown below, between the bottom of the armature stop and the top of the core.



GAUGE

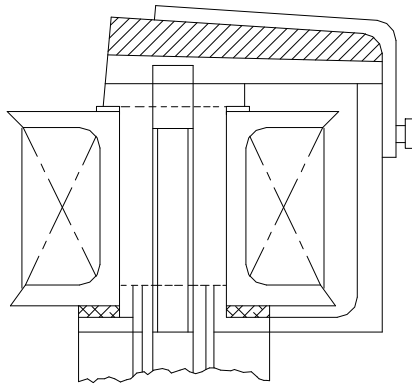


Figure 2.6

- After fitting the gauge, if there is a gap between the armature stop and the gauge, bend the armature stop suitably to remove the gap.
- Take out the gauge and fit back the armature and armature stop.

2.5.4.6 Testing of Magnet Valve After Re-assembly

- Check that the valve travel is in line with the data.
- Check that the projection of valve stem above the core when energized and de-energised is in line with the data.
- By applying soap water check that there are no air leaks.

2.5.5 Overhauling of Cylinder Assembly

- Clean all the parts of cylinder assembly thoroughly with kerosene and wipe with a clean and soft cloth.
- Check visually all parts for any damage/ defect and replace the defective part if required.
- Check visually shaft key groove for any deformation and rectify the defect. Replace the shaft if required.
- Check shaft key for its proper shape and replace if any deformation is found.
- Visually check the oilite bush and bearings and replace if found damage/ defective.
- Check pinion, rack and piston visually for any defect/ damage and replace if required.
- Check PVC air pipe for any crack/ damage and replace if required.
- Replace all the rubber components and gaskets with new one.
- Examine the both side inner bore of the cylinder for any scoring mark and replace if scored.

- Check the condition of copper sealing gasket and cylinder caps for any damage.
- Lubricate the cylinder and piston with few drops of grade SAE 30 oil.
- Assemble all the components of cylinder assembly.

2.5.6 Overhauling of Main Contacts Assembly

- Clean all the parts of power contacts assembly, terminal bars, finger blocks and shunts.
- Check the contact tips of fixed and moving contacts and replace if excessively worn.
- If contact tips are pitted less than 0.8mm, dress them with a fine file. During filing, ensure that the curvature is not destroyed.
- Check the copper shunts for any loose strands, cut off, fraying and discolouring at their ends. Replace with new one if required.
- Examine the insulating surface of the terminal bars for any damage, cracks etc. and replace if required.
- Check the shunt fixing clamps threaded portion for any damage and replace if required.
- Check the insulation of all bus bars and reinsulate with fibre glass tape if necessary.
- Check power finger and finger block for any deformation/ defect and replace if required.
- Assemble all the components and ensure that all the circlips are properly seated on their grooves.

2.5.7 Overhauling of Auxiliary Interlock/ Bridge Interlock Assembly

- Dismantle all the parts of auxiliary interlock/ bridge interlock assembly.
- Follow the instructions given in RDSO SMI no. RDSO/ ELRS/ SMI/ 173/ dt.02.02.1995 to improve reliability of interlocks.
- Visually examine the condition of the contact tips for any damage. Replace with new one if required.
- Check the springs of all auxiliary contacts for any abnormality and replace if required.
- Check the condition of all loop wires and their crimping shoe for any defect/ damage and replace if required.
- Check the condition of interlock support for any crack and replace the defective support if required.
- Assemble all the components.

2.5.8 Re-assembly of Apparatus

- Re-assemble all the assemblies of the apparatus in reverse order.
- Provide new magnet valve gasket while refitting the magnet valve assembly on the cylinder assembly.

2.5.9 Final Inspection and Testing

- Ensure the free movement of all finger blocks by operating the operating lever manually and take corrective action if required.
- Ensure free movement of rack and pinion on both sides.
- Place the apparatus on test bench.
- Connect the magnet valve to 4.9 kg/sq cm air supply and 110V d.c. variable supply to the magnet valve solenoid.
- Check the operation in both directions by depressing magnet valve armature manually. At the same time check for air leakage from piston sealing rings, magnet valve and cylinder end caps by applying soap water.
- Check the operation of apparatus in both direction at 110V d.c. & 55V d.c. (min. pick up), both the main contacts and auxiliary contacts should close & open properly.
- Check that the auxiliary change over contacts and the auxiliary bridge contacts make after and break before the first closing main contact.
- Check the bedding of all main contacts with carbon paper method at 4.9 kg/sq cm. air pressure and record them.
- Check that all the main contacts close in such a manner that no contact closes in advance of any other by more than 1.2mm.

2.5.9.1 Measurement of Contact Gap

Contact gap should be measured at the narrowest point.

- Measure the contact gap of main contacts, it should be in line with data i.e.

For reverser (K1-K2) = 19.05 ± 1.6 mm

For WCO = 12.7 mm. (min.)

- Measure the contact gap of auxiliary contacts, it should be in line with data i.e.

For auxiliary change over contacts = 31.75 mm (min.)

For auxiliary bridge contacts = 28.6 mm (min.)

2.5.9.2 Measurement of Contact Over Travel

Contact over travel is the distance the contact finger travels after just touching the stationary contact. It is to be measured as follows:

- Remove the interlock assembly from the operating lever and operate the reverser/ WCO switch manually in such a way that the movable finger just touches with the out side stationary contact. Check the continuity of contacts with continuity tester.
- Keep a bevel protractor on the machined portion of the operating lever as shown in figure and measure the angle of rotation of the operating lever from its neutral position.

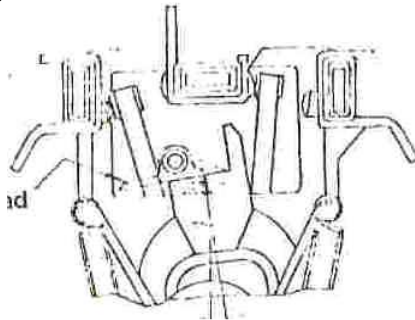


Fig. 2.7- FINGERS JUST TOUCHING WITH STATIONARY CONTACTS

- Operate the switch manually till the finger fully wipes with the outside stationary contact and again measure the angle of rotation of the operating lever from its neutral position as shown in fig. 2.8.

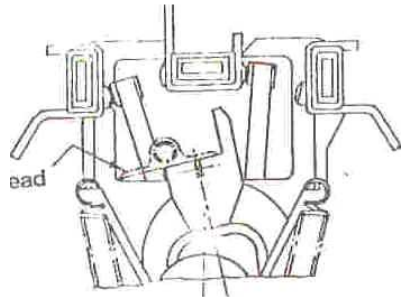


Fig.2.8- Fingers fully knuckled with stationary contacts

- The difference between above two measurements shall be between 3 to 5°. This is equal to 4.75 to 7.95 mm specified over travel.

2.5.9.3 Measurement of Contact Pressure

- Use a spring balance and measuring arm. Operate the apparatus to one position. Ensure that the contact gap and over travel are in line with Data.
- Place the measuring arm on the contact finger and fit the spring balance in it as shown in fig. 2.9. Pull the spring balance until the contact fingers first breaks away from the stationary contact.

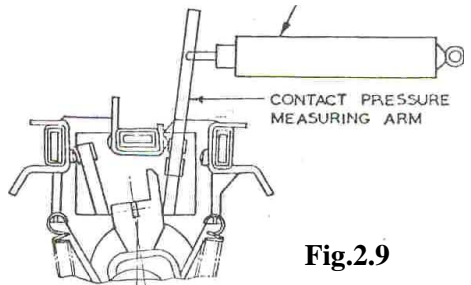


Fig.2.9

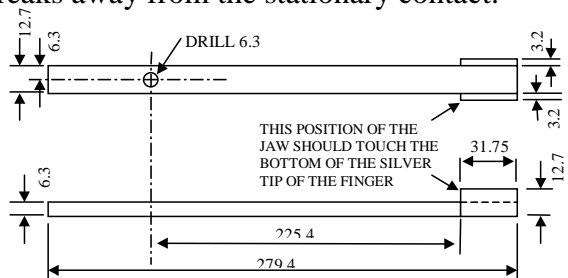


Fig.2.10 MEASUREING ARM

- Read the spring balance when the contacts just break. On the out side contacts the reading should be 2.3 to 3.6 kg, on the inside contacts the reading should be 2.49 to 4.1 kg.

2.5.9.4 Interlock Adjustment

The main contacts should close before and open after the interlock fingers. Adjust the auxiliary contacts in the following manner:

- Loosen the M5 locknuts on the contact screws. With air on the apparatus and the main contact fully wiped, hold the M5 nut and turn the contact screw towards contact finger until the contact just touches the finger.
- Turn the contact screw four more turns towards the contact finger to gain the proper over travel.
- Hold the contact screw and tighten the lock nut.
- Adjust each contact by repeating above steps for each inter lock finger.

CHAPTER 3

COMMON DEFECTS, CAUSES & THEIR REMEDIES

S. No	Defect	Possible cause	Suggested remedial actions
1.	Apparatus not operating	<ul style="list-style-type: none"> - Magnet valve coil open/short circuited. - Control feed not coming to magnet valve coil. - Sufficient air supply not coming to magnet valve. 	<p>Replace the coil and carry out following testing during overhauling to avoid such failures.</p> <ol style="list-style-type: none"> a. Inter turn short testing to be done during every overhauling with help of Shorted Turn Indicator. b. Surge comparison test to be done during every overhaul with Surge Comparison Tester so that weak coil may be identified before they fail in service. <p>Check the concerned circuit as per circuit diagram and rectify the defect.</p> <p>Check the magnet valve operation by depressing the armature manually. If not operating, check the air supply and rectify the defect.</p>

S. No	Defect	Possible cause	Suggested remedial actions
2.	Sluggish operation of apparatus	The rust and dust particles might have entered into magnet valves and rest on rubber seatings.	<p>a. During POH of EMU/MEMU or when ever any reverser/ WCO is replaced, the pneumatic pipe line of concerned apparatus should be blown before providing apparatus.</p> <p>b. Line strainer with sintered bronze filter element should be provided in pneumatic pipe line of apparatus.</p> <p>c. Care should be taken during schedule maintenance of reverser/ WCO to avoid entry of dust particles into magnet valve assembly.</p>
3.	Auxiliary inter lock not passing the feed.	Inadequate contact force or presence of foreign particles between contact faces.	<p>a. Follow RDSO SMI/173 during inspection and overhauling to improve reliability of interlocks.</p> <p>b. Examine the auxiliary interlock contact pressure manually during schedules and with tension gauge during overhauling. If spring is weak, replace the same.</p>

S. No	Defect	Possible cause	Suggested remedial actions
4.	PVC pipe burst.	<ul style="list-style-type: none"> - Poor quality of PVC pipe. - Cracks developed in PVC pipe. - Pipe in service beyond its life. 	<p>Use proper PVC pipe.</p> <p>Examine PVC pipe during inspection for any crack etc.</p> <p>Ensure replacement of pipe after its coded life.</p>
5.	Air leakage from magnet valve/ cylinder assembly	<ul style="list-style-type: none"> - Dirt/ dust in the pneumatic pipes fouling the valve seats. - Defective valve, valve stem, piston sealing ring etc. 	<p>Blow the pneumatic pipe lines before providing apparatus after overhauling.</p> <p>Examine the rubber seating of valve stem, valve and piston sealing ring etc. and replace if necessary. Ensure 100% replacement of rubber items during overhauling.</p>
6.	Fixed and moving contact tips flashed/ pitted.	<ul style="list-style-type: none"> - Low contact pressure. - Improper bedding. - Contacts worn out. 	<p>Examine contact pressure and contact spring for weakness.</p> <p>Check the bedding of contacts with each other.</p> <p>Check the contact air gap. Fit new contacts, if gap is more then specified.</p>

S. No	Defect	Possible cause	Suggested remedial actions
7.	Auxiliary interlock shunt broken.	<ul style="list-style-type: none"> - Loose crimping. - Tension on lug/shunt. 	<p>Always use proper size lug and crimping tool and ensure checking of lug crimping during every inspection</p> <p>Ensure that there is no tension on lug and loop wire have sufficient length.</p>
8.	Mechanical jam/ hard.	<ul style="list-style-type: none"> - Insufficient lubrication of piston and cylinder. - Insufficient lubrication of rack, pinion and levers. - Other mechanical defect such as rack/pinion teeth, shaft key broken. 	<p>Lubricate the cylinder of apparatus with grade SAE 30 oil through nipples provided in the cylinder walls during every IC schedules. Ensure that the piston is coincident with its nipples before applying the lubricant.</p> <p>The rack, pinion and levers of apparatus should be lubricated with shell alvania 3 grease or 4 x grease or equivalent during every IC schedule.</p> <p>Check the defect and rectify the same. Shaft key made from proper material should be used.</p>

CHAPTER 4

DO'S AND DON'TS

4.1 DO'S

1. Do check every electrical connection carefully for tightness.
2. Do ensure that one solenoid is not used repeatedly as the “standard” for surge comparison test.
3. Do ensure that all SMIs are being implemented during maintenance schedules/ overhauling.
4. Do ensure that auxiliary interlock assembly is in good condition.
5. Do ensure that all rubber gaskets/packings are replaced with new ones during overhauling.

4.2 DON'TS

1. Don't use emery or glass paper to clean contacts as particles of these materials which might adhere to the surfaces would cause bad contact.
2. Don't use wire wool to clean contacts or any other electrical apparatus.
3. Don't interchange magnet valve parts during schedule/ overhaul as this may result in incorrect valve stem lengths which will fail to give the specified operational test values.
4. Don't use cloth, emery paper, sand paper etc. for cleaning/ dressing of auxiliary interlock contacts.
5. Don't touch auxiliary contact tips by hand.

ANNEXURE ‘A’**SPECIAL MAINTENANCE INSTRUCTIONS ISSUED
BY RDSO FOR EP DEVICES**

S.No.	SMI No. & Date	Brief Description
1.	RDSO/ELRS/SMI/59 dt. 12.12.1979	Short turn testing of solenoids with the help of “Shorted Turn Indicator”.
2.	RDSO/ELRS/SMI/157 dt. 16.07.1993	Condition monitoring of solenoids by surge comparison method with the help of surge comparison tester.
3.	RDSO/ELRS/SMI/173 dt. 02.02.1995	Measure to improve reliability of interlocks.

REFERENCE

1. Manual of AC Traction - Maintenance and Operation, Volume III, 1994.
2. BHEL Maintenance Manual for 25 kV broad gauge AC and Main Line Electrical Multiple unit (Electrical Equipment). Book Number : MM/AC-M/EMU/003, January, 2001.
3. Field study and literature collected from various car sheds/ workshops.

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 specific comments please write to us.

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