
**GOVERNMENT OF INDIA**
**MINISTRY OF RAILWAYS**

(FOR OFFICIAL USE ONLY)

# MAINTENANCE HANDBOOK ON PROTECTION FUSES AND RELAYS OF ELECTRIC LOCOMOTIVES

**CAMTECH/ 2001/ E/ F & R / 1.0**

**MARCH, 2001**

**C**entr*e*
for
**A**dvanced
**M**aintenance
**TECH**nology

उच्च अनुरक्षण प्रौद्योगिकी केन्द्र

*Excellence in Maintenance*

**Maharajpur, GWALIOR - 474 020**

# MAINTENANCE HANDBOOK ON PROTECTION FUSES AND RELAYS OF ELECTRIC LOCOMOTIVES



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# FOREWORD

Railway is a service-oriented organization and it should aim to provide comfortable journey to the passengers as well as transport goods. Arrangement of proper electric supply is a key factor for properly operating the electric locomotives. Fuses and Relays of correct rating for each circuit should be provided.

This handbook on Protection Fuses and Relays contains very good information on correct maintenance procedure including their testing and trouble shooting for common problems.

I hope this handbook will prove to be very useful for all the field personnel of electric loco sheds and work shops.

***CAMTECH, GWALIOR*** ***(M. L. GUPTA)***
***30$^{TH}$ MARCH, 2001*** ***EXECUTIVE DIRECTOR***



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# PREFACE

Use of the Protection Fuses and Relays makes possible for the safe and perfect operation of all conventional electric locomotives. Their proper upkeep and maintenance is necessary to ensure reliability and availability of electric locomotives. This handbook on Protection Fuses and Relays has been prepared by CAMTECH with the objective of making our maintenance personnel of electric loco sheds and workshops, aware of correct maintenance procedure including their testing and trouble shooting for common problems.

It is clarified that this handbook does not supersede any existing provisions laid down in the "Maintenance manual of electric locomotive" and "AC traction manual" or instructions issued by Railway Board/RDSO.

I am sincerely thankful to all officers and staff of electric loco directorate of RDSO/LKO, IRIEEN/Nasik and various loco sheds for their valuable 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 us for any addition/modification in this handbook or if you have any ideas. I shall highly appreciate your contribution in this direction.

***CAMTECH, GWALIOR*** ***KHUSHI RAM***
***20$^{TH}$ MARCH, 2001*** ***DIRECTOR(ELECT.)***



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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

## 1.0 FUSE

Fuse is a simplest current interrupting device for protection from excessive current. It is used for overload and short circuit protection in medium voltage (up to 650 V) and low voltage (up to 400 V) installation as safety device. Modern high rupturing capacity (HRC) cartridge fuse provides a reliable discrimination and accurate characteristics.

Fuse is always used in the circuit before the load. In ac circuit it is connected in the live wire. In dc circuit the fuse is kept in +ve circuit. There are many types of fuses i.e. semi-enclosed or rewirable type, totally enclosed or cartridge type, dropout type, HRC cartridge type, expulsion type etc.

## 1.1 HRC Fuses

High Rupture Capacity (HRC) fuse links used to protect the system against over load and short circuit. It minimizes the damage by limiting the short circuit current. Fuse link housed in a ceramic body filled with chemically treated high quality quartz sand to ensure effective quenching of arc under short circuit conditions.

An indicator is provided in the body to clearly show the blowing of the fuse. In some fuses spring actuated indicator provided on the top end plate to positively indicate the blowing of fuse. HRC fuses are designed such that replacement is easy. It is available in the range of 2 amps to 500 amps. Different types of fuses are bolted type, Knife type, bottle type etc. fitted in porcelain & Bakelite fittings and suitable for DC supply and AC 415V, 50Hz. The short circuit rupturing capacity is greater than 80 kA and some manufacturer designed with colour coding for easy identification of different rating of HRC fuses. HRC fuses are reliable and accurate in performance as it is tested for its quality while manufacturing. It also ensures safety of transformers, cables etc. due to its cut off properties by reducing the electromagnetic and thermal stresses. Following are the advantages of HRC fuses:

1. Sparking does not come out from the fuse.
2. Atmosphere conditions do not affect the fuse.
3. Less maintenance
4. Fusing time decreases as per the increase in fault current.
5. Available in vides range from 2 Amp to 500 Amp. capacity.

## 1.2 **Action of HRC fuse**

Normally the fuse elements of (silver or copper) are in parts and connected in the middle by tin bridge.

Melting point is approx. 230°C. Therefore the bridge will not melt at ambient temperature. The current passing through fuse element produces heat, at certain current the temperature rises and the tin bridge melts producing a break in the circuit. There by an arc is produced. This arc is immediately spread over the neighboring elements and they too melt. The metal vapour diffuses with the quartz sand and the product of chemical reaction produces a substances of high resistance that becomes an insulator does not permit the current to flow.

## 1.3 HRC TYPE OF FUSES USED IN WAM4, WAG5 AND WAP1 ELECTRIC LOCOMOTIVES

| SN | Abbreviation | Description | Rating | Location |
|---|---|---|---|---|
| 1. | CCBA | Fuse for batteries | 35A | TB |
| 2. | CCDJ | Fuse for MTDJ circuit | 6A | TB |
| 3. | CCLC | Fuse for Cab, corridor, HT compartment lighting and wall socket. | 6A | TB |
| 4. | CCLF1-2 | Fuse for marker and PC lamps | 6A | TB |
| 5. | CCPT | Fuse for control circuit | 16A | TB |
| 6. | CCRA1-2 | Fuse for cab heaters | 16A | TB |
| 7. | CCRTPR | Fuse for head light circuit | 5A | TB |
| 8. | CCLS | Fuse for sending circuit | 6A | TB |
| 9. | CCTFS | Fuse for Selsyn transformer | 6A | TB |
| 10. | CCVT | Fuse for cab fan motors | 6A | TB |
| 11. | CCA | Fuse for auxiliary control circuit | 6A | TB |
| 12. | CCUA | Fuse for Voltmeter UA 1-2 | 6A | TB |

## 1.4 INSTRUCTION FOR MAINTENANCE OF FUSES

1. HRC fuses should be used of approved makes only.
2. Ensure that the breaking capacity of the fuse is lower than the prospective fault current.
3. Fuses should be so selected as to achieve discrimination with other protective devices in the system.
4. The terminating wires at fuse holders should be tightened properly otherwise it causes the burning of cable and damage of fuses.
5. Fuse should be of rated capacity. If it is overrated at the time of system overloading it may not break, causes the fire and failure of the systems. If it is underrated always breakdown of fuses causes interruption of system working.
6. In case of HRC fuse the healthiness of fuse to be checked periodically, otherwise it causes overheating, damage of fuse holder, terminating wires and system working.

## 1.5 **PROTECTION RELAYS**

The main function of a protective relay is to protect the vital equipment of locos with the least interruption to service by controlling the circuit breaker, when abnormal conditions develop. Thus the relays are designed to detect and to measure abnormal conditions and actuate the circuit breaker tripping circuit.

The following two categories of relays are most commonly used in protective device.

(a) Secondary indirect acting relays: A group including practically all kinds of relays, e.g. current, voltage, power, impedance, reactance and frequency, whether minimum or maximum.

(b) Secondary direct-acting relays: A group of over current and under voltage relays designed to operate instantaneously or with time lag. These are primarily relays of the electromagnetic type, which are built into circuit breaker operating mechanisms.

Following relays are provided in WAM4, WAG5 and WAP type of electric locomotives for protection of equipment against abnormal current/ voltage and other faults.

### 1.5.1 Line Overload Relay QLM

The relay QLM is fed by means of the high voltage current transformer TFILM, which causes high voltage circuit breaker DJ to trip out, if the current taken in by the main transformer exceeds the setting value of the relay.

### 1.5.2 Overload Relays for Silicon Rectifies (QRSI 1 and 2)

The relays QRSI 1-2 are fed by means of the rectifier current transformer RSILM 1 and 2 (4000/5A) which cause the high voltage circuit breaker to trip, if the current taken in by the rectifiers exceeds the setting value of the relays (3600 A).

### 1.5.3 Slipping Device Differential Relay QD 1-2

Wheel slip relays are of differential type. When the current difference is 125 A in between traction motors 2 and 3 and traction motors 4 and 5, the relay operates. In case of wheel slipping, it feeds relay Q-48, thereby energising sanding electrovalves VESA and sand is applied to corresponding wheels Relay Q-51 is also energises causing regression of tap changer till the slipping stops.

### 1.5.4 Power Circuit Earthing Relays QOP 1-2

In case of failure of insulation of traction power circuit to earth, the battery supply available across the allows to pick up the relay through the earth fault path and in turn opens the HV circuit breaker DJ.

The switch HQOP 1-2 makes it possible to isolate the relay QOP 1 or 2 and inserts a resistance RQOP in the earthed path in order to limit the fault current. Otherwise it will not be possible to switch on again the circuit breaker DJ to clear the section and bring the locomotive to the shed.

### 1.5.5 Traction Motor Over Voltage Relay Q-20

Relay Q-20 with series resistance RQ-20 is connected across rectifier output and causes buzzer SON 1-2 to work. The relay picks up if, TM voltage exceeds 854 V. When voltage falls to 740 V, the Q20 relay resets and buzzer stops working.

### 1.5.6 No Voltage Relay Q-30

The relay Q-30 drops out if the single-phase auxiliary winding voltage drops below 215 volts. Its contacts switch off relay Q-44, thereby tripping DJ. Relay Q-30 is switched on directly through the contacts of the relays Q-45 and remains in the circuit with series resistor RQ-30 after the relay Q-45 opens/drops.

### 1.5.7 **Arno Starting Relay QCVAR**

Relay QCVAR has been put across 'W' phase and neutral of arno to ensure that the arno starting resistance are 118 is disconnected from the circuit when generated face voltage is in between 150 to 160 V AC. This cuts out arno starting contactor C118. The relay picks up at 155-160 volts AC.

### 1.5.8 **Battery Charger Signaling Relay QV-61**

This relay is provided across battery charger CHBA and indicates the working of the charger. This relay is English Electric make picks up below 68V DC.

### 1.5.9 **Regression Relay QRS**

Relay QRS is energised when the loco is in running condition and deenergised when the brake is applied. This relay operates through its N/C contacts and regresses the tap changer.

### 1.5.10 **Passenger Alarm Relay (PAR)**

This relay operates in case of Alarm Chain pulling or trains parting. The relay will energise the Buzzer B1 & B2 and extinguish lamps LPAR 1 & LPAR 2.

### 1.5.11 Buzzer Isolation Relay (BIR)

This relay operates when BIS push button switch is pressed, thereby isolating the buzzer from the circuit.

### 1.5.12 Breaking Excitation Overload Relay QE

The relay QE is fed by means of the excitation current transformer which causes the braking excitation contactor C145 to trip out, if the current taken by the excitation winding of the motors exceed the setting value of the relay (900 A).

### 1.5.13 Braking Overload Relay QF-1 & QF - 2

The relays QF 1-2 are connected through the shunts SHF 1-2, which cause the braking excitation contactors C-145 to trip out, if the current in the braking resistance RF-1 and 2 exceeds the setting value of the relays (900 A).

## 1.6 Basic Principle of Operation of Protective System

Each relay in a protection scheme performs certain function and responds according to a certain type of change in the circuit quantities. For example one type of relay may operate when the current increases above a certain magnitude, while another

may compare current and voltage and operate when the ratio V/ I is less than a given value. The first relay is known as an overcurrent relay while the latter an under impedance relay. Similarly various combinations of these electrical quantities could be worked out according to the requirements.

## 1.7 Basic Terminology

Some of the important terms used for relays are defined below:

### 1.7.1 Protective Relay

An electrical device designed to initiate isolation of a part of an electrical installation or to operate an alarm signal, in the event of an abnormal condition or a fault.

### 1.7.2 Characteristic Quantity

The quantity to which the relay is designed to respond viz. current in an overcurrent relay, impedance in an impedance relay, phase angle in a directional relay, etc. Some relays have a calibrated response to one or more quantities, such quantities are called characteristic quantities.

### 1.7.3 **Setting**

The actual value of the energizing or characteristic quantity at which the relay is designed to operate under given conditions.

### 1.7.4 **Pickup**

A relay is said to pickup when it moves from the off position to the on position. The value of the characteristic quantity above, which this change occurs, is known as pickup value.

### 1.7.5 **Dropout or Reset**

A relay is said to dropout when it moves from the on position to the off position. The value of the characteristic quantity below which this change occurs is known as dropout or reset value.

### 1.7.6 **Primary Relays**

Those relay which are connected directly in the protected circuit.

### 1.7.7 **Secondary Relay**

Those relays connected to the protected circuit through current and potential transformers.

### 1.7.8 **Auxiliary Relays**

Relays which operate in response to the opening or closing of its operating circuit to assist another relay in the performance of its function. The auxiliary relay may be instantaneous or may have a time lag and may operate within large limits of the characteristic quantity.

### 1.7.9 **Backup relay**

A relay, which operates usually after slight time delays if the normal relay, does not operate to trip its circuit breaker. A backup relay acts as a second line of defence.

### 1.7.10 **Consistency**

Accuracy with which the relay can repeat its electrical or time characteristics.

### 1.7.11 **Flag or Target**

A device used for indicating the operation of a relay, it is usually spring or gravity operated.

### 1.7.12 **Blocking**

Preventing the protective relay from tripping either due to its own characteristic or due to an additional relay.

# CHAPTER 2

# INSPECTION SCHEDULE

Inspection schedule of WAP1, WAM4 and WAG5 class of electric locomotives is as under.

'*' Inspection to be done, '-' Inspection not to be done

| S.N | ITEM | I A | I B | I C | AO H |
|---|---|---|---|---|---|
| 1. | **Auxiliary Contacts** | | | | |
| | Check contact pressure and wipe. | - | - | * | * |
| | Visually examine and clean contacts, terminals and contact support, bus bar connectors. | - | - | * | * |
| | Check and tighten all wiring terminals | - | - | * | * |
| | Check alignment and bedding of contacts. | - | - | * | * |
| 2. | **Coil** | | | | |
| | Check coil for electrical or mechanical damage. | - | - | * | * |
| | Dusting – parts of all relays. | - | - | * | * |



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| S.N | ITEM | I A | I B | I C | AO H |
|---|---|---|---|---|---|
| 3. | **Bolts, nuts, screws and wiring terminals**<br>Tighten all nuts and fixing screws. | - | - | * | * |
| 4. | **Time delay relay**<br>Check the time setting and operation.<br>Overhaul all relays and test | *<br>- | *<br>- | *<br>- | *<br>* |

## 2.1 MONTHLY SCHEDULE (IA)

| | |
|---|---|
| **Relay** | 1. Check working of relay Q 30 on test bench.<br>2. Check and record time lag of Q44, Q118. |

## 2.2 BI-MONTHLY SCHEDULE (IB)

In addition to IA, following work to be carried out.

| | |
|---|---|
| **Relays** | Polish and clean the contacts of QCVAR, Q-45, Q-48, Q-50, Q-47 & Q-51. |
| **Time lag relays** | Check and adjust time lag setting in seconds of Q44 (0.6) and Q118 (5). |
| **SMGR Relays** | Remove relays Q46, Q52 and check up their proper working on test bench. |

## 2.3 FOUR MONTHLY SCHEDULE (IC)

In addition to IB, following work to be carried out.

| | |
|---|---|
| **Air flow relays** | 1. Remove airflow relays QVMT-1, QVMT-2, QVRH, QVSIs and QVSL.<br>2. Check the condition of their diaphragm.<br>3. Thoroughly overhaul and test the relays.<br>4. Refit along with a proper gasket. |
| **Relay's Panel** | Check, fixed and mobile contacts of relays Q-45, Q-50, Q-47, QWS, Q-100 and QPV. |
| **Time lag relays** | Check the time lag setting of QTD-105, QTD-106 and C-118. Adjust if necessary. |

## 2.4 TESTING OF RELAYS

### 2.4.1 Testing of DI – Oerlicon Relays

| S. N. | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Q LM | Q RSI-1 | Q RSI-2 | Q E | Q F1 | Q F2 |
| 1. | Coil Resistance at 20°C | 0.03 ± 0.0024 Ω | | | | | | |
| 2. | Contact Pressure | 12 ± 3 gms | | | | | | |
| 3. | Contact Gap | 0.7 mm (approx.) | | | | | | |
| 4. | Record drum setting value | | | | | | | |
| 5. | IR value with 500V megger<br>i) Coil to earth<br>ii) Contact to earth. | <br>10 M ohms<br>10 M ohms | | | | | | |

## 2.4.2 **Testing of DU – Oerlicon Relays**

| SN | TEST | STANDARD | ACTUAL | | |
|---|---|---|---|---|---|
| | | | QOP | QOA | Q30 |
| 1. | Insulation resistance with 500 Volts Megger between<br>(a) Coil to Body<br>(b) Contact to Body | <br><br>10 M Ω<br>10 M Ω (min.) | | | |
| 2. | Check visually the body and cover for crack and damage. | No crack<br>No damage | | | |
| 3. | Check the condition of contact tips. | Good condition | | | |
| 4. | Check the coil resistance<br>i. For QOP & QOA relay<br>ii. For Q30 relay. | <br>1800 ± 8% Ω<br>1190 ± 8% Ω | | | |
| 5. | Check the Minimum pick up voltage of the relay.<br>i. For QOP & QOA relay<br>ii. For Q30 relay | <br><br>50 Volts DC<br>215 Volts AC | | | |
| 6. | Check the drop out Voltage of Q30 relay. | 140– 160 V AC | | | |
| 7. | Check the Contact gap | 0.7 mm | | | |
| 8. | Check the contact pressure | 09 – 15 gms. | | | |
| 9. | Check the coil for interurn shorting as per SMI-59. | No interturn shorting | | | |
| 10. | Screening of the coil as per SMI-69 | To be done | | | |
| 11. | Provide minlex paper cover for protection cover of coil | To be provided | | | |
| 12. | Colour sealing of drum setting and wire sealing of front cover. | To be done | | | |

2.4.3 **Testing of Auxiliary Sequence and Control Relays**
**Type and Make**: VAA11 or 12, EEC, PC-8 axm/ABB GKS-4 and KS-6/ Oerlikon.

| SN | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Q 45 | Q 47 | Q 50 | Q 100 | Q PV | Q WC |
| 1. | Insulation resistance with 500 volt Megger between<br>(a) Coil to earth<br>(b) Contact to earth<br>(c) Coil to contact | 10 Mega ohms (Minimum) | | | | | | |
| 2. | Check the body and cover for crack and damage | No crack No damage | | | | | | |
| 3. | Check the condition of contacts | Good condition | | | | | | |
| 4. | Check resistance of the coil<br>(a) EEC make<br>(b) BBC make<br>(c) Oerlikon make<br>(d) ABB make | 5000 ± 20 %Ω<br>1000 ±10 % Ω<br>1215 ± 8 % Ω<br>1100 ± 15% Ω | | | | | | |
| 5. | Check the minimum pick up voltage of the relay | 68 V DC | | | | | | |
| 6. | Check the contact gap (for N/O contact)<br>(a) EEC make<br>i) VAA 11 type<br>ii) VAA 12 type<br>b) PC8 type<br>c) Oerlikon make<br>d) ABB make | <br><br>1.77–2.03 mm<br>1.52–2.03 mm<br>2.5 mm<br>2 - 1.8 mm<br>1.8 ± 0.4 mm | | | | | | |



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| SN | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Q 45 | Q 47 | Q 50 | Q 100 | Q PV | Q WC |
| 7. | Check the contact pressure (for both N/O and N/C pair of contact)<br>a) EEC make<br>b) BBC make<br>c) Oerlikon make | <br><br>20 –25 gms.<br>15 – 20 gms<br>18 – 30 gms. | | | | | | |
| 8. | Check the closing of contact by bell tester or multimeter. | Bell should ring, or multimeter should indicate zero resistance. | | | | | | |
| 9. | Check the value of resistance connected in series with coil<br>a) For PC-8 axm type<br>b) For KS-4 & KS-6 type<br>i)For Q50, Q100, QPV, QWC<br>ii) For Q45, Q47 relay | <br><br>1.0±5%K Ω<br><br>1.5±5%K Ω<br>1.3±5%K Ω | | | | | | |
| 10. | Check the coil for inter turn shorting as per SMI – 59 | No inter turn shorting | | | | | | |
| 11. | Coil screening as per SMI-69 | To be done | | | | | | |
| 12. | Wire sealing of front cover. | To be done | | | | | | |

### 2.4.4 **Testing of Auxiliary Sequence and Control Relays**

**Type and Make**: VAA 11 or 12/EEC, PC-8 AXM/BBC

| S N | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Q 46 | Q 49 | Q 52 | Q 51 | Q PR1 | Q PR2 |
| 1. | Insulation resistance with 500 volts megger between<br>a) Coil to earth<br>b) Contact to earth<br>c) Coil to contact | 10 Mega ohms (minimum) | | | | | | |
| 2. | Check body and cover for any crack/ damage | No crack<br>No damage | | | | | | |
| 3. | Check the condition of contacts. | Good condition | | | | | | |
| 4. | Check resistance of the coil<br>a) EEC make<br>b) BBC make<br>c) Oerlikon make | 5000 ± 20% Ω<br>1000 ± 10% Ω<br>1215 ± 8% Ω | | | | | | |
| 5. | Check the minimum pick up voltage. | 68 Volts DC. | | | | | | |
| 6. | Check the contact gap (for N/O contacts).<br>a) EEC make<br>i)VAA11 type<br>ii)VAA 12 type<br>b) BBC make<br>c) Oerlikon make | 1.77– 2.03 mm<br>1.52–2.03 mm<br>2.5 mm<br>2 - 1.8 mm | | | | | | |

| SN | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Q 46 | Q 49 | Q 52 | Q 51 | Q PR1 | Q PR2 |
| 7. | Check the contact pressure (for both N/O and N/C pair of contact)<br>c) EEC make<br>d) BBC make<br>c) Oerlikon make | <br><br><br>20 –25 gms.<br>15 – 20 gms<br>18 – 30 gms. | | | | | | |
| 8. | Check the closing of contact by both tester and multimeter. | Bell should ring, or multimeter should indicate zero resistance | | | | | | |
| 9. | Check the value of resistance connected in series with the coil.<br>a) For PC-8 axm type (Q51, QPR1 & 2 relay)<br>b)For KS-4 & KS-6 type | <br><br><br>1.0 ± 5% KΩ<br>1.5 ± 5% Ω | | | | | | |
| 10. | Check coil for inter turn shorting as per SMI- 59 | No inter turn shorting | | | | | | |
| 11. | Screening of coil as per SMI – 69 | To be done | | | | | | |
| 12. | Wire sealing of front cover. | To be done | | | | | | |

### 2.4.5 **Testing of Signaling Relays**

**Type and Make**: VAA 11 or 12/EEC, PC-8 AXM/ BBC KS-4 and KS-6/ Oerlikon.

| SN | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | QV 60 | QV 61 | QV 62 | QV 63 | QV 64 | QV LS |
| 1. | Insulation resistance with 500 Volt megger between<br>a)coil to earth<br>b)contact to earth<br>c)Coil to contact | 10 M Ω (minimum) | | | | | | |
| 2. | Check the body and cover for cracks of damage. | No crack<br>No damage | | | | | | |
| 3. | Check, condition of the contacts. | Good condition | | | | | | |
| 4. | Check, resistance of coil.<br>a)EEC make<br>b)BBC make<br>c)Oerlikon | 5000 ± 20% Ω<br>1000 ± 10% Ω<br>1215 ± 8% Ω | | | | | | |
| 5. | Check the minimum pick up voltage of the relay. | 68 V. DC | | | | | | |
| 6. | Check the contact gap (for N/O contacts)<br>a) EEC make<br>i) VAA11 type<br>ii) VAA 12 type<br>b) BBC make<br>c) Oerlikon make | <br><br>1.77–2.03 mm<br>1.52 –2.03 mm<br>2.5 mm<br>2 - 1.8 mm | | | | | | |



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| SN | TEST | STANDARD | ACTUAL | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | QV 60 | QV 61 | QV 62 | QV 63 | QV 64 | QV LS |
| 7. | Check the contact pressure (for both N/O and N/C pair of contact)<br>a) EEC make<br>b) BBC make<br>c) Oerlikon make | <br><br>20 –25 gms.<br>15 – 20 gms<br>18 – 30 gms. | | | | | | |
| 8. | Check the closing of contacts by bell tester or multimeter. | Bell should ring or multimeter should indicate zero resistance | | | | | | |
| 9. | Check value of resistance connected in series with coil<br>a) QV 61 of VAA type<br>b)For PC – 8 axm type<br>c)For KS-4 & KS-6 type | <br>1.8 ± 5% KΩ<br>1.0 ± 5% KΩ<br>1.5 ± 5% KΩ | | | | | | |
| 10. | Check the coil for interturn shorting as per SMI-59. | No inter turn shorting | | | | | | |
| 11. | Screening of coil as per SMI –69 | To be done | | | | | | |
| 12. | Wire sealing of front cover | To be done | | | | | | |



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### 2.4.6 **Testing of AC- QCVAR Relay**

**Type and Make**: VAG/ English Electric Co. Madras

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 1. | **Incoming test**<br>Connect the relay on test bench and check the following:<br>a) Minimum pick up voltage<br>b) Drop out voltage | <br><br><br>162 V AC<br>100 V AC | |
| 2. | Insulation resistance with 500 V megger between<br>a) Coil to earth<br>b) Contact to contact | <br><br>10 Mega ohms ( minimum) | |
| 3. | Check the resistance of following coils:<br>a) AC Coil<br>b) DC Coil Unmodified.<br>c) DC Coil Modified. | <br><br>4000– 6000 Ω<br>1200 –1300 Ω<br>4000– 6000 Ω | |
| 4. | Check the value of external resistance connected in series with the following coils<br>a) AC coil<br>b) DC coil (Unmodified) | <br><br><br>27 ± 5% K Ω<br>1.3± 5% K Ω | |
| 5. | Check the capacitor by charging and discharging method. | Capacitor should be in healthy condition | |
| 6. | Check the AC and DC coil for inter turn shorting as per SMI–59 | No inter turn shorting | |
| 7. | Screening of AC and DC coil, as per SMI-69 | To be done | |
| 8. | Check the contact gap in mm | 1.77 to 2.03 | |

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 9. | Check the pressure required to make the N/O contact tips to touch each other. | 10 – 25 grams | |
| 10. | Nominal armature gap. | 1.27 mm | |
| 11. | Check (after overhauling)<br>a) Minimum pick up voltage<br>i) Modified relay as per SMI-131<br>ii) For unmodified relay<br>b) Drop out voltage<br>i) Modified relay as per SMI-131<br>ii) For unmodified relay. | <br><br>155–160 V AC<br>110–140 V AC<br><br>75 – 77 V Ac<br>60 – 80 V AC | |

2.4.7 **Testing of Time lag Relays**

**Type and Make**: RTP 61-63/ Alsthom, VTT12/ EEC

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 1. | Insulation resistance with 500 v megger between<br>a) Coil to body<br>b) Contact to contact<br>c) Contact to coil. | <br>10 Mega ohms (minimum) | |
| 2. | Check the resistance of coil<br>a) Alsthom make<br>b) EEC make<br>c) ABB make | <br>1500 ± 10% Ω<br>5000 ± 20% Ω<br>900 ± 12% Ω | |
| 3. | Check the contact gap<br>a) Alsthom make<br>b) EEC make<br>c) ABB make | <br>1.5 – 2.5 mm<br>1.77– 2.03 mm<br>1.5 – 2.5 mm | |

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 4. | Check the contact pressure<br>a) Alsthom make<br>b) EEC make<br>i) Pressure required to make tip to touch (for N/O contact)<br>ii) Pressure required to lift the moving contact to clear off the fixed contact (for N/C contact) | <br>90 – 120 gms.<br>20 – 30 gms<br>20 – 25 gms<br><br>15 – 25 gms | |
| 5. | Check the minimum pick up voltage of the relay<br>a) Alsthom make<br>b) EEC make<br>c) ABB make | <br>60 – 68 V DC<br>77 –140 V DC<br>50 – 55 V DC | |
| 6. | Sponge and provide sealing compound on the rear side, if found damage. | To be provided. | |
| 7. | Check the time lag obtained after de-energisation of coil<br>a) Q – 44<br>b) Q – 118 | 0.6 + 0.3 secs.<br>- 0.0 secs.<br>5.0 + 0.9 secs.<br>- 0.0 secs. | |
| 8. | Check the coil for inter turn shorting as per SMI – 59 | No inter turn shorting | |
| 9. | Screening of coil, as per SMI-69 | To be done | |
| 10. | Lubrication of balance wheel of clock mechanism of ABB makes relay, as per SMI – 119. | To be done | |

### 2.4.8 **Testing of Time lag Relays**

**Type and Make**: RTPN/ BCH, VTT/ EEC, Unilec

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 1. | Insulation resistance with 500 volt megger between<br>a) Coil to body<br>b) Contact to body<br>c) Contact to coil | 10 Mega ohms (minimum) | |
| 2. | Check the coil resistance<br>a) EEC make<br>b) Unilec make<br>c) Cutler hammer make | <br>1350 – 1650 Ω<br>100 – 200 Ω<br>50 – 80 Ω | |
| 3. | Check the contact gap in mm – (for EEC make) | 1.77 – 2.03 | |
| 4. | Check the contact pressure (for EEC make)<br>a) Pressure required to make the tip to touch (for N/O contact)<br>b) Pressure required to lift the moving contact to clear the fixed contact (for N/C contact) | <br>20 – 25 gms<br>15 – 25 gms | |
| 5. | Check the microswitch contacts closing with the help of multimeter or bell tester (for Unilec and Bharat Cutler Hammer make)<br>Switch 1<br>Switch 2<br>Switch 3 | Bell should ring or Multimeter should indicate zero resistance. | |



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| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 6. | Check the minimum pick up voltage –<br>a) EEC make<br>b) Unilec make<br>c) Cutler Hammer make | <br><br>77 –140 V DC<br>65 – 75 V DC<br>65 – 75 V DC | |
| 7. | Check the value of economy resistance<br>a) Unilec make<br>b) Cutler Hammer make | <br><br>1000 ± 5% Ω<br>500 ± 5% Ω | |
| 8. | Check the time lag obtained after deenergisation of coil. | 4 seconds | |
| 9. | Screening of coil, as per SMI–69 | To be done | |

2.4.9 **Testing of Time Delay Relays**

**Type and Make**: RTPN/ BCH, Universal Elect. Co.

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 1. | Incoming test:<br>Connect the relays on test bench and check function of timer assembly. | To be done | |
| 2. | Insulation resistance with 500 volts megger between<br>a) Coil to earth<br>b) Contact to earth<br>c) Coil to contact | <br><br>10 mega ohms (minimum) | |



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| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 3. | Check resistance of operating coil<br>a) Universal electrical co.<br>b) Cutler hammer unmodified<br>c) Cutler hammer modified. | <br>600 – 800 Ω<br>50 – 80 Ω<br>500 ± 5% Ω | |
| 4. | Check the value of economy resistance<br>a) Universal electrical Co.<br>b) Cutler hammer unmodified. | <br><br>400 ± 5% Ω<br>550 ± 5% Ω | |
| 5. | Check the micro switch contacts closing with the help of multimeter or bell tester-<br>Switch – 1<br>Switch – 2<br>Switch – 3 | Bell should ring or<br>Multimeter should indicate zero resistance | |
| 6. | Check the minimum pick up voltage | 60 – 68 V DC | |
| 7. | Check condition of diaphragm of timer assembly | Good condition | |
| 8. | Check the time delay obtained after energising operating coil. | 5 ± 0.9 seconds. | |
| 9. | Check the coil for inter turn shorting as per SMI – 59 | No inter turn shorting | |
| 10. | Screening of coil , as per SMI 69 | To be done | |

### 2.4.10 **Testing of Differential Relays**

**Type and Make**: TR-70/ Alosthom, Rotomac

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 1. | Insulation resistance with 2.5 kV megger between<br>a) Coil terminals to fix armature<br>b) Contact to fix armature | 10 Mega ohms (minimum) | |
| 2. | Check minimum pick up value of current | 125 A, DC | |
| 3. | Check the drop out current | 40A, DC | |
| 4. | Check the condition of contacts | Good. | |
| 5. | Check the closing of contact by bell tester or multimeter<br>Switch – 1<br>Switch – 2 | Bell should ring or multimeter should indicate zero resistance. | |
| 6. | Check contact gap | 5 – 6 mm | |
| 7. | Check contact pressure | 125 – 200 gms | |
| 8. | Check, terminal plate & terminal separator for crack, damage. | No crack<br>No damage | |
| 9. | Check the condition of threads of terminal studs. | Good condition | |
| 10. | Varnishing of coil, connection plates frame plate, and coil packing with antitrack varnish. | To be done | |



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| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 11. | Carry out HV testing<br>i) At 2.5 kV, 50 HZ for one minute between coil and magnetic circuit connected to ground (leakage current)<br>ii) At kV, 50 HZ for one minute between<br>a) Contacts to ground<br>b) Opened contacts<br>c) Terminals 3-4, 4-5, 5-6 | 10 Milli amps (maximum)<br><br>10 Milli amps (maximum) | |
| 12. | Sealing of adjusting screws contact nuts and cover. | To be done | |

2.4.11 **Testing of Over voltage Relays**
**Type and Make**: TR-751/ Alosthom, Rotomac

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 1. | Insulation resistance with 2.5 kV megger between<br>a) Coil terminals to earth<br>b) Contact to earth | 10 Mega ohms (minimum) | |
| 2. | Check the coil resistance<br>a) Alsthom make<br>b) Rotomac make | 722 ± 8% ohms | |
| 3. | Check the minimum pick up voltage | 1500- 48 V DC | |
| 4. | Check the drop out voltage | 1350– 43 V DC | |
| 5. | Check the condition of contact | Good | |

| S.N. | TEST | STANDARD | ACTUAL |
|---|---|---|---|
| 6. | Check the closing of contact by bell tester or multimeter | Bell should ring or multimeter should indicate zero resistance. | |
| 7. | Check contact gap | 1.6 mm | |
| 8. | Check contact pressure | 75 – 85 gms | |
| 9. | Check terminal plate & terminal separator for crack, damage. | No crack<br>No damage | |
| 10. | Check the condition of threads of terminal studs. | Good condition | |
| 11. | Carry out HV testing<br>i) At 2.5 kV, 50 HZ for one minute between coil and magnetic circuit connected to ground (leakage current)<br>ii) At kV, 50 HZ for one minute between<br>a) Contacts to ground<br>b) Opened contacts<br>c) Terminals 3-4, 4-5, 5-6 | 10 Milli amps (maximum)<br><br>10 Milli amps (maximum) | |
| 12. | Sealing of adjusting screws contact nuts and cover. | To be done | |
| 13. | Screening of coil, as per SMI – 69 | To be done | |
| 14. | Sealing of adjusting screws, contact nuts and cover. | To be done | |

# CHAPTER 3

# PROBLEM AND REMEDIES

## 3.1 COMMON PROBLEM AND THEIR REMEDIES

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 1. | UBA needle not deflect or it shows less voltage | Battery may be defective or discharged.<br>CCBA may be defective |
| 2. | All pilot lamps do not glow. | Check CCLS and replaced if required.<br>Check continuity of the circuit. |
| 3. | LSDJ does not glow in driving cab.<br><br>LSDJ does not glow in both cabs. | Pantograph do not raise<br>Put MPJ in 'F' or 'R' position. If LSB extinguishes, conclude DJ is locked.<br>Increase pressure to 7 kgs/$cm^2$. If LSDJ not glows then<br>Put HBA on zero.<br>Ground the loco.<br>Release the pressure fully by opening RDJ drain cock.<br>Remove bottom cover of DJ.<br>Open DJ with the help of 32, mm spanner. Close DJ on 'LT' and open again. If DJ closes and opens, then close on 'HT'. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 4. | LSCHBA does not glow. | Check LSCHBA in non-working cab. If it is glowing, then replace LSCHBA bulb of working cab. |
| 5. | LSB does not glow. | Check LSB in non-working cab. If it is glowing, then replace LSB bulb of working cab. |
| 6. | LSGR does not glow. | Check LSGR in non-working cab. If it is glowing, then replace LSGR bulb of working cab. |
| 7. | MCPA does not start. | Check fuse CCBA. Replace if, fused. |
| 8. | MCPA working but pressure does not increase. | Open 'RAL' cock. Ensure the RDJ pipe is coupled. Arrest any leakage in the system. Ensure that the followings are closed.<br>a. RL cock<br>b. Panto drain cock.<br>c. MCPA drain cock.<br>d. Emergency reservoir drain cock.<br>e. RDJ drain cock.<br>f. DJ oil separator drain cock. |
| 9. | Pantograph do not raise | Change the position of ZPT. If it do not rise, check VEPT. If it is not energising, check CCPT. Change if it is fused. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 10. | Relay Q118 dose not pick up | Battery may be defective or discharged. CCBA may be defective<br>Relay may be defective<br>CCPT may be defective<br>Check CCPT and other normally closed interlocks on the branch of relay Q118.<br>a. Place HVMT-1 on '0' Q-118 gets energised. Conclude that normally closed interlock of C-105 is defective.<br>b. Place HVMT-2 on '0' Q-118 gets energised. Conclude that normally closed interlock of C-106 is defective.<br>c. Place HVRH on '0' Q-118 gets energised. Conclude that normally closed interlock is defective.<br>d. Place HVSL, HPH, and HQCVAR on '0' Q-118 gets energised. Conclude that Q-44 normally closed interlock is defective.<br>If, DJ closes as a result of operation (a) to (d) above, put the switches (HVMTs, HVRH, HVSL, HPH, HQCVAR) on normal position. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| | | e. If, Q-118 does not energise by the above operations, take manual control of relay Q-118. Close DJ and start all auxiliaries. Conclude that '0' to 5 interlock of 'GR' are defective.<br>f. If 'DJ' trips again on releasing Q118, wedge Q118. |
| 11. | Relay Q-118 energises but Q-44 is not energising. | a. Check CCDJ fuse and replace if required.<br>b. CCDJ fuse OK. Operate BP1DJ a couple of times if DJ closes, close DJ by BP2 DJ.<br>c. If Q-45 does not energise by BP2DJ, check that GR is at 'O'. Then take manual control of relay Q-45 for closing DJ and release Q-45 after LSCHBA extinguishes or after 4 seconds after DJ closing.<br>d. If DJ still does not close, then change the cab. If DJ closes and maintains, clear the section by observation traffic rules. |
| 12. | Q-45 energises but Q44 does not energise. | Take manual control of Q44 for closing DJ and release it after DJ closes. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 13. | LSDJ extinguishes and glows again (DJ not maintaining i.e. LSDJ just flickers) QLM relay drops alone. | Check safety relay targets. If any safety relay has operated. Reset the target.<br><br>Lower the pantograph and do not energise loco. |
| 14. | Target of relay 'QOA' dropped. | 1. Reset the target. Close DJ If it drops again, isolate the relay by putting HQOA in 'O' position.<br>2. In case of burnout of any auxiliary motor, isolate that particular motor and put out the QOA in service. |
| 15. | Target of relay QOP dropped. | 1. Reset the target. Close DJ. If it is drops, again isolate the relay by putting HQOP in off position.<br>2. If QOP is dropping at notches, isolate the traction motor group by changing the position of HMCS. If QOP still drops, isolate RSI block. If QOP still drops isolate QOP. If you have isolated any RSI block, limit the traction motor current to less than 500 amp. in parallel locos and less than 750 amps in series parallel locos. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 16. | LSDJ extinguishes and UA deviates when BLRDJ is pressed but glows again, i.e. just flickers once immediately even when BLRDJ is pressed (No relay target drops). | 1. Check air pressure in auxiliary reservoir. If less, increase it up to 7 kg/cm$^2$ by working MCPA.<br>2. If pressure is OK then isolate QPDJ and keep a constant watch on pressure gauge and do not allow pressure to drop below 6.5 kg/ cm$^2$<br>If DJ still trips with the above indication, this indicates Q-30 is defective. |
| 17. | LSDJ and LSCHBA extinguish, UA deviates, when BLRDJ is pressed but LSDJ glows again 0.6 seconds after releasing BLRDJ. | 1. Check LSGR is glowing and GR is on 'O'.<br>2. Keep MP on 'O' and wedge relay Q-44 for closing DJ. |
| 18. | LSDJ and LSCHBA extinguish. UA deviates when BLRDJ is pressed but LSDJ glows again after 5-6 seconds. | 1. Isolate QPH, QVSL or QCVAR one by one which ever is defective. If QPH or QVSL are defective and isolated, physically check and ensure that MPH and MVSL are working.<br>2. Check that C-118 is open after closing DJ. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 19. | LSDJ extinguishes, LSCHBA does not extinguish but UA deviates and DJ trips after 5-6 seconds. | 1. If arno is working, isolate relay QCVAR.<br>2. If arno is not working then ask to TLC. |
| 20. | LSDJ extinguishes, LSCHBA does not extinguish and UA does not deviates and DJ opens. | Try to close DJ after 2 to 3 minutes, ensuring air pressure in auxiliary reservoir is more than 7 $kg/cm^2$. After waiting for 6 minutes, lower the panto and try with front panto.<br>Note: To differentiate DJ tripping in Serial No. (16, 17, 18, 19 and 20), driver should watch the relays Q118 and Q44 asking the assistant driver to close DJ from BP2DJ.<br>1. For Serial No.16, detonation of DJ opening will be heard first. Relay Q44 will be energising later.<br>2. For Serial No. 17 and 20 relay Q-44 will de-energise first, and DJ tripping sound will be heard later.<br>3. For Serial No. 18 and 19 relay Q-118 will de-energising first and then relay Q-44 will de-energise followed by opening sound of DJ. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 21. | C-101 does not close. | Close BLCPD. If compressor start, it means BLCP switch is defective. If MCP still does not start, then close BLPV. If exhausters also do not work, then close BLVMT. If all auxiliaries do not start, then trouble shoot as explained in para 3.2 page 42 "All auxiliaries not starting". If CP is not starting but PV starts then wedge contactor C-101 and create a leak to avoid blowing of safety valve. |
| 22. | On closing BLVMT, LSDJ glows again after 5-6 seconds. | This is due to QVRH defective. Put HVRH on '3' and ensure that MVRH is working. |
| 23. | On closing of BLVMT, LSDJ glows again after 10.6 seconds. | This is due to QVMT-1 defective. Ensure that MVMT-I is working isolate relay QVMT-1, by placing, HVMT-I on position '3'. |
| 24. | On closing of BLVMT, LSDJ glows after 15.6 seconds. | This is due to QVMT-2 defective. Isolate relay QVMT-2 by putting switch, HVMT-2 on '3' and ensure functioning of MVMT-2. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 25. | LSB does not extinguish | Check position of MP on ‘ 0’. Both J1 and J2 are in desired direction. If not, ground the loco and operate the concerned J manually. Check if LSB extinguishes. If LSB does not extinguish, then wedge Q-50. |
| 26. | LSGR does not extinguish and NR does not progress. | Switch over to EEC<br>Preparation for EEC<br>1. MP on N<br>2. ZSMS on ‘1’.<br>3. Press BPP for progression, if EEC does not respond then check relay Q-51 is not nergised. If Q-51 is energised then remove wire no 115 from relay and tape it properly and check Q-51 is de-energised. If Q-51 is not energised then switch over to manual control.<br>**Preparation for manual control of GR**<br>Take out ZSMGR handle and fit it on GR shaft in 6, O’ clock position. Move the handle one revolution in clockwise direction for progression and anti clockwise direction for regression.<br>**Precaution:**<br>1. Do not wedge Q-44 .<br>2. If ‘DJ’ trips on notches, bring GR and MP to ‘0’ manually and close DJ. Put MP on ‘N’ caption and again make preparation for manual control. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 27. | LSGR extinguishes. NR also moves but ammeter needle does not deviate. | Ensure that line contactors are not closed. Ground the loco, enter in HT compartment and press the spindle of EP valve 2 to 3 times and see if the line contactors close. |
| 28. | LSP glows on 1st notch and automatic regression takes place. | Place HMCS on 2, 3 or 4 position in case of parallel locos and in case of SP combinations place HMCS on 2 or 4 and clear the section if load and road permits. On arrival at station, check the following.<br>1. Closing of L3 and L4 on LT.<br>2. Mobile jaw of L3 and L4.<br>3. Flexible shunts behind line contactors.<br>4. Fixing bolts.<br>Note: Ascertain that loco wheels are not slipping. Check RS valve limit switches not acted. |
| 29. | Automatic regression on 1st notch without LSP glowing | Go in unoccupied cab and lock the BL properly. If after removing BL key the pilot lamps are glowing it indicates that BL of other cab is not locked properly. If you are unsuccessful, Wedge Q-118 and work with EEC. |

| SN | PROBLEM | REMEDIES |
|---|---|---|
| 30. | LSGR extinguishes and DJ trips on 1st notch after 0-6 seconds. | MVSI 1-2 or QVSI 1-2 is defective. Isolate the respective MVSI or QVSI. |
| 31. | DJ trips on 6th notch | 1. Bring MP on '0'.<br>2. Open all BL switches.<br>3. Close DJ.<br>4. Close BL switches, BLCP, BLPV, BLVMT.<br><br>5. Ensure that C-105, C - 106 and C-107 are closed and corresponding auxiliaries are working.<br>If any of the contactors not closing, wedge the respective contactor and put the respective programs switch in position '0' or '3'.<br><br>6. If all the contactors are closed and DJ still trips on 6th notch, then wedge Q-118 relay. |

## 3.2 TROUBLE SHOOTING FOR ALL AUXILIARIES NOT STARTING

| S.N | PROBLEM | REMEDIES |
|---|---|---|
| 1. | EM contactors do not close and auxiliaries do not start. | Check CCA fuse. If CCA fused, act according to para 3.3 page 44, for replacement of fuse. If still not closing then wedge the following:<br>a. 1. C-101 C-111 or C-121<br>2. VER 1 or 2 respectively<br>3. Q-118 relay and clear the section with traction motor current restricted to 500 amps. While working a train under these circumstances, isolate synchronizing cutout cock but do not isolate it while working light engine.<br>b. If CCA fuse is o.k. press BPQ-100, put HQCVAR at '0'. If auxiliaries do not start check, Q-100 is energising or not. If not energised, wedge Q-100. If auxiliaries still do not start, clear the section by following the instruction at (a) above. |



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## 3.3 **REPLACEMENT OF FUSES**

1. Remove the fuse from its housing and test it at the test lamp – LECC. If the fuse is found to have blown, take another spare fuse of the same capacity from the spare fuse-board and test it with LECC. In case, it is okay. Switch off the battery by putting HBA in 'O' position, screw the good fuse properly into its housing and then switch on the battery. Put HBA on position '1'. If the fuse holds, carry on.

2. In case the fuse so replaced does not hold, put HOBA in 'off' position. Take another fuse of the required capacity from the spare fuse board and test it with LECC. Switch off the battery, screw the good fuse in position and switch on the battery again and carry on.

3. If the fuse again blows and the fuse in question is CCPT, CCDJ or CCBA and CCLS. Try to rectify the cause as per para 3.1 page 32.

4. In case of CCA not holding inspite of HOBA in 'off' position wedge C-101, C-111, or C-121 and the corresponding VER valve and clear the section limiting the traction motor current to 500 amps. if, load and road permits.

## 3.4 INSTRUCTIONS FOR WEDGING RELAYS

1. Switch off the battery before wedging the relay.
2. Wedge the relay and see that all the auxiliary contacts of the relay are fully operated.
3. Switch on the battery.
4. No relay should be wedged in open condition.

## 3.5 PRECAUTIONS FOR WEDGING OF RELAY CONTACTORS

| SN | RELAY | PRECAUTIONS |
|---|---|---|
| 1. | Q-100 | 1. No restriction<br>2. Stagger the start of auxiliaries whenever DJ is opened and closed. |
| 2. | Q-50 | 1. No restriction<br>2. Physically ensure proper setting of reversor at the time of changing direction of loco. |
| 3. | Q-48 | 1. No restriction<br>2. If Q-48 is enegising due to wrong feed, remove both wires coming to Q-48 and tape them.<br>3. Keep constant watch on ammeters. If its needle fluctuates due to wheel slip.<br>i) Regress GR<br>ii) Operates VSA. |

| SN | RELAY | PRECAUTIONS |
|---|---|---|
| 4. | Q-118 | 1. No restriction<br>2. Check that C-118 has opened after closing DJ.<br>3. Check working of all auxiliaries including MVSI-1 and 2.<br>4. If GR does not come to zero, when MP is brought to '0', regress notch by notch since Q-46 is by passed.<br>5. Contactors C-105, C-106 and C-107 do not chatter. |
| 5. | Q-44 | 1. **Precaution before wedging Q44**:<br>See that MP in on '0'. LSGR is glowing and GR is on '0' and C-118 is open.<br>2. **Precaution after wedging Q-44 and after closing DJ but before moving MP from 'O' check following**:<br>i. LSDJ has extinguished and C-118 has opened.<br>ii. All auxiliaries, specially (MPH & MVSIs have started.<br>iii. See that DMVIs are not tripped.<br>iv. Ask your assistant to stand near RGR and keep the corridor door open. In case of any smoke emission from RGR on taking, notches assistant should advise the driver immediately. |

| SN | RELAY | PRECAUTIONS |
|---|---|---|
| | | 3. **Precaution after wedging Q-44 and after moving MP from 'O' to 1st notch** :<br>i. Do not take manual control of GR.<br>ii. Keep a constant watch on UA and trip DJ immediately whenever UA does not deviate.<br>iii. Try to work on odd notches. |
| 6. | QPDJ is isolated | 1. No restriction<br>2. Keep watch on pressure and do not allow it to fall below 6.5 kg/cm2 |
| 7. | Manual control of C-118 | Never allowed. Only ensure that all wire connections to C-118 are intact. |

## *REFERENCE*

1. Maintenance Manual of CLW for WAM4, WAG5, WAP1 Locomotives.

2. Maintenance Manual of BHEL for WAG5 Locomotives.

3. AC Traction Manual.

4. Comments/ Suggestions given by RDSO.

5. IRIEEN journals.

6. Comments/ Suggestions given by various sheds during visit as well as during Seminar.

7. Electric Locomotives POH check sheet.

8. IS: 2208 – 1962
Specification for HRC cartridge fuse links up to 650 V

IS: 3106 – 1964
Code of practice for selection, installation and maintenance of fuses

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