LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE AND SERVICE MANUAL

SECTION 09 HIGH VOLTAGE DISTRIBUTION SYSTEM

Metro

AnsaldoBreda

LOS ANGELES COUNTY

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RUNNING MAINTENANCE AND SERVICE MANUAL

VOLUME M-01
PART I
THEORY OF OPERATION
SECTION 09 - HVDS

SECTION 09

HIGH VOLTAGE DISTRIBUTION SYSTEM

PART I

THEORY OF OPERATION

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HIGH VOLTAGE DISTRIBUTION SYSTEM

09-I-01 INTRODUCTION

This Section of the Heavy Repair & Maintenance Manual is divided into three Parts:

- Part I: Theory of Operation
- Part II: Troubleshooting
- Part III: Maintenance

Each Paragraph is numbered accordingly, to avoid that paragraphs of the same Section, pertaining to a different Part, have the same number.

Part I - Theory of Operation

Part I gives a thorough overview of the System structure and operation, by means of descriptions, figures, photos, schematics, block diagrams and flow charts, together with references to other documents or Sections when needed.

Part II - Troubleshooting

It gives the Maintenance Technicians a path to troubleshoot the System in every condition by means of the available tools:

- The PTU, equipped with the specific SW program
- The IDU
- The Fault Isolation Table

The Part III - Maintenance consists of:

- Preventive Maintenance
- Corrective Maintenance
- Consumable Materials
- Test Equipment, Tools, & Special Tools

09-I-01.a LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

The Abbreviations, Acronyms and Symbols commonly used throughout this manual are given below with their related meaning.

Abbreviation	Meaning
APS	Auxiliary Power Supply
ATP	Automatic Train Protection
BCU	Brake Control Unit
C/L	Centerline
CAN	Controller Area Network
CEMIPS	Conductive EMI Protection System
DSP	Digital Signal Processor
EDU	EMI Detector Unit
EMI	ElectroMagnetic Interference
FIR	Finite Impulse Response
FPGA	Field Programmable Gate Array
HSCMOS	High Speed Complementary Metal-Oxide Semiconductor
HCT	Harmonic Current Transducer
HSCB	High Speed Circuit Breaker
HVAC	Heating Ventilation & Air Conditioning
IDU	Integrated Diagnostic Unit
IGBT	Insulated Gate Bipolar Transistor
LBA	LonWorks Bus Adaptor
LH	Left Hand Side
LPF	Low-Pass Filter
LRV	Light Rail Vehicle
LV	Low Voltage
LVPS	Low Voltage Power Supply
MBL	Metro Blue Line
PCA	Driving Control Processor
PGL	Pasadena Gold Line
PTU	Portable Test Unit
R-C	Resistor - Capacitor
RH	Right Hand Side
TBS	To Be Supplied
TCU	Traction Control Unit
TWC	Train-to-Wayside Communication
WD	WatchDog

09-I-01.b LIST OF DEFINITIONS

The Definitions commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
'A' body section	The section of an articulated vehicle containing the pantograph
'B' body section	The section of an articulated vehicle not containing the pantograph
AW0	Empty car operating weight
AW1	Full seated load plus AW0
AW2	Standees at 4 persons per square meter plus AW1
AW3	Standees at 6 persons per square meter plus AW1
AW4	Standees at 8 persons per square meter plus AW1
Front door	The door close to the Operator's Cab
Rear door	The door close to the Articulation Section
Pin-out	Relationship between Pin number and carried Signal

09-I-01.c LIST OF MEASUREMENT UNITS AND SYMBOLS

The measurement units commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
Ω	Ohm
°C	Celsius degree
°F	Fahrenheit degree
A	Ampere
AC	Alternate Current
DC	Direct Current
F	Farad
ft	Foot
gal	Gallon
H	Henry
Hz	Hertz
in	Inch
kg	Kilogram - approx 2.205 pounds
km	Kilometer - approx 0.621 miles
kN	Kilo-Newton - approx 224.809 pounds force
kVA	Kilo Volt Ampere
kW	Kilo Watt
lb	Pound
lb-ft	Pound force
lps	Liters per Second
m	Meter - approx 3.28 feet
mH	Milli Henry
mm	Millimeter - approx 0.0394 inches
ms	Milli second
Pa	Pascal
rms	Root Mean Square Voltage
rpm	Revolution per Minute
V	Voltage
W	Watt

09-I-02 THEORY OF OPERATION

09-I-02.01 General Description of the System

The HVDS is the vehicle backbone. It gets electric power (750 Vdc nominal) from the catenary through the Pantograph and distributes it to the Propulsion System (refer to Section 07) and to the APS/LVPS System (refer to Section 10).

The Propulsion System uses this energy to supply the four motors of the vehicle in order to move the train.

The APS/LVPS System, instead, transforms the High Voltage into Medium Voltage and Low Voltage to supply all Low Voltage train systems.

Before distributing the High Voltage electric power to the Propulsion and the APS/LVPS systems, the HVDS checks, by means of the EMI System, the High Voltage current value and prevents producing disruptive electrical interface in its own or wayside equipment.

The High Voltage Distribution System includes the Grounding System, divided into two subsystems:

- Car-body Grounding System, which provides a safety ground and return path to the ground to all carborne systems operating on the low and middle voltages provided by the APS/LVPS Systems
- Propulsion Inverter Grounding System, which provides a return path to the ground for the Propulsion System

Figure 09-I-02.1 shows the functional block diagram of the HV Distribution System.

The 750 Vdc is collected from the catenary by the pantograph, located on the roof of the “A” Car Section.

From the Pantograph the 750VDC goes to three parallel circuits:

- Lightning Arrester
- Traction Inverters, through the EMI Detector, the High Speed Circuit Breaker and the Knife Switch;
- Auxiliary Power Supply, through the EMI Detector, the Auxiliary Fuse and the Knife Switch

The Lightning Arrester provides a low impedance path for high-voltage current pulses and is capable of absorbing energy when lightning strikes.

For more details refer to paragraph 09-I-02.02.01.

The Traction Inverters, which generate the Variable Voltage Variable Frequency (VVVF) 3-phase AC power for the traction motors, are part of the Propulsion System (Refer to Section 07) and are protected by the High Speed Circuit Breaker (HSCB) against over-currents, filter over-voltages, ground faults and IGBT failures.

The Auxiliary Power Supply (APS - “B” car section underframe) circuit, together with the LVPS circuit, is protected by the Auxiliary Fuse 01F02 (200A) and feeds the Auxiliary subsystems.

The Auxiliary Power Supply (APS - refer to Section 10 for details) converts the 750 VDC line input into the 208 VAC 3-phase/60Hz and 120VAC single phase 60Hz.

The 120VAC single phase 60Hz is for convenience outlets and defrosters. It is obtained from the 208 Vac by using a single phase voltage to neutral.

The APS provides auxiliary power for the vehicle, while the LVPS DC/DC converter (refer to Section 10 for details), converts the 750VDC into 37.5 VDC for the Low Voltage loads and the battery charger circuit.

The 208 VAC line output goes to the Circuit Breaker Panels located inside the Electric lockers at the center of the vehicle, close to the aisle, and to the MV CB panels of the operator cabs.

The 208 VAC supplies the following devices:

- Propulsion Inverter motor fan, in the propulsion inverter enclosure
- APS/LVPS converter motor fan
- HVAC loads (evaporator and condenser fans, heaters, compressor)
- Air Compressor
- Cab Heaters
- Convenience Outlets in the two Electric Lockers and in the Operator Cabs.

The Shop Power Socket located inside the Knife Switch box, under the car floor, connects the 750 VDC shop power to the Auxiliaries.

When the Shop Power Socket is in use, and external shop power is applied, then no high voltage is applied to the Traction Inverters of the Propulsion Systems.

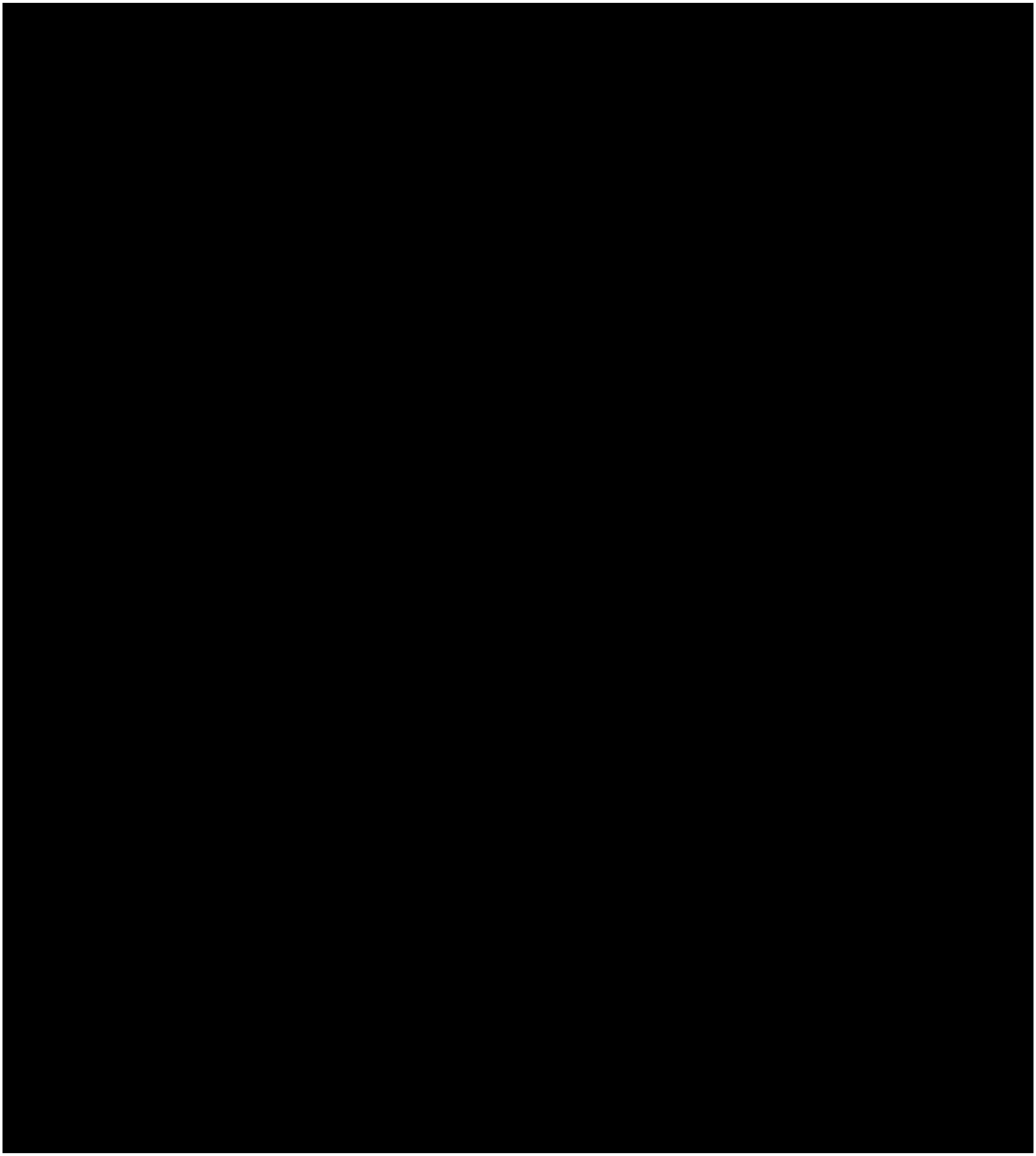
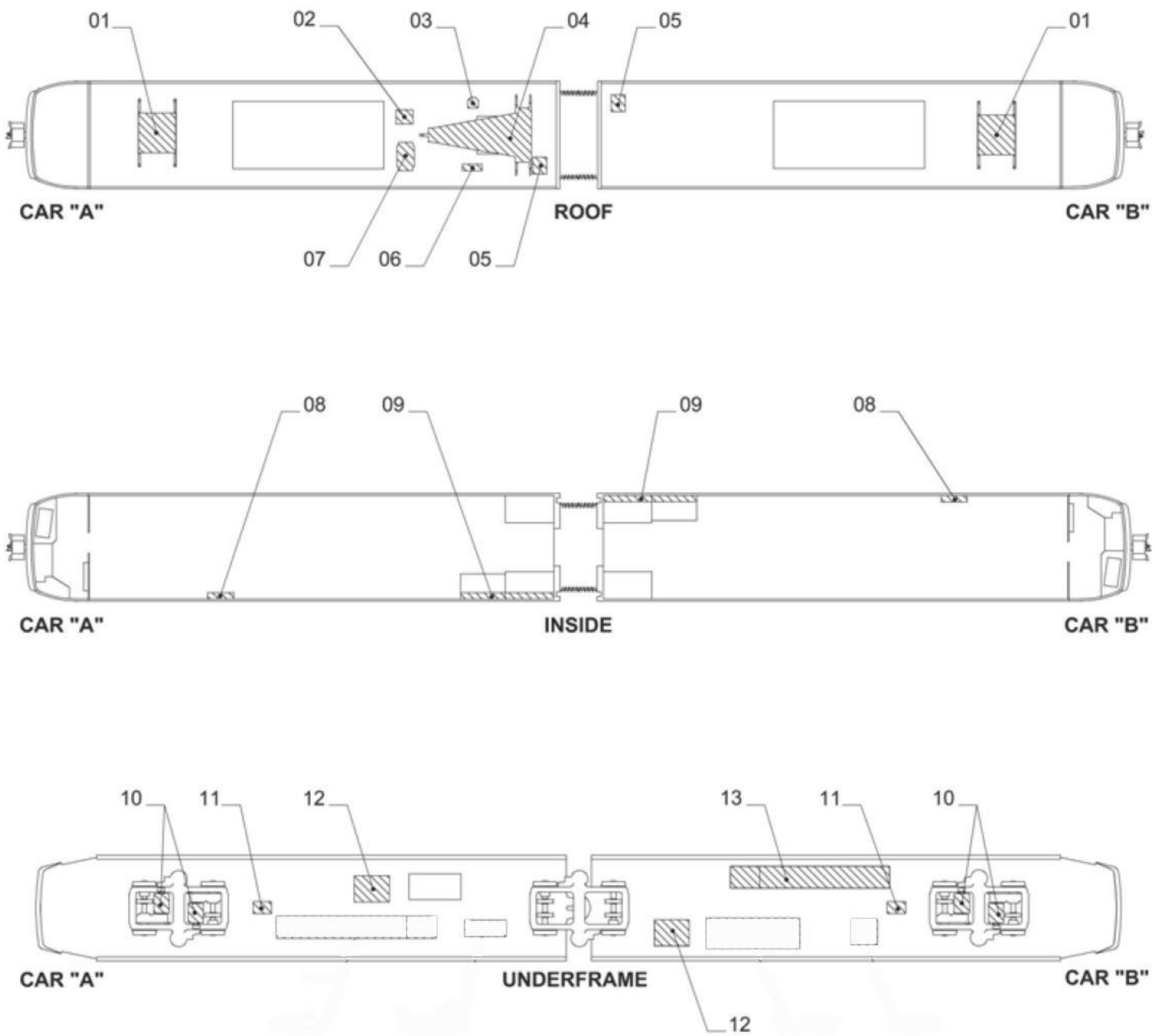


Figure 09-I-02.1 HV Distribution - Functional Block Diagram



OTHER SYSTEMS

01. BRAKING RESISTOR
04. PANTOGRAPH
10. TRACTION MOTOR
11. DISCONNECT BOX
12. PROPULSION LINE REACTOR
13. PROPULSION INVERTER

HVDS

02. HCT
03. LIGHTNING ARRESTER
05. JUNCTION BOX
06. AUXILIARY FUSE
07. HSCB
08. BRAKE RES. CABLE PSGW
09. CABLE PASSAGEWAY

Figure 09-I-02.2 HV Main Component Location

The main components of the HV Distribution System are listed below (Refer to paragraph 09-I-02.01):

- Lightning Arrester
- Harmonic Current Transducer (HCT) (HCT is a HV component of the EMI System)
- Auxiliary Fuse Box
- HSCB
- Knife Switch

The Return path is provided via the Ground System (refer to paragraph 09-I-02.03).

i. System-Vehicle Relationship

The HVDS distributes the High Voltage current to all systems of the vehicle.

The current that is collected from the Pantograph (refer to Section 08) is divided into two main branches:

- One branch goes to the Propulsion System (refer to Section 07) and to the traction motors, through the HSCB
- The other branch goes to the APS/LVPS system for the Low Voltage Distribution System (refer to Section 10)

The Propulsion Inverter Grounding System and the APS/LVPS High Voltage Grounding System provide a return path to ground (the running rails for the LRV consist) for both Systems.

The Car-body Grounding System provides a safety ground to all carborne systems operating on the low and medium voltages provided by the APS/LVPS

[redacted]

The TCMS (refer to Section 18) is linked to the HV Distribution System and displays information coming from the HVDS on the IDU monitors in the operator cabs.

The information related to the HVDS and displayed on the IDUs are the following:

presence of EM Interferences checked by the EMI System and displayed on the EMI System Status Screen of the IDU;

HSCB tripped, displayed on the Propulsion System Status Screen of the IDU;

Ground Fault, displayed on both the Propulsion and the APS/LVPS Systems Status Screens of the IDU.

The same information can be gathered with the PTU.

ii. System-Equipment Relationship

The HV Distribution System serves to direct or to control the line current coming from the catenary line and going to the train through the pantograph.

The HVDS is made up of the systems/components listed below:

Lightning Arrester: provides a low impedance path for high voltage current pulses and is capable of absorbing energy when lightning strikes. Refer to paragraph 09-I-02.02.01.

EMI Detector: provides continuous vehicle EMI emission monitoring to detect any harmonic higher than the maximum allowable. The electronic element of the EMI Detector unit is linked to the TCMS in order to inform maintenance personnel that an electromagnetic interference has occurred. Refer to paragraph 09-I-02.02.02.

HSCB: protects the Propulsion System against over-currents and allows the Propulsion System to be disconnected from the HV power when the Propulsion system internal logic (the TCU) requires it or the EMI Systems detects any harmonics greater than the HSCB tripping threshold. Refer to paragraph 09-I-02.02.04.

Auxiliary Fuse: provides protection to the APS/LVPS system from overloads due to short circuits in the same system. Refer to paragraph 09-I-02.02.03.

Junction Boxes. They gather the HV cables to create a cable path from the roof to the underframe and vice versa, and from one body section to the other. Refer to paragraph 09-I-02.02.06.

Knife Switch: connects the HV System to the inverter modules of the Propulsion System and to the APS/LVPS System. The Knife Switch also allows the APS/LVPS System to be supplied by means of an external Shop Power Socket. Refer to paragraph 09-I-02.02.05.

Grounding System: it determines a return path for the current coming from the pantograph and connects all metallic elements of the train in order to prevent their electric charging. Refer to paragraph 09-I-02.03.

KNIFE SWITCH POSITIONS

NORMAL: PROPULSION AND APS/LVPS SYSTEMS ARE SUPPLIED BY THE CATENARY LINE;
AUXILIARY: THE APS/LVPS SYSTEM IS SUPPLIED BY THE CATENARY LINE WHILE THE PROPULSION SYSTEM IS CUT OUT;
OFF: NO SYSTEM IS SUPPLIED;
SHOP: THE APS/LVPS SYSTEM IS SUPPLIED BY THE SHOP POWER LINE, WHILE THE PROPULSION SYSTEM IS CUT OUT.
REFER TO FIGURE 09-I-02.26 FOR KNIFE SWITCH ELECRICAL SCHEMATIC

Figure 09-I-02.4 System-Equipment Relationship

HV wires connect all equipment of the HV Distribution System.

With regard to the Ground System, the connection between different equipment is realized by means of special wires for the return current path of the inverters and the APS/LVPS, which connect all metallic parts of the vehicle to the ground contacts.

09-I-02.02 Main System Components

09-I-02.02.01 Lightning Arrester

The lightning arrester provides a low impedance path for high-voltage current pulses and is capable of absorbing energy when lightning strikes. This device is realized through a MO (Metal Oxide) between Pantograph and Car Body. The MO material is an open-circuit in normal condition (750Vdc nominal), but it becomes a shortcircuit for a very large voltage.spike (which could occur in the event of a lightning strike).

The Lightning Arrester suppresses voltage transients resulting from lightning surges entering the 750Vdc power source.

Transients are limited by the arrester to approximately 3.8 kVdc for a 70,000 A surge.

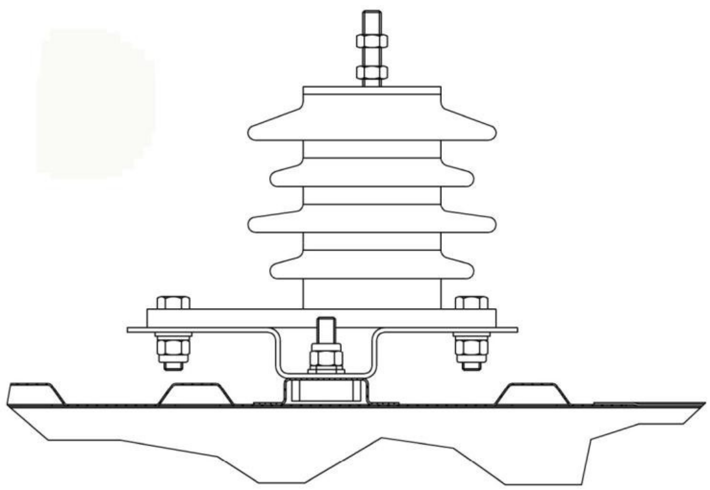


Figure 09-I-02.5 Lightning Arrester

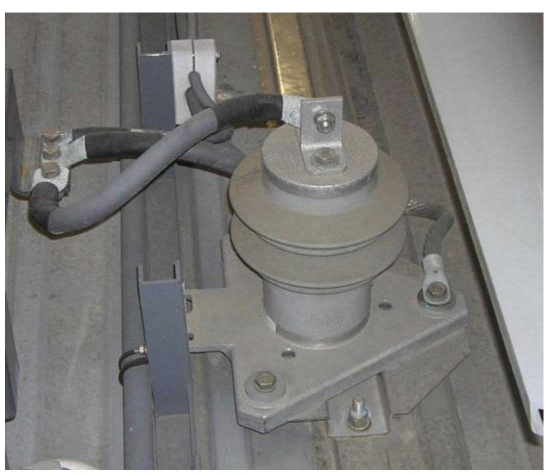
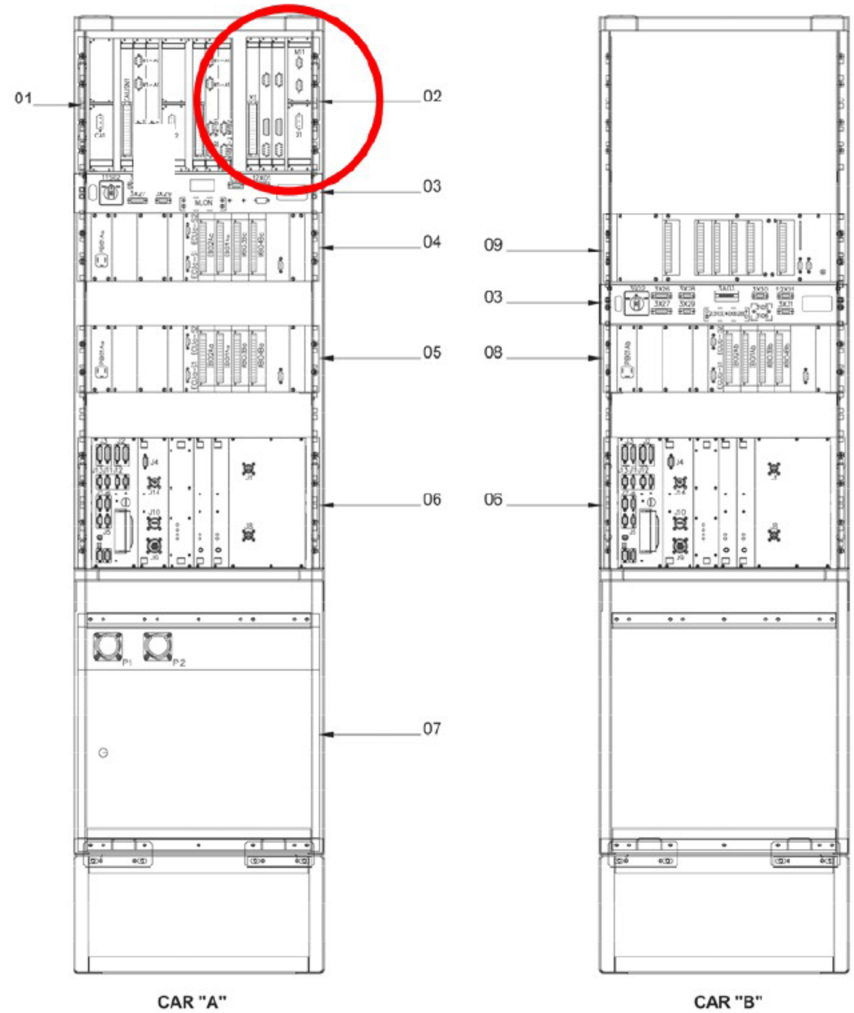


Figure 09-I-02.6 Lightning Arrester (photo)

09-I-02.02.02 EMI Detector

The AnsaldoBreda EMI Detector (EMI: ElectroMagnetic Interference) is designed to operate on railway vehicles supplied by a 750Vdc catenary system and is made up of two components: a HCT (Harmonic Current Transducer), mounted on the roof and an EDU (EMI Detector Unit) located in the "A" car section Electronic Locker (refer to Figure 09-I-02.7).



01. GATEWAY	02. EDU	03. DATA DOWNLOAD PANEL
04. ECU A	05. ECU C	06. COMMUNICATIONS RACK
07. ATP RACK	08. ECU B	09. EVENT RECORDER

Figure 09-I-02.7 Electronic Rack

The main purpose of the EMI Detector is to provide continuous vehicle EMI emission monitoring and to detect any harmonic higher than the maximum allowable to protect the wayside ATP equipment from any interference due to Electromagnetic emissions generated by the IGBTs, or any other LRV electric/electronic equipment, which could be fed back into the track circuitry.

The line current harmonic spectrum is continuously monitored. Each current harmonic is compared with a maximum allowed value. In case of excessive emission the EMI detector will trip the high speed circuit breaker to isolate the offending devices.

The CEMIPS (Conductive EMI Protection System) classifies EMI violations into three different groups, according to their current magnitude, frequency and duration.

These three parameters are compared with two thresholds:

- The first level originates a WARNING (0.8A for a Warning level), while
- The violation of the second level originates an ALARM (1A for an Alarm level)

If a WARNING is detected, the CEMIPS provides protection to the LRV electric and electronic equipment and to the outside environment by requesting the Propulsion System to reduce the vehicle performance in an attempt to reduce emissions.

If an ALARM event is detected, the CEMIPS will trip the HSCB by de-energizing the Safety Relays (for details refer to Table 09-I-02-4 EDI-01 X3 Connector Pin-out)

In case of three ALARM detections within a 5 minute period, the CEMIPS will LOCK the HSCB OUT, immobilizing the vehicle unless the EMI by-pass (located in the ‘A’ Cab by-pass panel) is activated or a manual reset is done (Propulsion Reset button on the operator Console).

If the CEMIPS is not working correctly or is OFF, the HSCB will also be locked out, unless the EMI by-pass is activated.

In case of an ALARM, a LOCK-OUT or a CEMIPS failure, a message will be sent via the LONWorks bus, to the TCU and the IDU, for redundancy and for diagnostic purpose only. Whenever the EMI limit is exceeded, a diagnostic event is generated and memorized in the non-volatile memory of the PCA board (refer to 09-I-02.02.02.02d).

In order to operate with a high level of reliability, the EMI Detector is based on two microprocessor boards that evaluate the harmonic current emission independently. The measurements made by the two boards are compared and in case they do not match, a fault is tripped.

The EMI Detector System is connected to the vehicle logic, using digital interfaces, to the Propulsion System (refer to Section 07 of this Manual) and to the Diagnostic System (IDU), by means of the LONWorks bus.

To view the real-time harmonic content of the line current, and/or to download the events log database, the AnsaldoBreda PTU can be connected to the RS 232 port on the front of the left PCA-03 Board of the EDU

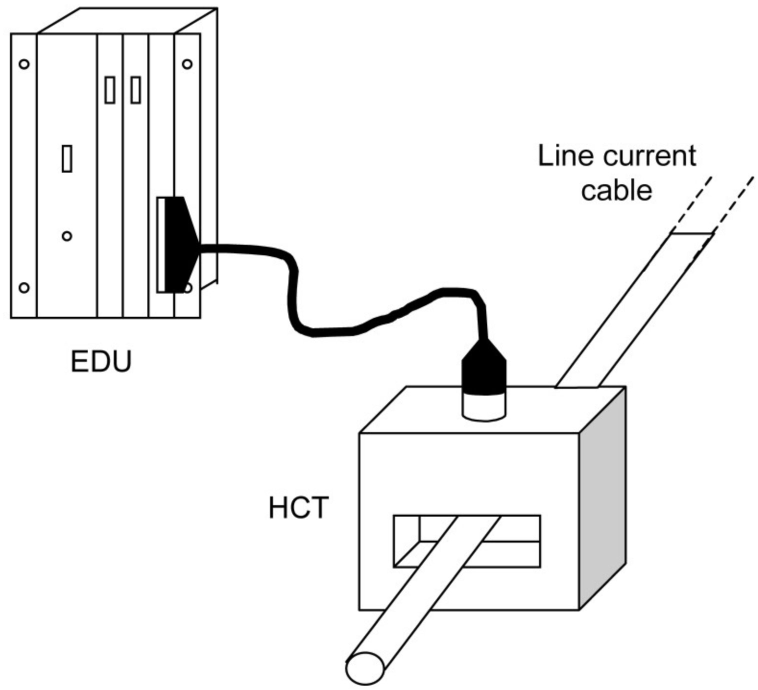


Figure 09-I-02.8 EMI System

The EMI Detector System consists of two main components:

- The Harmonic Current Transducer (HCT)
- The EMI Detector Unit (EDU)

The EMI Detector Unit (refer to Figure 09-I-02.11) consists of an E2 rack containing:

- Mother Board (back plane)
- One DC/DC Low Voltage Power Supply
- Two PCA-03 boards
- One EDI-01 board
- One LBA-01 board

The HCT is located on the roof and the EDU is located in the “A” car Electronics Locker.

09-I-02.02.02.01 HCT Harmonic Current Transducer

The HCT is a double, passive, transformer based, current transducer.

The current transducer consists of a magnetic core through which the line current wire passes.

The primary winding is made up of the line current wire itself.

The secondary winding is used to read a voltage signal proportional to the harmonic current flowing in the primary circuit.

An auxiliary winding (refer to Figure 09-I-02.9) is used to inject a test current into the transducer to check for correct operation.

Two current transducers are assembled together to form a single device.

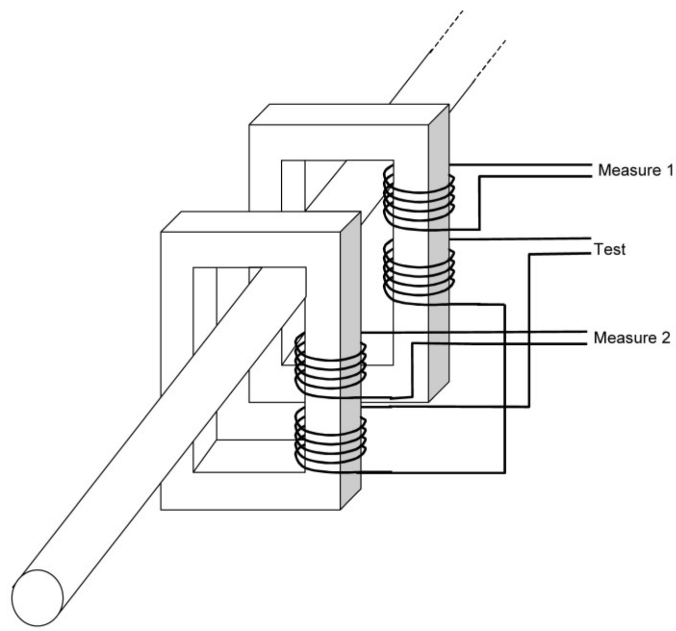


Figure 09-I-02.9 HCT System

Measure and Test windings are connected to the EDU by means of a shielded cable.

In particular, the two test windings are series connected in phase opposition.

This causes the test current in the secondary circuits to eliminate each other.

In this way the test signal, a potentially dangerous oscillator signal, does not flow through the line.

The HCT acts like a mixer between the harmonic current flowing in the primary wire and the injected test current; the measurement outputs are therefore:

$$I_{measure1} = I_{harm} + I_{test}$$

$$I_{measure2} = I_{harm} - I_{test}$$

The HCT transducer is connected to the EDI-01 board of the EDU by means of a 19-pin connector.

The System Pin-out (relationship between Pin number and carried signal) is shown in Table 09-I-02-1.

Table 09-I-02-1 HCT Connector Pin-out

Pin	Signal	Description
A	TR2_SCREEN	Measurement windings shields
B	TR2_TST_N	Test windings
C	TR2_TST_P	Test windings
D	TR2_P	Measurement windings
E	TVS_TR2	Measurement windings transzorb
F		SPARE
G	TVS_TR1	Measurement windings transzorb
H	TR1_P	Measurement windings
J	TR1_TST_P	Test windings
K	TR1_TST_N	Test windings
L	TR1_SCREEN	Measurement windings shields
M	Ground	Connection to the Heart (test windings shields)
N	Ground	Connection to the Heart (test windings shields)
P	TR2_P	Measurement windings
R	TR2_N	Measurement windings
S	TR1_N	Measurement windings
T	TR1_P	Measurement windings
U	Ground	Connection to the Heart (test windings shields)
V	Ground	Connection to the Heart (test windings shields)

The connection between the EDI-01 board and the HCT transducer is realized by means of three twisted-pair cables, shielded individually, with shields connected to the GND on the EDI board side by means of its X3 connector dedicated pins.

On the HCT transducer side the shields of wires TR1 and TR2 must be connected to the relevant pins of the transducer, while the shield of the TR_TST wire must not be connected.

Table 09-I-02-2 HCT Electric Connections

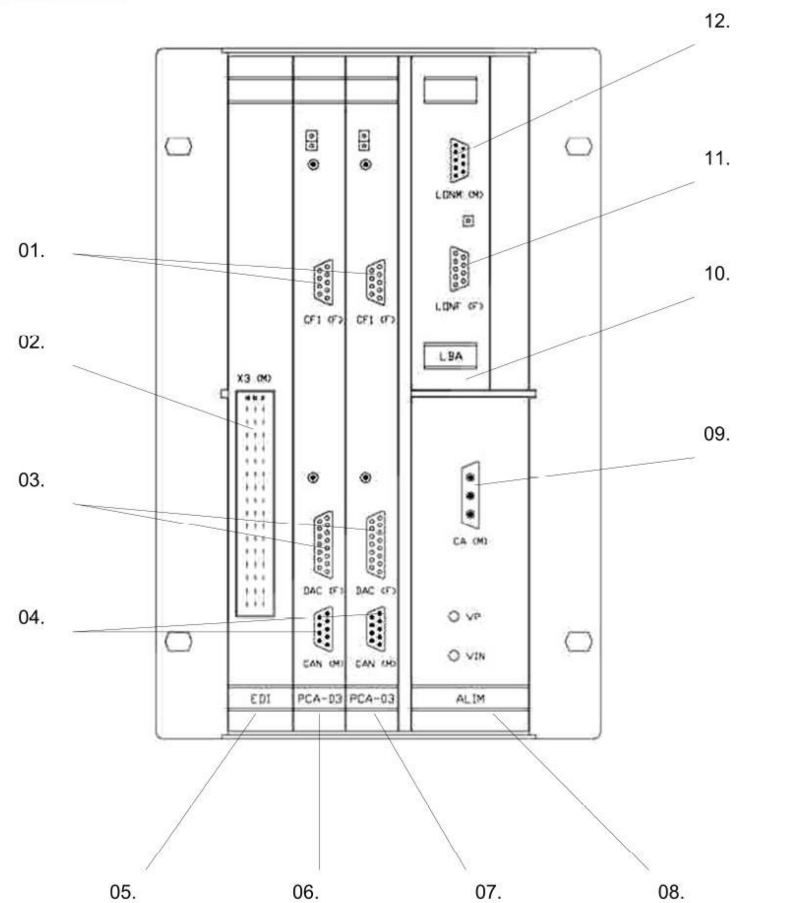
Pin	Signal	Connected to	Through
A	TR2_SCREEN	EDI-TR2_SCREEN (10bX3)	shield twisted-pair cable 2
B	TR2_TST_N	HCT (pin K)	jumper
C	TR2_TST_P	EDI-TR_TST_P (2dX3)	Twisted-pair cable 3
D	TR2_P	HCT (pin E)	jumper
E	TVS_TR2	HCT (pin D)	jumper
F			
G	TVS_TR1	HCT (pin H)	jumper
H	TR1_P	HCT (pin G)	jumper
J	TR1_TST_P	EDI-TR_TST_N (2zX3)	Twisted-pair cable 3
K	TR1_TST_N	HCT (pin B)	jumper
L	TR1_SCREEN	EDI-TR1_SCREEN (6bX3)	shield twisted-pair cable 1
	Do not connect to HCT	EDI-TR_TST_SCREEN (2bX3)	shield twisted-pair cable 3
M	Ground	Vehicle metallic structure	
N	Ground	Vehicle metallic structure	
P	TR2_P	EDI-TR2_P (10dX3)	Twisted-pair cable 2
R	TR2_N	EDI-TR2_N (10zX3)	Twisted-pair cable 2
S	TR1_N	EDI-TR1_N (6zX3)	Twisted-pair cable 1
T	TR1_P	EDI-TR1_P (6dX3)	Twisted-pair cable 1
U	Ground	Vehicle metallic structure	
V	Ground	Vehicle metallic structure	

[redacted]

09-I-02.02.02.02 EDU (EMI Detector Unit)

The EMI Detector Unit consists of one E2 rack containing:

- Mother Board (back plane)
- One DC/DC Low Voltage Power Supply
- Two PCA-03 boards
- One EDI-01 board
- One LBA-01 board



01. PCA CF1 CONNECTOR
02. EDI X3 CONNECTOR
03. PCA DAC CONNECTOR
04. PCA CAN BUS CONNECTOR
05. EDI BOARD
06. PCA BOARD
07. PCA BOARD
08. SUPPLY
09. SUPPLY CA CONNECTOR
10. LONWORKS BUS ADAPTER
11. LONWORKS BUS CONNECTOR (F)
12. LONWORKS BUS CONNECTOR (M)

Figure 09-I-02.11 EDU Front View

a) Mother board

The EDU Mother Board is a back-plane board through which all boards and power supply are connected.

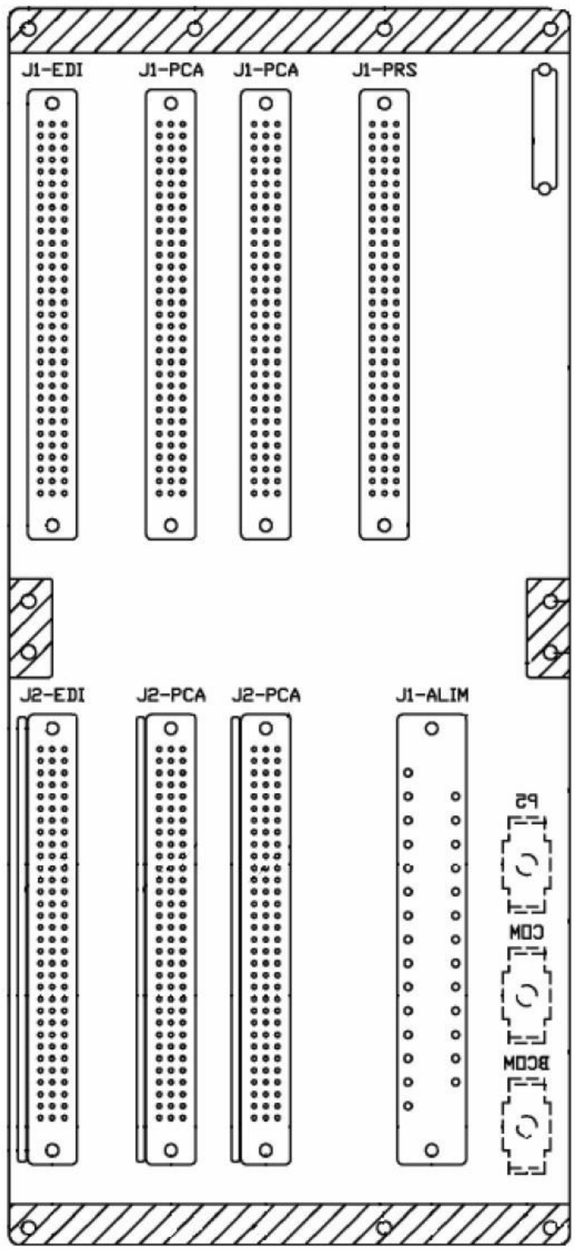


Figure 09-I-02.12 EDU Motherboard

NOTE: The 237EE40327C AnsaldoBreda document contains the EDU Motherboard Functional Schematic.

b) One DC/DC Low Voltage Power Supply

The DC/DC LVPS supplies the boards and the test signal.

Input:

Rated input voltage	24Vdc
Input voltage static range	16,8Vdc - 42Vdc
Input voltage dynamic range (<100ms)	14,4Vdc - 50Vdc

Output (galvanically isolated):

V1	+5Vdc ± 5%, 5A
V2	+24Vdc ± 5%, 0,5A
V3	Square wave 20Vpp ± 5%, 100Hz ± 5%, 1A

Rated Power 45W

The CA (power supply connector) pin-out is shown in Table 09-I-02-3:

Table 09-I-02-3 CA Connector Pin-Out

Pin	Signal	Description
1	PBATT	Positive
2	NBATT	Negative
3	GND	Ground

c) EDI-01 board

NOTE: The 237EE60431C AnsaldoBreda document contains the EDI-01 board Functional Schematic.

The EDI-01 board Components location is described in the 232EE60431C AnsaldoBreda document.

The EDI-01 board is an analog board designed to accomplish the following functions:

- Filtering, amplifying and mixing the signals coming from the HCT
- Generating the sinusoidal test signals
- Watchdog supervising of the PCA boards
- Digital interface to the vehicle logic

The EDI-01 board interfaces the HCT and the EDU (refer to Table 09-I-02-2), through the X3 connector (refer to Figure 09-I-02.11).

Table 09-I-02-4 EDI-01 X3 Connector Pin-out

X3	d	b	z
HCT Interface			
2	TR_TST_P	TR_TST_SCREEN	TR_TST_N
4	GND	GND	GND
6	TR1_P	TR1_SCREEN	TR1_N
8	GND	GND	GND
10	TR2_P	TR2_SCREEN	TR2_N
12	GND	GND	GND
Vehicle Logic Interface			
14	SPARE	SPARE	SPARE
16	SAFE_1_P	SAFE_1_N	SAFE_2_P
18	-	SAFE_2_N	-
20	NC_A	COMMON_A	NO_A
22	NC_B	COMMON_B	NO_B
24	NC_C	COMMON_C	NO_C
26	NC_D	COMMON_D	NO_D
28	IN_A_P	-	IN_C_P
30	IN_A_N	IN_B_P	IN_C_N
32	IN_D_P	IN_B_N	IN_D_N

Where:

SAFE_1_P, SAFE_1_N SAFE_2_P, SAFE_2_N	are Safety relays normally-open conctacts
IN_A_P, IN_A_N IN_B_P, IN_B_N IN_C_P, IN_C_N IN_D_P, IN_D_N	are Digital inputs
NC_A, COMMON_A, NO_A NC_B, COMMON_B, NO_B NC_C, COMMON_C, NO_C NC_D, COMMON_D, NO_D	are Digital Outputs (NC=normally closed: NO=normally open)

Safety Relays

Normally-open contacts SAFE_1_N/P and SAFE_2_N/P, made up of two contacts in series of the two different safety relays RL1 and RL2 (refer to Figure 09-I-02.13), protected by 1.5A delayed fuses, are made available by the EDI board to the J3 connector.

[redacted]

Digital Inputs

Figure 09-I-02.13 shows the interface between the EDI board and the two PCA boards, through the J2 rear connector.

The EDI-01 board has four digital input interfaces that permit the acquisition of the status of relay contacts, contactors, electro-valves etc. with one terminal connected to the positive battery voltage or to the negative battery voltage.

When the contact closes, the EDI-01 board provides the automatic removal of any oxide present on the contacts (the operation of contacts cleaning is called fritting).

The inputs can also be driven directly from solid state high-side or low-side outputs provided that their maximum leakage current is less than the maximum allowed.

Vil	-50V < Vin < 3V	Input voltage for channel deactivation
Iil_max	1 mA	Maximum input current for channel deactivation
Vih	14.4V < Vin < 45V	Input voltage for channel activation
Vih_max	45V < Vin < 50V	Maximum Vin for 100ms
Iih	3.6mA @ Vin = 24V	Input continuous current (typical)
Iih_max	5.5mA @ Vin = 45V	Input continuous current (maximum)
Iih_pk	(Vin/0.35) mA	Input peak current (fritting)
tau_Iih_pk	15 ms	Fritting pulse width
Iih_pk_min	30mA @ Vin = 14.4V	Minimum input pulse current
Iih_pk_max	160mA @ Vin = 50V	Maximum input pulse current
fmax	0.75 Hz	Maximum working frequency

[redacted]

As shown in Figure 09-I-02.14, only the IN_A_P (d28) input is used to acquire the bypass signal.
The other three digital inputs are kept as spare inputs for later specifications.

The CEMIPS by-pass function is activated by means of the EMI By-pass switch (3S09), located in the “A” Cab by-pass panel.

In the event of a by-pass activation, the vehicle logic prevents the CEMIPS from opening the HSCB.

The CEMIPS by-pass is a hardware function of the vehicle logic (not a CEMIPS function).

When activated, the normally open contacts of the safety relays will be by-passed, so that the CEMIPS will not be able to trip the HSCB.

The CEMIPS bypass activation will allow the closing of the HSCB also in case the CEMIPS is not working correctly or is OFF.

The bypass signal is also acquired by both PCAs.

In the event of activation of the bypass signal, power reduction (when a WARNING is acquired) and the opening of the HSCB (when an ALARM is acquired) are not performed.

In case the EMI by-pass has been operated, the EMI Detector and the event logging still work, so that EMI violations are recognized and logged in the memory of the master PCA board, even if EMI interventions are not implemented.

As shown in Figure 09-I-02.14 one Safety Relay output is used to drive the HSCB. The other one (pin b18, connector X3) is directly connected to the Event Recorder System to advise this system in case EMI interferences are detected.

The EDI-01 board has also four digital output interfaces made up of relay contacts protected by 0.75 A delayed fuses. These outputs are not used.

d) PCA-03 board

NOTE:	The 237EE60405C AnsaldoBreda document contains the PCA board Functional Schematic. The PCA-03 board Components location is described in the 232EE60467C AnsaldoBreda document.

The PCA-03 is a high performance microprocessor board.
The following devices are mounted on the PCA-03 board:

Texas Instruments TMS320C31 Digital Signal Processor (32 bit, floating point, 25MHz) used for the implementation of complex mathematical algorithms;

Infineon SAKC167CS Microcontroller (16 bit, 25MHz);

FPGA Spartan XCS40 (RAM technology) that implements all interfaces between C167, DSP and the other on-board devices;

In particular, the FPGA implements:

- The Dual Port Ram used to exchange data between C167 and DSP
- The interface between the DSP and the Analog to Digital Converter used to acquire the measurement and test current
- The interface between the C167 and the Digital to Analog Converter used to generate the sinusoidal test signal
- One Synchronous Serial Channel with TTL interfaces
- One Asynchronous Serial Channel with both RS232 and TTL interfaces
- Two independent CAN Bus channels with both transceiver and TTL interfaces
- Two 4-channel 12-bit fast analog-to-digital converters. The acquired data can be read both by the C167 and the DSP
- Two 4-channel 12-bit serial digital-to-analog converters
- One Real-Time Clock device with serial interface

RS-232 interface

A DB9 female type connector is mounted on both PCA-03 boards to connect the PTU to the RS-232 Serial Interface.

This type of connection is used for diagnostic purposes only.

Table 09-I-02-5 RS-232 Connector Pin-Out

		COM	5
9			
			4
8			
		RX	3
7			
		TX	2
6			
			1

Pin #2 is used to transmit data, pin #3 is used to receive data and pin #5 is the ground reference. The others are spare.

Digital to Analog Converter Interface

A DB15 female type connector is mounted on both PCA-03 boards to connect the PTU to the Digital-Analog converter D/A. This type of connection is used for diagnostic purposes only.

Table 09-I-02-6 DAC Connector Pin-Out

		COM	8
15	DA8		
		DA5	7
14	DA6		
		DA7	6
13			
			5
12			
			4
11			
		DA4	3
10	DA3		
		DA2	2
9	DA1		
			1

A DB9 male type connector is mounted on both PCA-03 boards to connect the PTU to the CAN bus. This type of connection is used for diagnostic purposes only.

Table 09-I-02-7 ICAN Connector Pin-Out

Pin	Signal	Pin	Signal
6		1	
7	CAN1H	2	CAN1L
8		3	COM
9	P5	4	
		5	

e) LBA-01 board

NOTE:

The 237EE30099C AnsaldoBreda document contains the LBA-01 board Functional Schematic.

The LBA-01 board Components location is described in the 232EE30099B AnsaldoBreda document.

The LBA-01 board is a LonWorks Bus Adapter.

The LBA-01 board communicates with the PCA-03 Slave through the Synchronous Serial Interfaces and a dedicated set of control signals.

The LBA-01 board has two DB9 type connectors to connect to the LonWorks bus:

- LONM: DB9 male
- LONF: DB9 female

Table 09-I-02-8 LON Connectors Pin-Out

LONM

Pin	Signal	Pin	Signal
6	DATA_B	1	DATA_A
7	DATA_B	2	DATA_A
8		3	
9		4	
		5	

LONF

Pin	Signal	Pin	Signal
9		5	
8		4	
7	DATA_B	3	
6	DATA_B	2	DATA_A
		1	DATA_A

09-I-02.02.02.03 Conductive Emission Limits

The vehicle current conductive emission limits are shown in Figure 09-I-02.15.

The EMI detector will monitor the current harmonic emissions at 60, 100 and 250Hz with a band width of ±10 Hz.

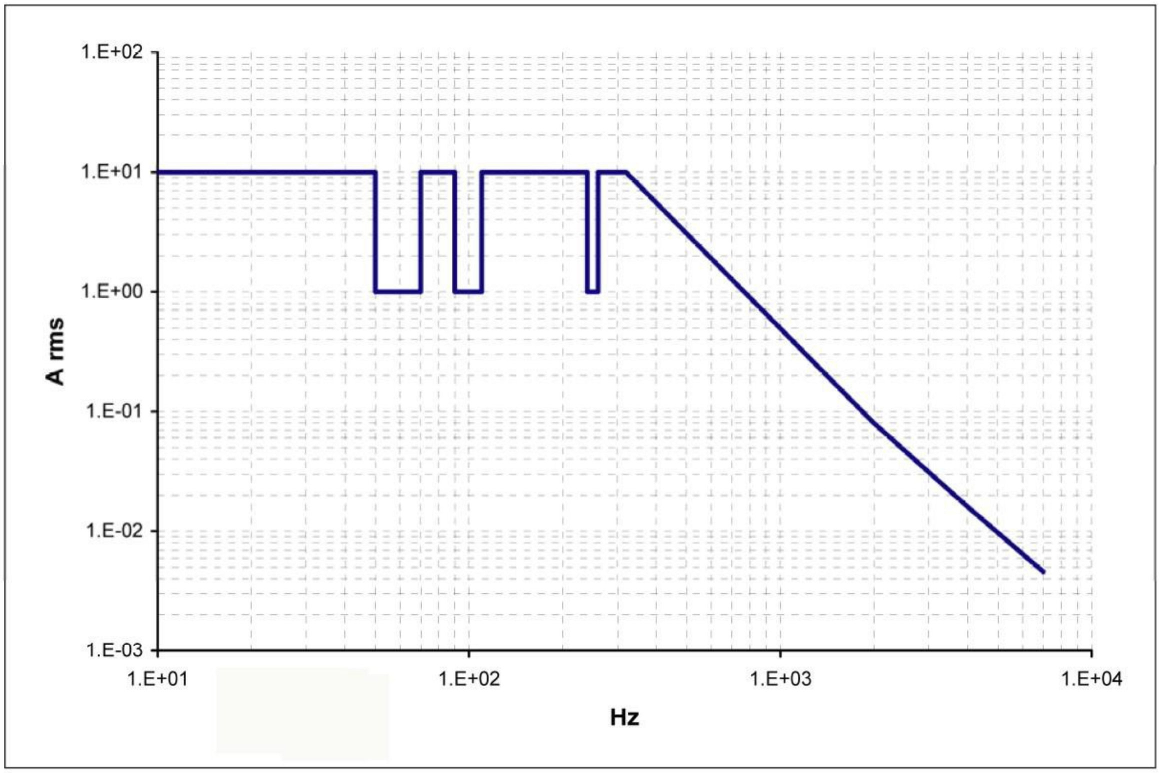


Figure 09-I-02.15 Vehicle Conductive Emission Current Limits

[redacted]

The EDU sends one sinusoidal test current signal to the HCT and receives two measurement signals in return (refer to Figure 09-I-02.16).

$$I_{measure1} = I_{harm} + I_{test}$$

$$I_{measure2} = I_{harm} - I_{test}$$

The sinusoidal test current is generated by the EDU to check that the measurement chain is operating properly.

A sinusoidal voltage signal is generated by the PCA Master (RH) board by means of a Digital to Analog Converter (G output).

The signal is then low-pass filtered and transformed into a sinusoidal current by the EDI board and injected into the HCT.

The two measurement currents are converted to voltage signals and are sent to a circuit that evaluates the sum and difference.

By doing this the original *Itest* and *Iharm* current are separated again, with the following result:

$$I_{measure1} + I_{measure2} = I_{harm} + I_{test} + I_{harm} - I_{test} = 2I_{harm}$$

$$I_{measure1} - I_{measure2} = I_{harm} + I_{test} - I_{harm} + I_{test} = 2I_{test}$$

Each PCA board has its own signal adder and low-pass filter.

In this way, if a failure occurs in the adder and/or the LPF that causes the harmonic measurement to be wrong, the other PCA board will still measure a correct value.

This failure can be detected by comparing the values through the CAN bus.

The acquired measurement (M) and test signal (T) are sampled and digitalized by the two PCA boards.

The test signal which is within a specified range is checked. The harm signal is evaluated to check for dangerous harmonic content.

By means of the CAN bus each PCA board checks the proper operation of the other board.

A mismatch in the measurements will cause a PCA board to signal a harmonic detection failure.

The use of separate independent hardware acquiring circuits, the software harmonic analysis carried out by each of the two PCA boards and the continuous checking and comparing of the results between the two PCA boards, ensure that the CEMIPS frequency and amplitude conducted emission limits remain unchanged with time.

The CEMIPS architecture is made in such a way that the CEMIPS itself continuously verifies the integrity of measurement and calculations.

High Reliability Alarm Output and Watchdog Circuit Description:

Each PCA board generates a 100Hz square wave signal on the WD output.

This signal is generated as long as the PCA board is working properly and no dangerous harmonics are detected.

The WD is generated by toggling a dedicated C167 output signal each 5msec. The SUPERVISOR task continuously check if the single half-period of the watchdog signal is in the range 5msec±10%. In case of wrong value, the WD signal is immediately and definitely stuck. In fact, the software will recognize such event as permanent failure and will lock out the HSCB.

The WD circuit block, located on the EDI board, checks if the WD signal coming from the two PCA boards is active.

When one of these signals is stuck to 0 V or 5 V for more than 100ms, the WD hardware block circuit de-energizes the two output relays causing the HSCB to open.

Watchdog Circuit Description

The EDI board is provided with an output interface, made up of two identical and independent circuits driving two safety relays.

This interface is driven by the watchdog signals coming out of the two PCA boards and it makes two open contacts available, which are protected by using 1.5A delayed fuse.

Each open contact is made up of a series of two open contacts, one for each safety relay.

The open contacts will close if both watchdog signals have the right frequency and dutycycle.

Each independent circuit is provided with two HSCMOS digital outputs, used by the two PCA boards to monitor the state of the contacts of the two safety relays.

For this purpose, the normally closed contacts of the safety relays are used.

09-I-02.02.02.05 Software Description

The software is developed on a “2 by 2” hardware architecture made up of two PCA boards.

The software is identical for both boards. One is the Master PCA, according to a voltage level on a dedicated pin. The other one is the Slave PCA.

The software has been developed to operate with the three devices listed below:

- Microcontroller Infineon SAKC167CS
- DSP Texas TMS320C31
- FPGA Xilinx XCS40

The Master PCA generates the test signal, to be sent to the EDI board, by means of a Digital-Analog Converter (G output).

The EDI transforms the analog signal generated by the Master PCA, then it Low-Pass Filters and transforms the analog input into a sinusoidal current and injects it into the test (auxiliary) winding of the HCT.

Each PCA board acquires both the measurement signal and the test signal, by means of Analog-Digital Converters.

Each PCA board performs the harmonic analysis of both the measurement signal and the test signal.

According to the value of the calculated harmonics, the software will recognize a warning or an alarm event if the harmonics exceed certain threshold values.

Such an intervention value is written in a software table whose content cannot be changed by maintenance personnel.

The Master PCA logs the diagnostic events on a non-volatile memory.

By means of the PTU, it is also possible to download the event data-base and monitor the harmonics on-line.

The two PCAs exchange data through the CAN bus performing the following checks:

- The relevant internal status
- The results of the harmonic analysis
- Possible hardware failures
- The status of the input digital signals

The information is also sent to the diagnostic system (IDU) through the LonWorks bus. In case of correct operation, each PCA generates a square wave signal to control the watchdog circuit.

Correct operation means that (for both PCAs):

- The signal spectrums are within the specified ranges
- No hardware failure is detected
- Software tasks operate properly

Each PCA is provided with 4 digital input interfaces towards the vehicle logic.

One is used to acquire the bypass signal.

The other three digital inputs are kept as spare inputs for later specifications.

Each PCA is provided with 2 digital output interfaces towards the vehicle logic.

Both digital outputs are kept as spare outputs for later specifications.

a) Test Signal Generation

The test signal is sinusoidal with a fundamental frequency of 156.25Hz and a sample frequency of 15,625Hz.

The value of the fundamental frequency has been chosen in order to keep the harmonics of the test signal out of the “holes” in the harmonic mask:

- 60 Hz ±10Hz
- 100 Hz ±10Hz
- 250 Hz ±10Hz

b) Harmonic Analysis

The harmonic analysis of the measurement signal is performed by using three band-pass 4th order Butterworth filters, with the following band-width values:

- 60Hz ± 10Hz
- 100Hz ± 10Hz
- 250Hz ± 10Hz

One band-pass 4th order Butterworth filter will be used for the test signal, with the following band-width value:

- 156Hz ± 10Hz

c) Harmonic Out of Range Detection

If the output of the Butterworth filter on the test signal exceeds a specified range, such an event will be recognized as an alarm condition.

The EMI violations will be classified in three different of increasing severity according to their magnitude, duration and frequency.

- Group 1 Warnings

The output of the FIR filter is compared with a “warning” threshold: the threshold is exceeded for a fixed time (intervention delay = 5s) such an event will be recognized as a “warning” (refer to Figure 09-I-02.17).

If a warning event is detected, a request will be sent (through the LonWorks bus) to the Propulsion system (TCU) in order to reduce the vehicle’s performances.

The event is logged in the event data-base.

- Group 2Alarm

The output of the FIR filter is also compared with an “alarm” threshold”: If the threshold is exceeded for a fixed time (intervention delay = 5s) such an event will be recognized as an “alarm” (refer to Figure 09-I-02.17).

If an alarm event is detected, the CEMIPS will trip the HSCB by opening the NO contacts of the Safety Relays.

It also sends a message via the LonWorks bus, for redundancies and for diagnostic purposes only.

— Group 3 - Lock out

After three within a minute period, the CEMIPS will lock out the HSCB, immobilizing the train. In order to continue the service a manual reset or CEMIPS bypass activation IS required

Table 09-I-02-9 Intervention Level and Duration

ID	Alarm level [Arms]	Warning level [Arms]	Intervention delay [s]
IM60	1.0	0.8	5.0
IM100	1.0	0.8	5.0
IM250	1.0	0.8	5.0

09-I-02.02.03 Auxiliary Fuse

The Auxiliary Fuse (01F02) provides protection from auxiliary equipment (APS/LVPS system) overloads due to short circuits.

The fuse is a bolted cartridge fuse inside a sealed molded holder.

The holder is mounted on stand-off insulators to the roof of the vehicle.

The fuse working principle is simple: the current to be checked enters the fuse, passes through a specifically dimensioned wire and exits.

If the current value is over the nominal current value for a determined time, the current burns the wire and the current flow is cut.

The current threshold of the Auxiliary Fuse is 200A (rated 900VDC). The response time is in proportion to the value that passes through the fuse.

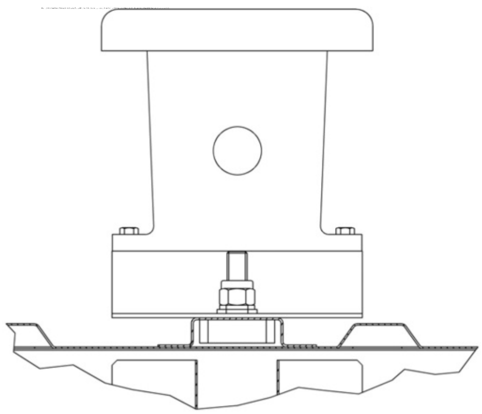


Figure 09-I-02.18 Auxiliary Fuse Box

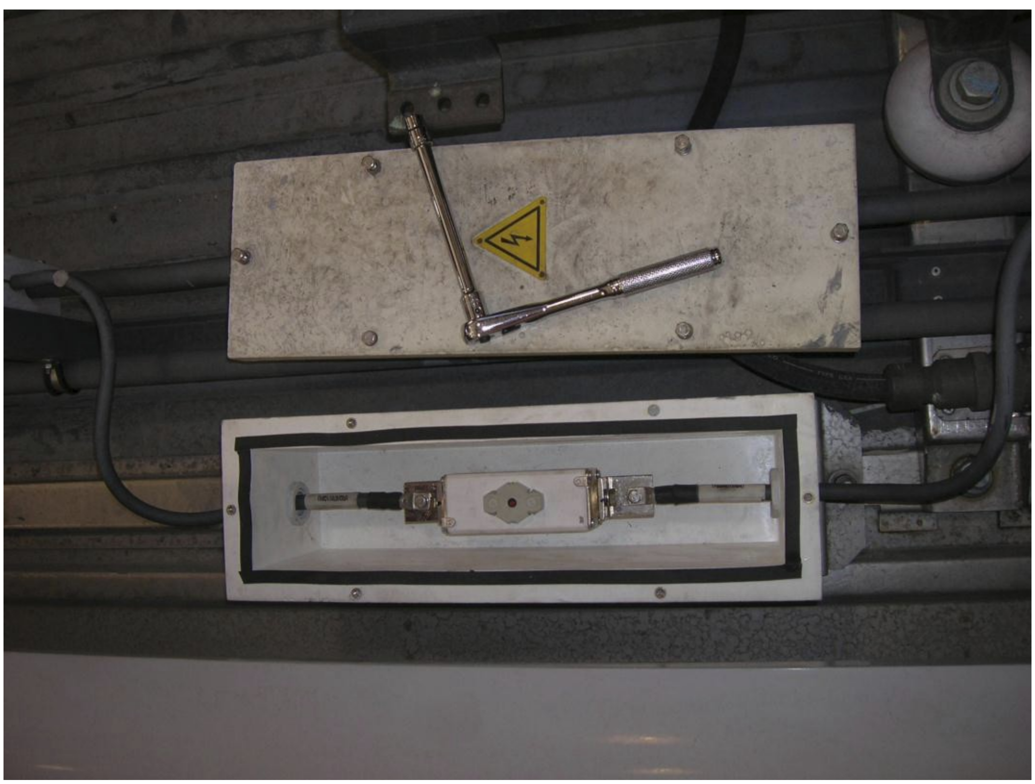


Figure 09-I-02.19 Auxiliary Fuse (photo)

09-I-02.02.04 HSCB (High Speed Circuit Breaker)

The HSCB (Type UR 6 - 31 TDP) is a single-pole electromagnetic DC circuit breaker with a bi-directional over-current and trip free release, whose tripping characteristics are independent from the current direction and not affected in the event of short circuits.

The HSCB is mounted inside a sturdy box (refer to Figure 09-I-02.20) provided with HV and LV cable connectors for quick mounting and dismounting operations, and is located on the roof of car section “A”.

The cooling of the circuit breaker is by ambient air.

When the current passing through the circuit breaker exceeds the tripping level, the release mechanism causes main contacts to open.

A new closing movement can take place only after resetting the operating circuit.

The HSCB is operated by LV power supply and has remote trip and reset.

Manual reset is obtained by means of the “Propulsion Reset” button on the cab operator console.

The HSCB is designed to respond very quickly upon detection of an excess current, or of a train logic HSCB trip request.

The HSCB main circuit is assembled on a rigid fiber-glass reinforced polyester insulating frame and consists of a lower connection, carrying a moving contact, and an upper connection with a fixed contact (refer to Figure 09-I-02.21).

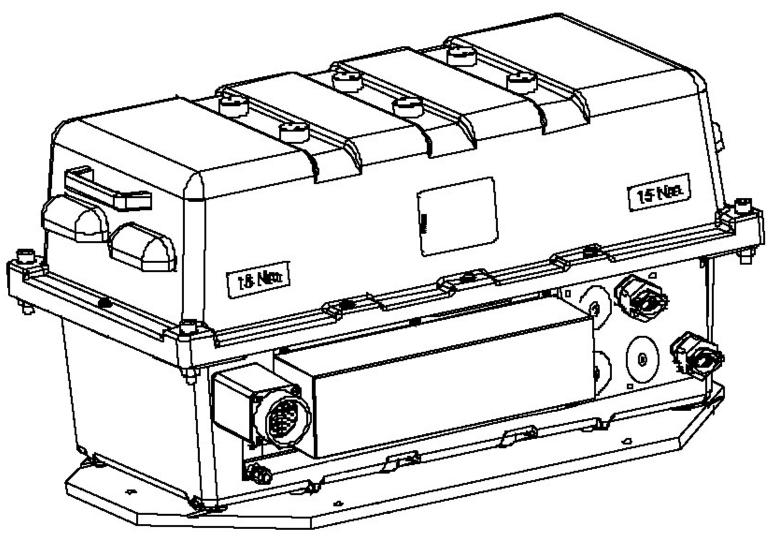
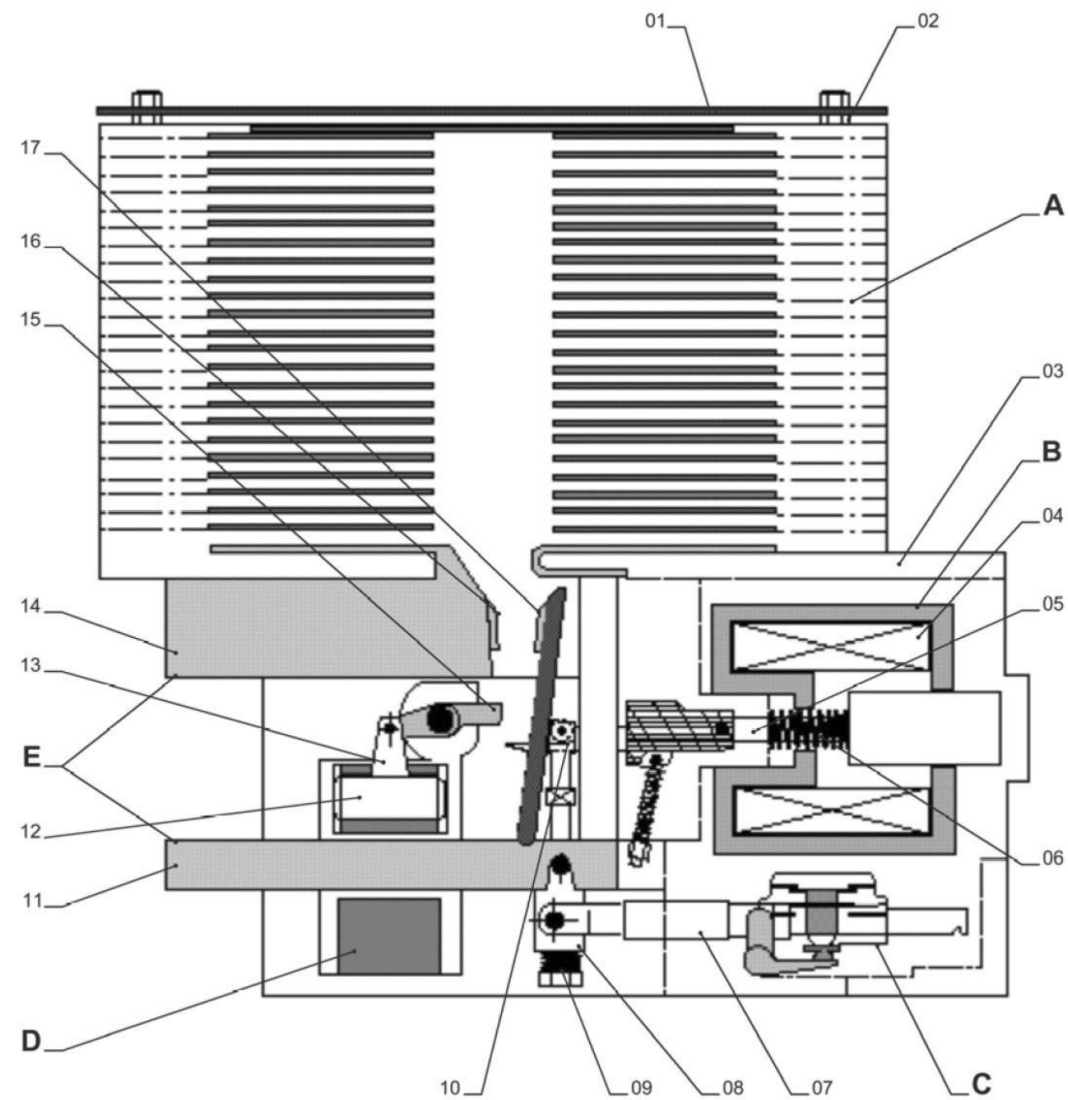


Figure 09-I-02.20 HSCB Box

09-I-02.02.04.01 System Description



A. ARC CHUTE	B. CLOSING DEVICE	C. AUXILIARY CONTACTS
D. TRIPPING DEVICE	E. MAIN CIRCUIT	
01. TOP PLATE	02. THREADED RODS	03. CHUTE PLATE
04. CLOSING COIL	05. ROD	06. PRESSURE SPRING
07. GUIDE ASSEMBLY	08. PIVOT SOCKET	09. PIVOT SOCKET SPRING
10. FORK	11. LOWER CONNECTION	12. SET OF PLATES
13. MOVING MAGNET	14. UPPER CONNECTION	15. LEVER
16. FIXED CONTACT	17. MOVING CONTACT	

Figure 09-I-02.21 High Speed Circuit Breaker

At rest the contactor remains open.

The closing of the main circuit is controlled by the closing device, a magnetic circuit containing the closing coil. If the closing device is active, it moves a rod connected (top) to a fork.

The fork pushes the moving contact against the fixed one.

The tripping device is shaped like a ring and is placed around the lower connector.

The tripping device consists of a set of plates enclosed in the casing sealed by a cover.

Fast return of the moving contact after tripping commanded by the vehicle logic or by excess current is ensured by the pivot socket spring.

The auxiliary contacts consist of 4 double-contact switches mounted on an auxiliary housing.

The switches are activated by a lever and controlled by the moving contact via a guide assembly.

The arc chute consists of a set of arc resistant insulating plates. This set of plates is sealed off by a top plate and mounted on an arc chute plate by means of threaded rods.

09-I-02.02.04.02 Logic HSCB Opening Request

The Train Logic (through the coil contactor box and the UR6 coil, refer to Figure 09-I-02.22) can open and close this breaker, so that the HSCB protects the propulsion system against overcurrent coming from the catenary line, and stops propulsion depending on the train status.

The train logic allows the HSCB to close only if:

- All active TCUs (TCUs that are NOT cut out) have no active faults
- A Cab or B Cab is enabled
- No Cab Console Pantograph Switch (5S01) is actively being placed into the Pan Down position
- Emergency Brake is not applied
- TCU does not require a HSCB open command.
- The Master Controller Handle must be in either COAST or FSB

The train logic opens the HSCB if one of the following conditions occurs:

- No cab is enabled
- Emergency Brake is applied
- EMI protection system points out a line noise
- TCU requires a HSCB open command
- Placing any cab console Pantograph Switch (5S01) in the Pan Down position will result in the HSCB opening

The TCU commands the HSCB to open if a HARDWARE or a SOFTWARE protection is active.

If the HSCB trips, the HSCB stays open until no HARDWARE or SOFTWARE protections are active anymore and the propulsion reset button has been pressed by the operator.

Table 09-I-02-10 and Table 09-I-02-11 show the HARDWARE ad SOFTWARE protections that will cause the HSCB to trip.

Table 09-I-02-10 HSCB Trip Caused by HARDWARE Protections

Name	Description	Activates if
SBF	Phase unbalance	Phase current difference>200A
SVF2	Filter overvoltage threshold2	vFIL>1050V
SCL	Line overcurrent	iLINP>600A
DIAR	Inverter phase A failure	Inverter phase A module diagnostic signal is high
DIAS	Inverter phase B failure	Inverter phase B module diagnostic signal is high
DIAT	Inverter phase C failure	Inverter phase C module diagnostic signal is high
DIACH	Inverter phase CH failure	Inverter phase CH module diagnostic signal is high

Table 09-I-02-11 HSCB Trip Caused by SOFTWARE Protections

Name	Description	Activates if
errAT	Main contactor wrong position detected	Filter voltage isn't present and the main contactor is closed
svfProl	The SVF1 protection is present for 10.0s. It's used to protect the braking resistor	vFIL>1000V for 10.0s
errPrec	The maximum energy on the charge resistor has been reached.	EnergyCnt>10.0 kJ
errHW	Hardware doesn't follow the SOFTWARE commands	Unable to open the HSCB or unable to force the chopper to fire
errDO	DO board failure	A DO channel error has been detected
errCOM	Command error	(FWD and REV) or (POWER and BRAKE) contemporarily present
ODAlarm	DO board - power supply failure	Unable to detect the power supply on the DO board
STBKO	STB board communication failure	The PCA board is unable to communicate with the STB board
gndFault	Ground fault	iLinP-iLinN>15A

[redacted]

When pins R and S are supplied with battery voltage and the breaker is not detecting an overcurrent:

- By energizing the 4K02 Relay, the relative NO (Normally Open) contactor (pins B1-B2) closes and consequently the UR6 closes (so in operative condition the 4K02 Relay must be energized)
- By de-energizing the 4K02 Relay, the relative NO (Normally Open) contactor (pins B1-B2) opens and consequently the UR6 opens

Note 1 (Refer to following Figure 09-I-02-24) Only while the operator takes the cab console pantograph switch to the down position will there be power available to energize 4K01. If the Pantograph is down (and has been down for some time) and no one is placing the cab console switch in the down position then 4K01 will NOT be energized. This means that even with the pantograph in the down position the 4K01 contact will be closed and the HSCB can in fact be closed

The HSCB Positive Battery Supply line (pin "R") is protected by the 4F02 Circuit Breaker. If this CB is open, the HSCB cannot energize the UR6 Coil.

Coil overheating must be prevented since not all the 37.5Vdc input power is needed to maintain the UR6 Coil closed, and the power in excess must be dissipated..

The four UR6 auxiliary contacts (Low Voltage) carry the UR6 main contactor status according to the following:

- Pin C-D, pin G-H, pin Z-a, pin d-e: are NORMALLY OPEN (NO) contacts and they are open if the main contactor is open and closed if the main contactor is closed.
- Pin A-B, pin E-F, pin X-Y, pin b-c: are NORMALLY CLOSED (NC) contacts and they are closed if the main contactor is open and open if the main contactor is closed.

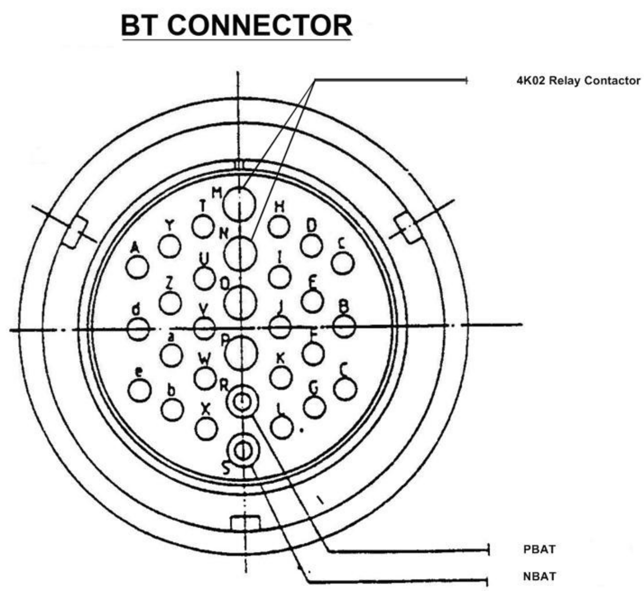


Figure 09-I-02.23 Low Voltage Pin Out (VQ1)

Table 09-I-02-12 HSCB Auxiliary Contactors

#	Pins	Normally Status	Function
1	C-D	open	HSCB closing latch
	A-B	close	Spare
2	G-H	open	HSCB status for TCU A
	E-F	close	Spare
3	Z-a	open	Spare
	X-Y	close	Spare
4	d-e	open	HSCB status for TCU_B
	b-c	close	"HSCB Open" Indicator Panel Lamp

[redacted]

09-I-02.02.04.03 HSCB Main Characteristics

a) Breaking Main Characteristics:

Rated voltage	750Vdc
Rated current	1000 A @ +104°F (40°C)
Short-circuit characteristics @ 900Vdc:	
L/R = 2 ms	Icc < 15 kA
L/R = 15 ms	Icc < 30 kA
L/R = 30 ms	Icc < 45 kA
Max. arc overvoltage	2500 V
Tripping range	1200 - 2400 A
Tripping set value	1700 A
Rated mechanical durability (operation)	5 x 100,000 500,000 is the number of operations that the device is capable of performing with maintenance checks every 100,000 operations
Power circuit connection	Diameter 0.5512 in
Auxiliary contacts	4 NO (Normally Open) 4 NC (Normally Closed)

b) Coil Control Box Main Characteristics:

Rated input voltage	36Vdc
Input voltage range	25.3Vdc … 45Vdc
Nominal input current	1.8A
Max. input current (during max. 1s)	25A @ 68°F (20°C)
Economy resistor	27 Ohm / 80W
Control signal - voltage (SW1)	0Vdc … 45Vdc (free of potential)
Control signal - current (SW1)	Rated current < 10mA

c) Timing (HSCB in operative condition):

Direct closing time @ 68°F (20°C) (time between the moment SW1 is closed and the circuit breaker main contacts are closed)	95 ms (typ.)
Direct open time @ 68°F (20°C) (time between the moment SW1 opens and the circuit breaker main contactors are open)	105 ms (typ.)

09-I-02.02.05 Knife Switch

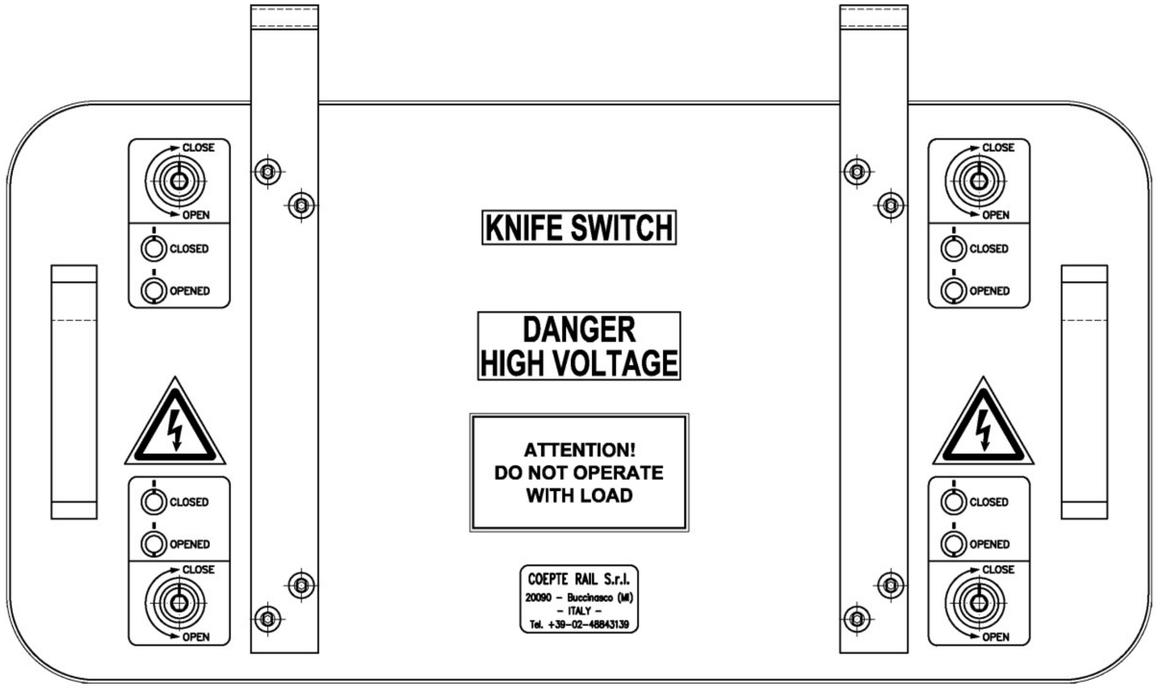


Figure 09-I-02.25 Knife Switch Cover

The Knife Switch, mounted on the underframe of the “A” car section, close to the articulation section, connects the HV System to the inverter modules of the Propulsion System and to the APS/LVPS system.

The Knife Switch (refer to Figure 09-I-02.26) has four positions:

- **Normal**: Propulsion and APS/LVPS Systems are supplied by the catenary line
- **Auxiliary**: the APS/LVPS System is supplied by the catenary line while the Propulsion System is cut out
- **Off**: no system is supplied
- **Shop**: the APS/LVPS System is supplied by the Shop power line, while the Propulsion System is cut out

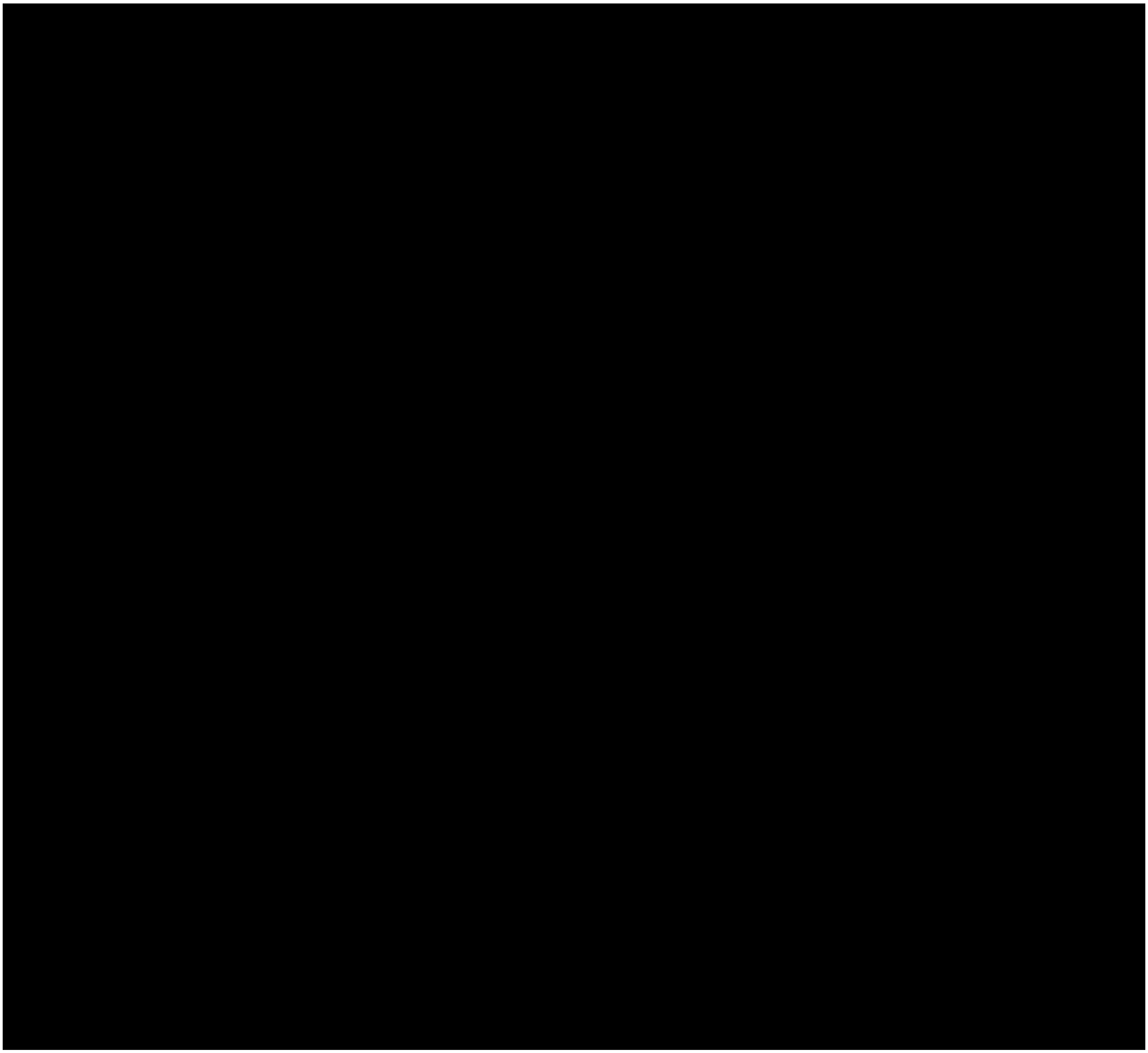
The Knife Switch is made up of an insulating watertight box (IP65) containing:

- A switch for no-load operation, with manual drive in high voltage circuit at 750Vdc. It is made up of two knives mechanically connected together, in parallel
- A high voltage (750VDC) Shop Power Socket

The switch is accessible through a watertight cover by means of the maintenance key. The cover is removable.

The switch can be moved horizontally by means of an isolated switch hook held in place inside the box by means of spring holders.

The internal part of the Knife switch cover is shaped in such a way that it is not possible to close it if the switch is not in Normal position.



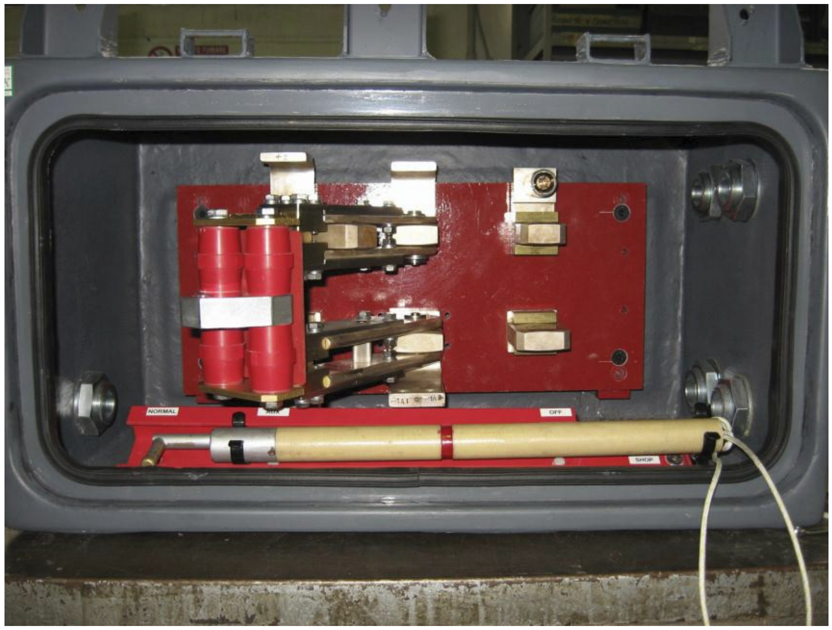


Figure 09-I-02.27 Knife Switch Box - Internal View

09-I-02.02.06 Junction Box

The two junction boxes, located on the roof of the two car sections, near the articulation section, connect the catenary line from the “A” Car Section to the “B” Car Section and from the Roof to the Underframe (and vice versa).

The two junction boxes are slightly different since the “A” Car section Junction Box is used to connect cables coming from the HSCB and the Auxiliary fuse to the Knife Switch.

From the Knife Switch wires go back to the “A” Car Section Junction Box and then, through the “B” Car section Junction Box, to the Propulsion and APS/LVPS Systems located in the “B” Body Section.

The wires that connect the two junction boxes are flexible and laid down in such a way that they can easily follow the movements of the two car sections in a curve.

Table 09-I-02-13 A Car Junction Box Connectors

Connector	# Cable	From	To
IS 1	0703	Knife Switch	B junction IS 1 connector (APS/LVPS 750 VDC Supply)
IS 2	0702	Knife Switch	B junction IS 2 connector (Propulsion Inverter 750 VDC Supply)
IS 3	0704	A section PT1	B junction IS 3 connector (750 VDC Return)
IS 4	0711	Auxiliary Fuse	Knife Switch (for APS/LVPS)
IS 5	0710	HSCB	Knife Switch (for Propulsion)

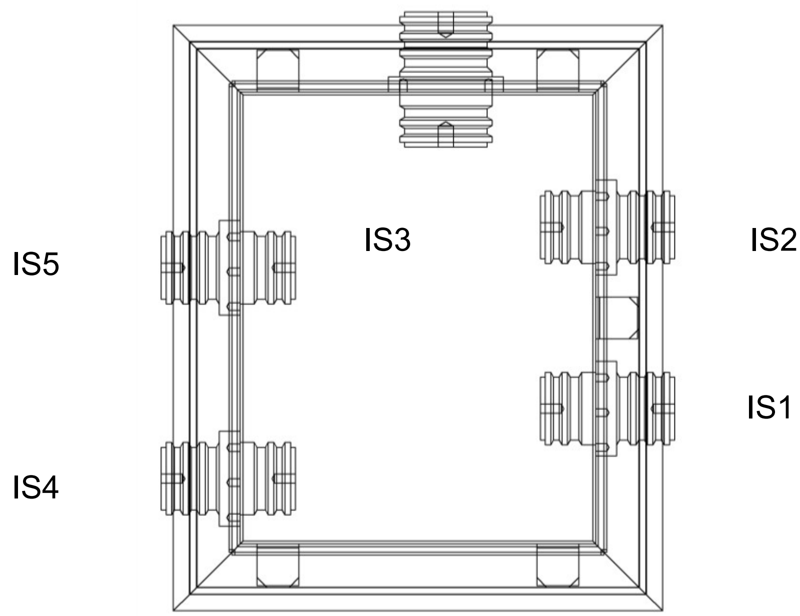


Figure 09-I-02.28 "A" Car Section Junction Box Drawing

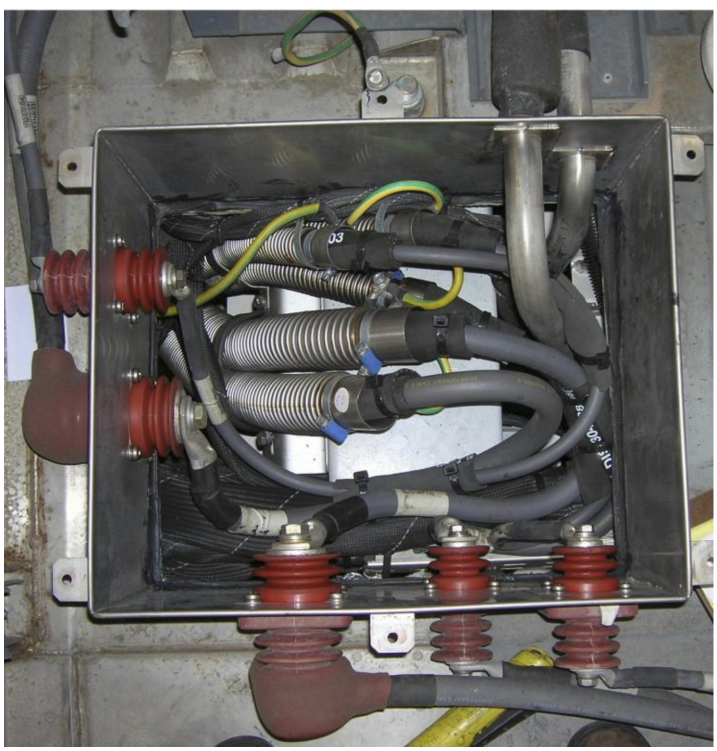


Figure 09-I-02.29 "A" Car Section Junction Box

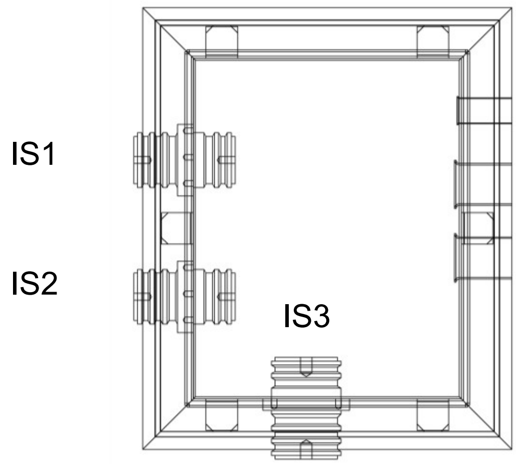


Figure 09-I-02.30 “B” Car Section Junction Box Drawing

Figure 09-I-02.31 “B” Car Section Junction Box

Table 09-I-02-14 B Car Junction Box Connectors

Connector	# Cable	From	to
IS 1	0703	A junction IS 1 connector	APS/LVPS line filter
IS 2	0702	A junction IS 2 connector	Propulsion Inverter
IS 3	0704	A junction IS 3 connector	B section PT1 (750 VDC Return)

09-I-02.02.07 High Voltage Wiring

All HV cabling is protected for safety reasons, from the catenary line to the Propulsion and the APS/LVPS Systems and back to the braking resistors, on the roof.

Particular attention has been paid to the passage of HV cables through the passenger compartment: each cable is protected by a sturdy flexible conduit.

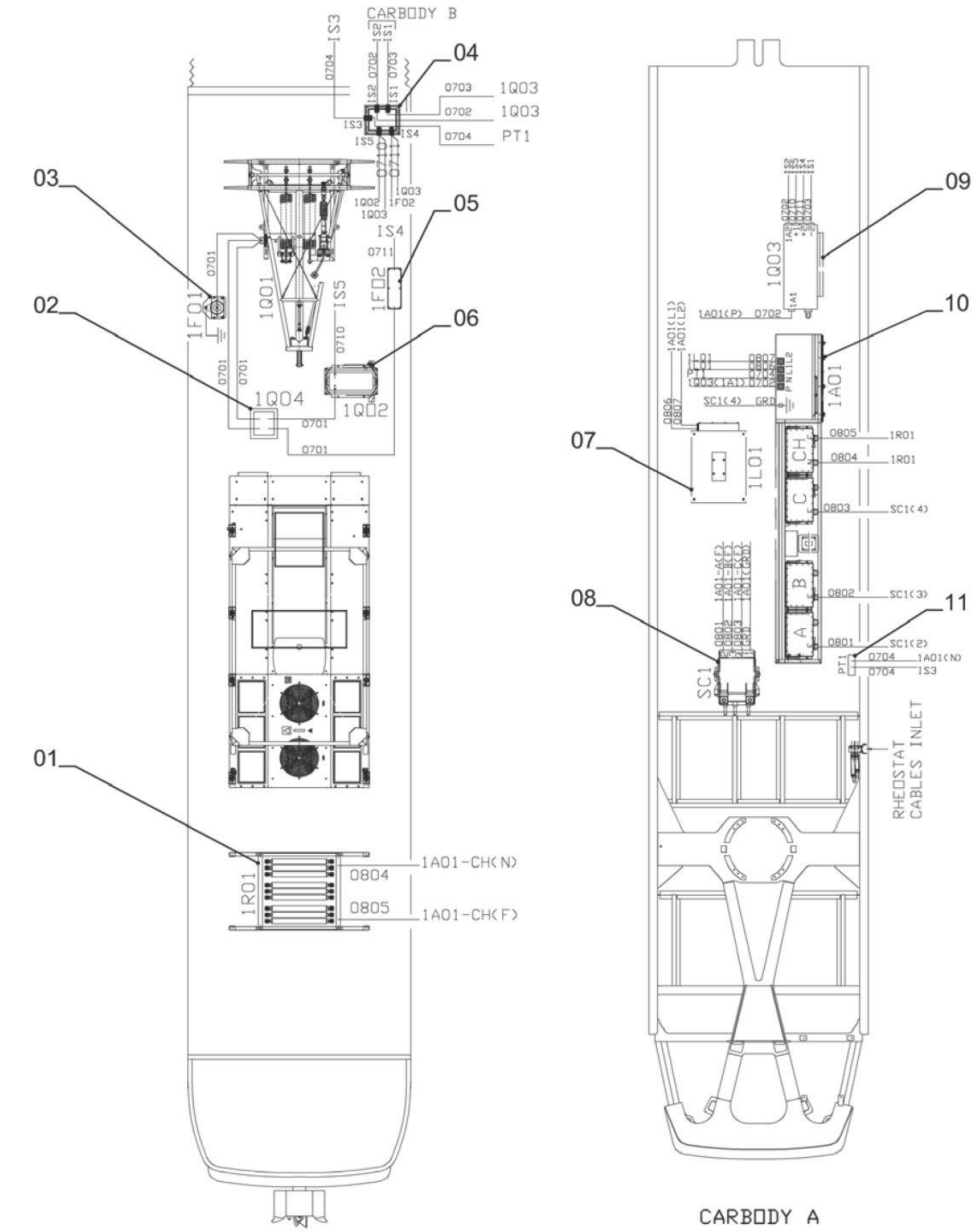
Flexible conduits are held in place by brackets (refer to Figure 09-I-02.37 and Figure 09-I-02.38).
The HV cables pass through the interspace between the external wall and the side panels of the passenger compartment.

Figure 09-I-02.32 and Figure 09-I-02.33 show how the HV wires of the two car sections are connected to the relevant systems.

Figure 09-I-02.35 and Figure 09-I-02.36 show the HV wiring underneath the vehicle.

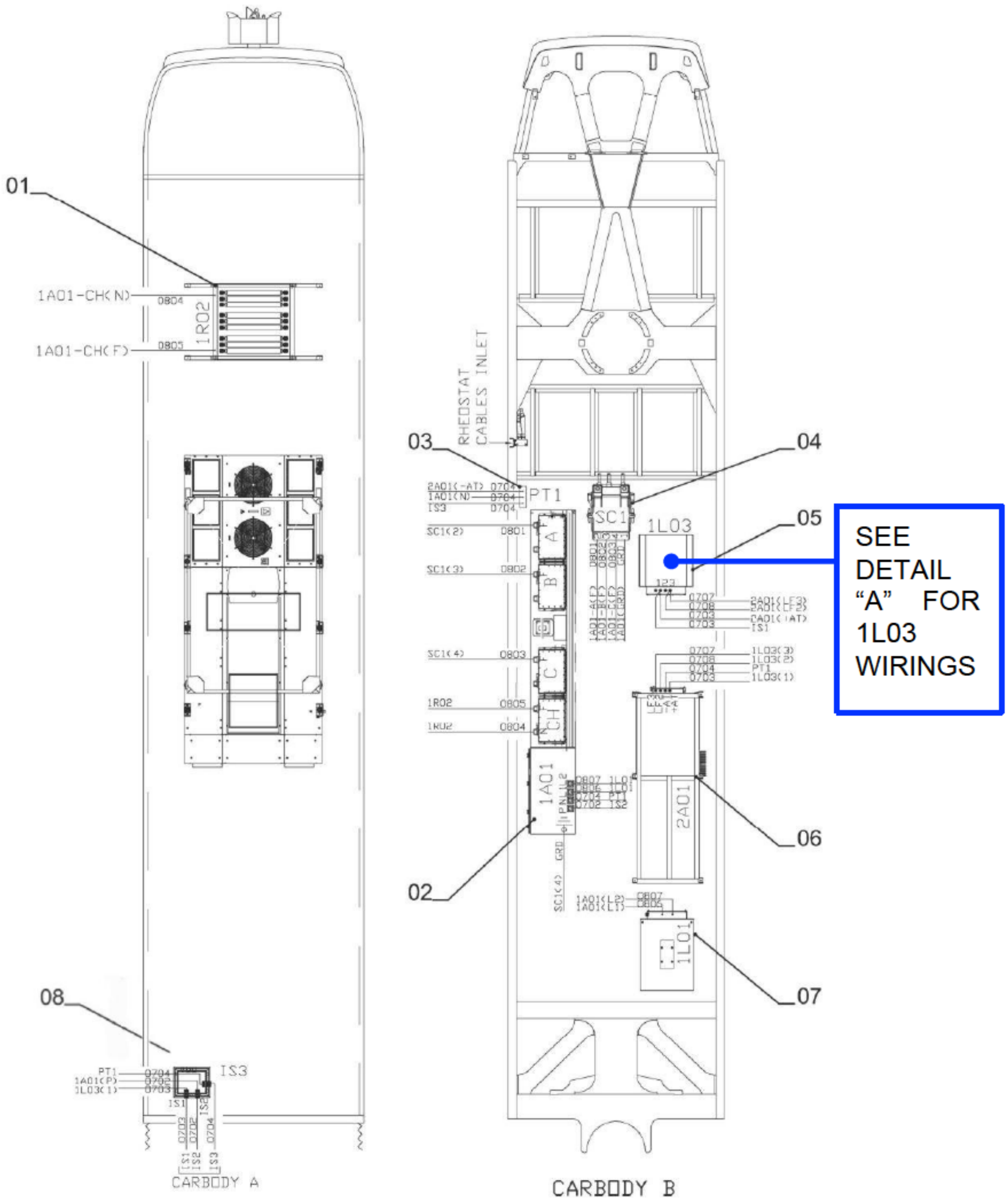
HV Wiring is represented in the AB document AA03ATY (HV Functional Schematic) and in the AB Topographics AA042BK, for the A Car, and AA042BL, for the B Car (see following figures).

For a more detailed description on How to use the Functional Schematics and the Topographics refer Section 00.



01. BRAKING RESISTOR
02. HCT (EMI)
03. LIGHTNING ARRESTER
04. JUNCTION BOX
05. AUXILIARY FUSE
06. HSCB
07. PROPULSION LINE REACTOR
08. TM CABLES QUICK DISCONNECT
09. KNIFE SWITCH
10. PROPULSION INVERTER
11. GROUND PLATE

Figure 09-I-02.32 A Section High Voltage Wiring



01. BRAKING RESISTOR
02. PROPULSION INVERTER
03. GROUND PLATE
04. QUICK DISCONNECT BOX
05. APS/LVPS LINE REACTOR
06. APS/LVPS
07. PROPULSION LINE REACTOR
08. JUNCTION BOX

Figure 09-I-02.33 B Section High Voltage Wiring

Figure 09-I-02.34 DETAIL "A" B Section High Voltage Wiring

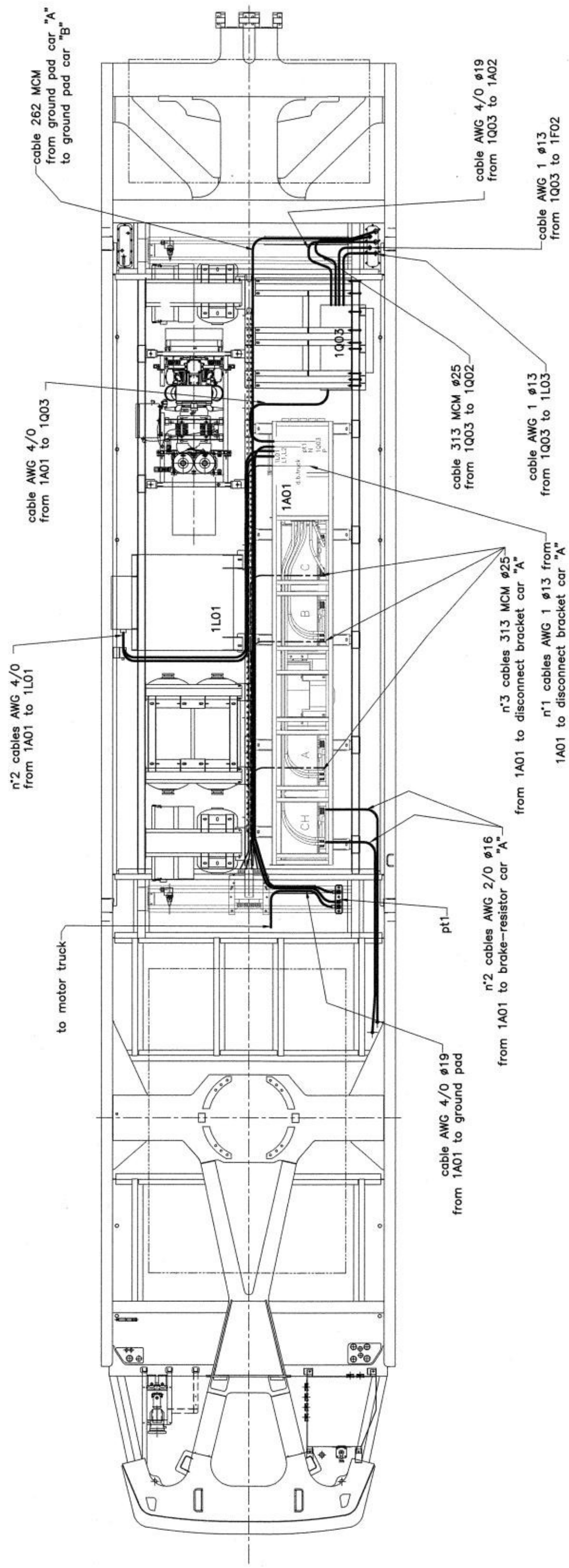


Figure 09-I-02.35 A Body section Underframe - HV Cabling Layout

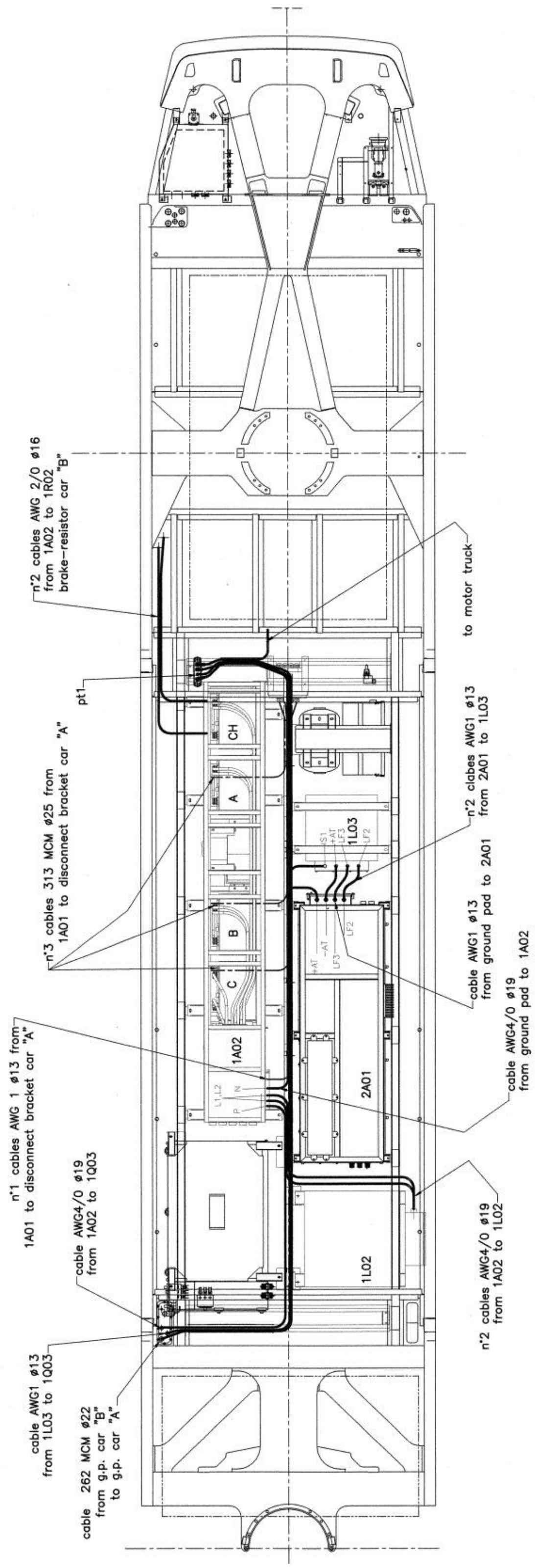


Figure 09-I-02.36 B Body section Underframe - HV Cabling Layout

To increase safety, HV cable passageways, from the roof to the underframe, use only limited parts of the vehicle sections, near the articulation section for HV supply cables (Figure 09-I-02.37) and near the two cabs for the Braking Resistor cables (Figure 09-I-02.38).

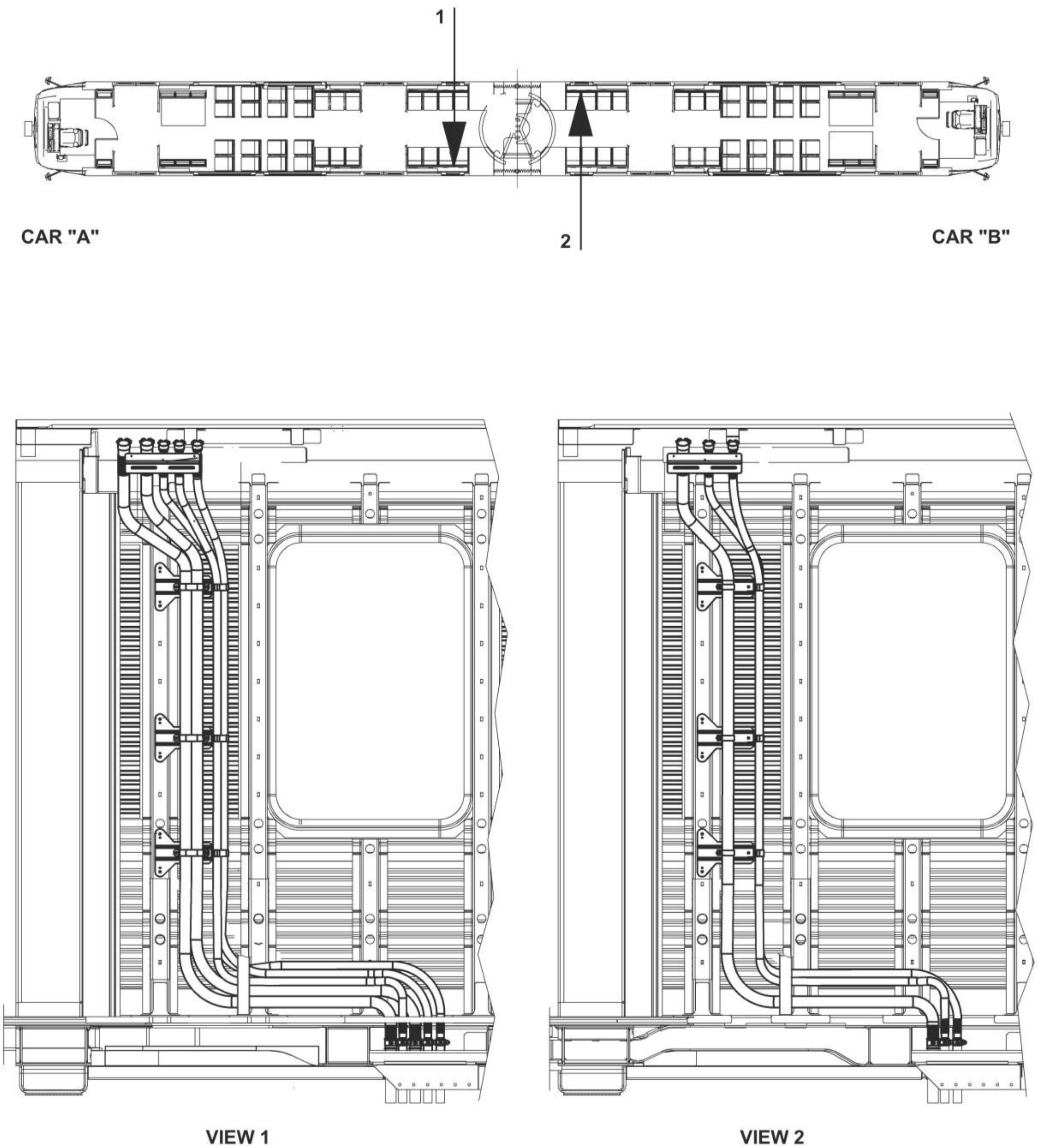


Figure 09-I-02.37 HV Cable Passageway

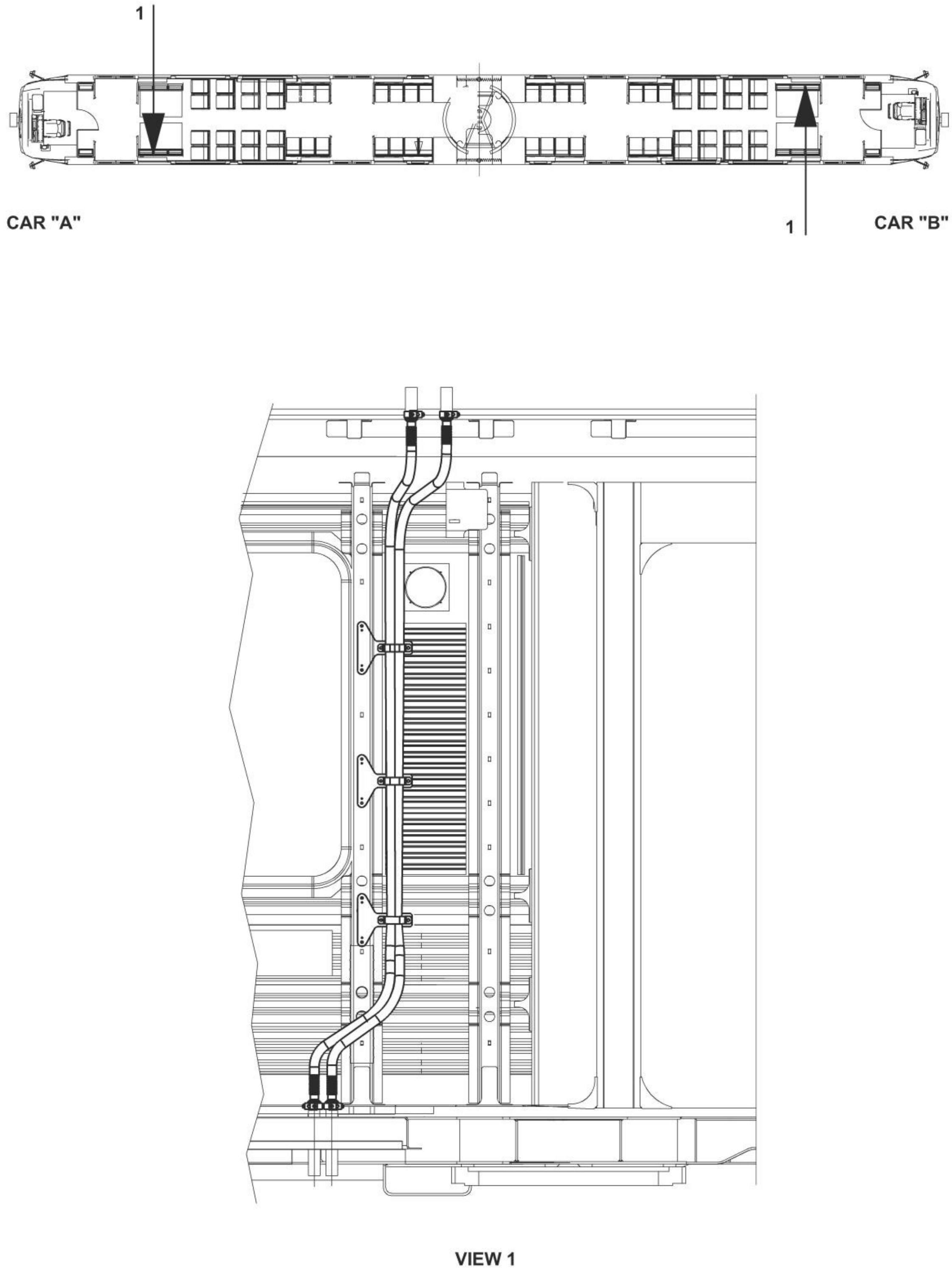


Figure 09-I-02.38 Braking Resistor Cable Passageway

09-I-02.03 The Grounding System

The Grounding System is characterized by two important functions and for this reason it is divided into two subsystems:

- Traction Inverter Grounding System
- Car Body Grounding System.

[redacted]

As shown in Figure 09-I-02.39, all electric systems need to be energized through a positive and a negative line.

In this way the current can flow through the electric systems of the train and supply them.

The positive line is the Catenary Line, while the running rails are used for connecting the negative line.

[redacted]

All metallic parts must be connected to the ground in order to protect people from unwanted electric charges (caused by a ground fault) or electrostatic discharge.

Since the voltages that could potentially energize any metallic part or the LRV can be very dangerous, and even lethal to a person who completes the path to the ground; therefore, this subsystem (unlike the Traction Inverter Ground System whose function is the proper working condition of all electric systems) is dedicated to passenger safety.

The function is realized by connecting to the ground through ground plates, all metallic elements of the train, including all metallic parts that are usually not energized (for example the Car Body, the Propulsion Inverter box, pipes, etcetera).

In this vehicle the current path to the running rails through the wheels is guaranteed by six Ground Contact Assemblies mounted on the six axles of the vehicle.

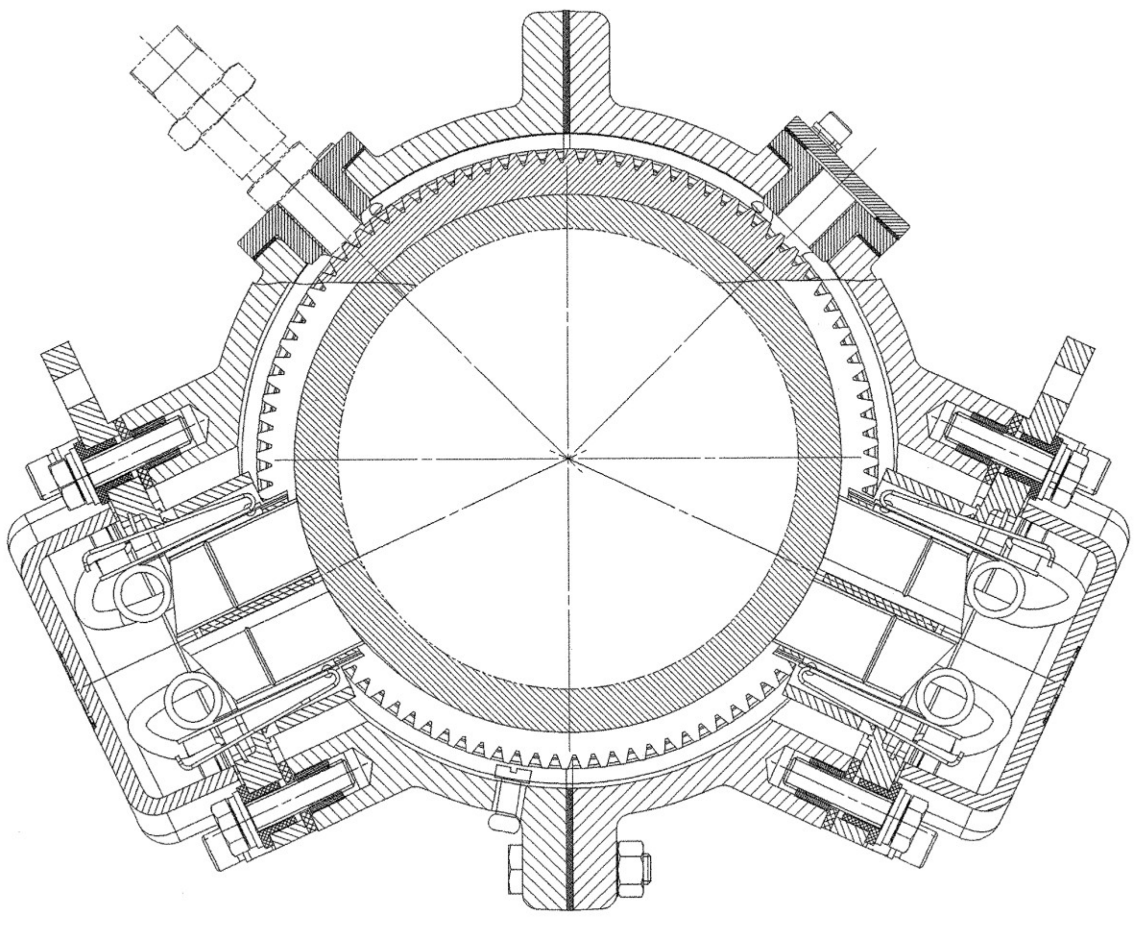


Figure 09-I-02.41 Ground Brush Assembly Drawing

Each Ground Contact Assembly includes two ground brushes and three speed sensor holders.

The ground brushes allow the current to flow from the vehicle to the axle (and from here to the running rails).

Figure 09-I-02.43 shows the Grounding System Block Diagram.

The line return current path and the grounding connections are shown, down to the six Ground Contact Assemblies mounted on the axles (1Q12-1Q15, 1Q13-1Q14, 1Q24, 1Q25, 1Q35-1Q37 and 1Q36-1Q38).

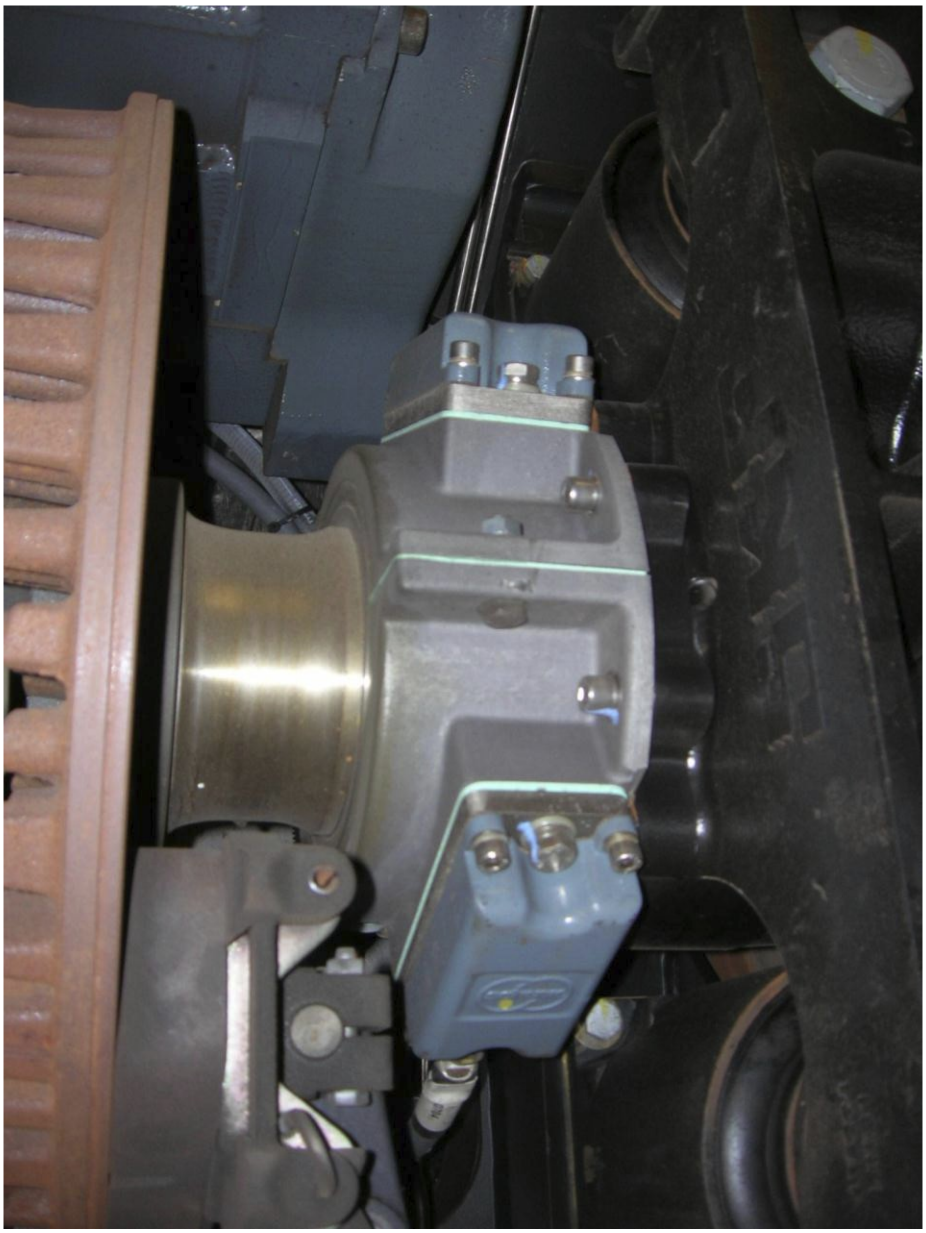


Figure 09-I-02.42 Ground Contact Assembly with Ground Brushes

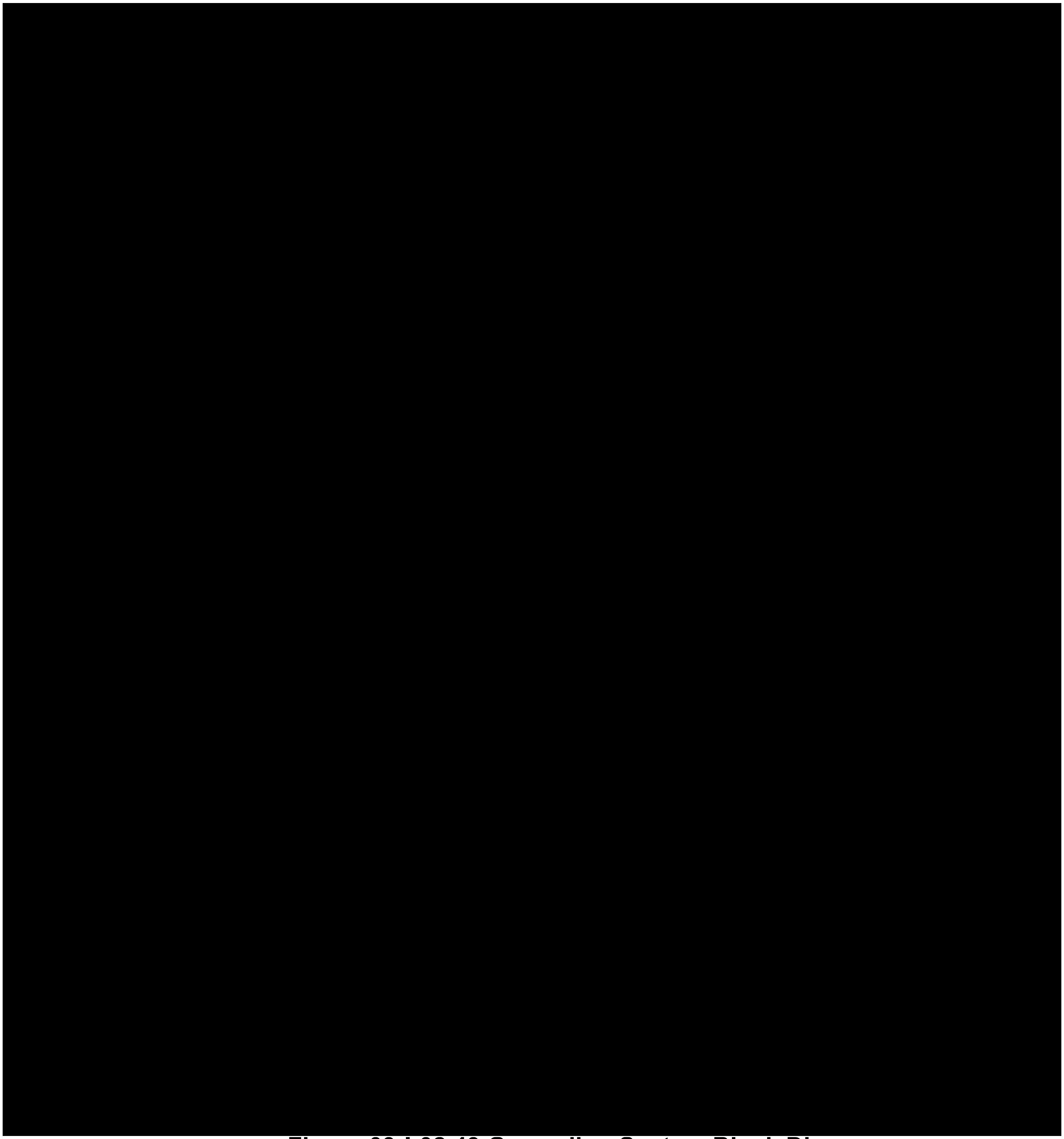


Figure 09-I-02.43 Grounding System Block Diagram

Table 09-I-02-15   Ground Brushes

Truck	Ground Brush Assembly	Ground Contact
A	Axle 1	1Q12
A	Axle 1	1Q15
A	Axle 2	1Q14
A	Axle 2	1Q13
C	Axle 3	1Q24
C	Axle 4	1Q25
B	Axle 5	1Q36
B	Axle 5	1Q38
B	Axle 6	1Q35
B	Axle 6	1Q37

Refer to Figure 09-I-02.42 and Table 09-I-02-15: Ground Contacts 1Q12, 1Q13, 1Q37, and 1Q38 collect the traction current return ground (N).and the APS/LVPS current return (-AT)

From the Propulsion and APS/LVPS units, the return current passes through the traction current return insulated plate PT1 and the Truck Insulated Plate.

The two Junction Boxes (refer to paragraph: 09-I-02.02.06) connect the PT1 of the A car to the PT1 of the B car. In this way, if a current path (from A Car or B Car) does not work properly or is overloaded, the other path does the job. PT1 plates are shown in Figure 09-I-02.44.

Ground Contacts 1Q15 and 1Q35 provide the safety grounds for the Traction Motor housings, the Propulsion Inverter housings, the junction boxes, and the TM quick disconnects for the respective trucks. Ground Contacts 1Q14, 1Q36, 1Q24, and 1Q25 collect the Car Body safety ground.

All metallic parts of the LRV Car Body are connected together through the four Grounding contacts (1Q14, 1Q36, 1Q24, and 1Q25) via the 0705 cable.

The metallic parts connected to the Grounding System are the following:

- A, B and C Truck Frames
- A, B, C Truck Bolsters
- A and B Car Bodies, and the Articulated Section Internal and External Dome Structures
- A and B Propulsion Unit boxes
- APS/LVPS box

All small metallic parts are connected to the bigger ones, and these are connected to the Ground Contact Assemblies, so that all metallic parts, small and big, are connected to ground.

It is important to notice that the LV negative line (2403 in Figure 09-I-02.43) is NOT directly connected to the APS/LVPS box and consequently to the ground like the HV system.

This function is carried out by a parallel R-C (Resistor - Capacitor) that uncouples the LV voltage reference from the HV reference, so that the LV reference is kept stable.

This is important since the HV System might possibly discharge currents towards ground at levels which could be much higher than any LV electronic instrument (like an electronic board) can bear.

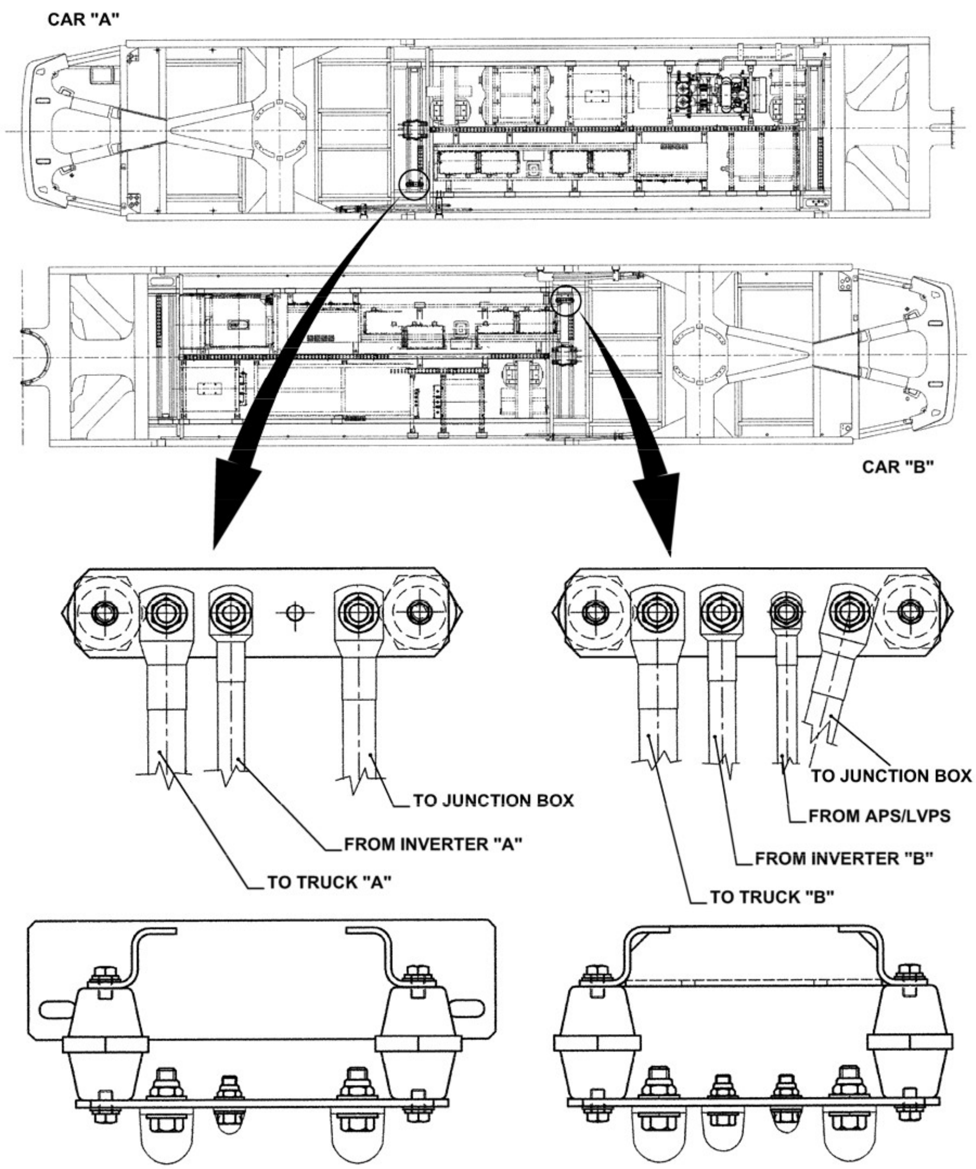


Figure 09-I-02.44 Traction Current Return Insulated Plate (PT1)

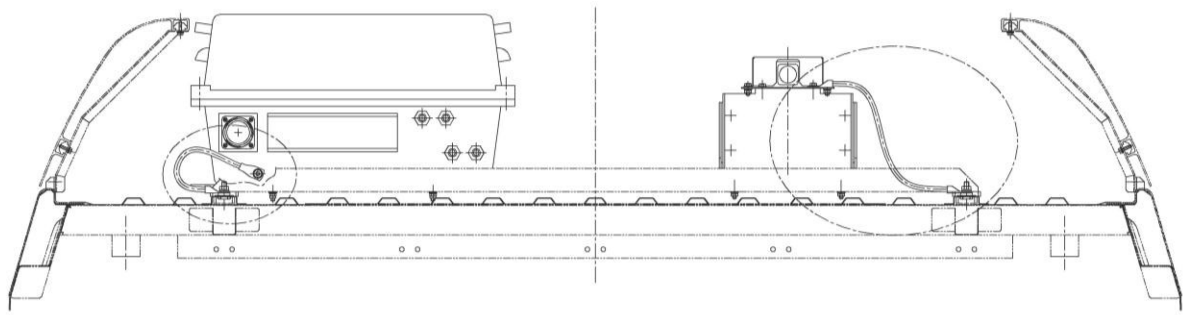


Figure 09-I-02.45 HSCB and Harmonic Current Transducer Ground Connection

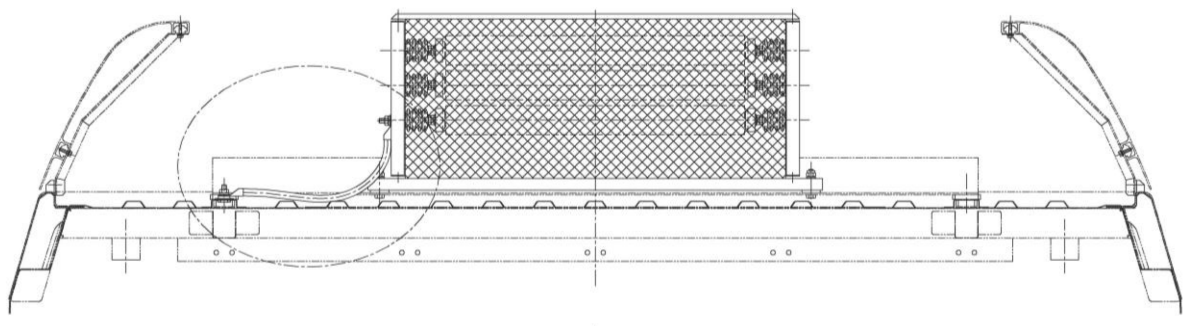


Figure 09-I-02.46 Braking Resistor Ground Connection

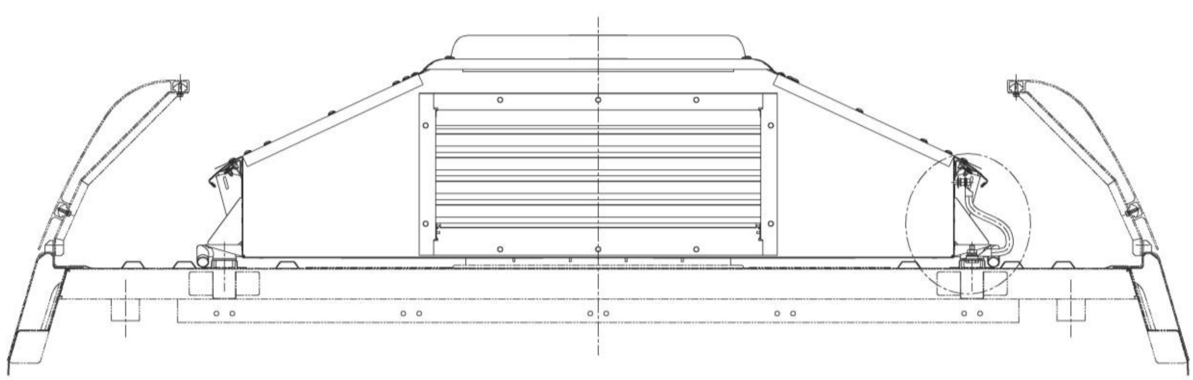


Figure 09-I-02.47 HVAC Ground Connection

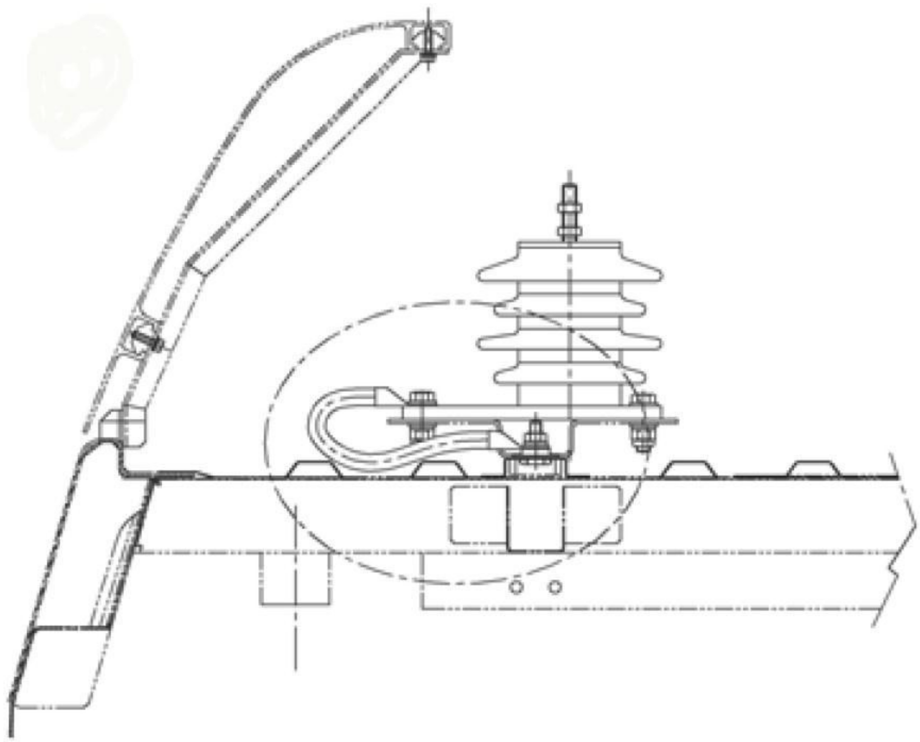


Figure 09-I-02.48 Lightning Arrester Ground Connection

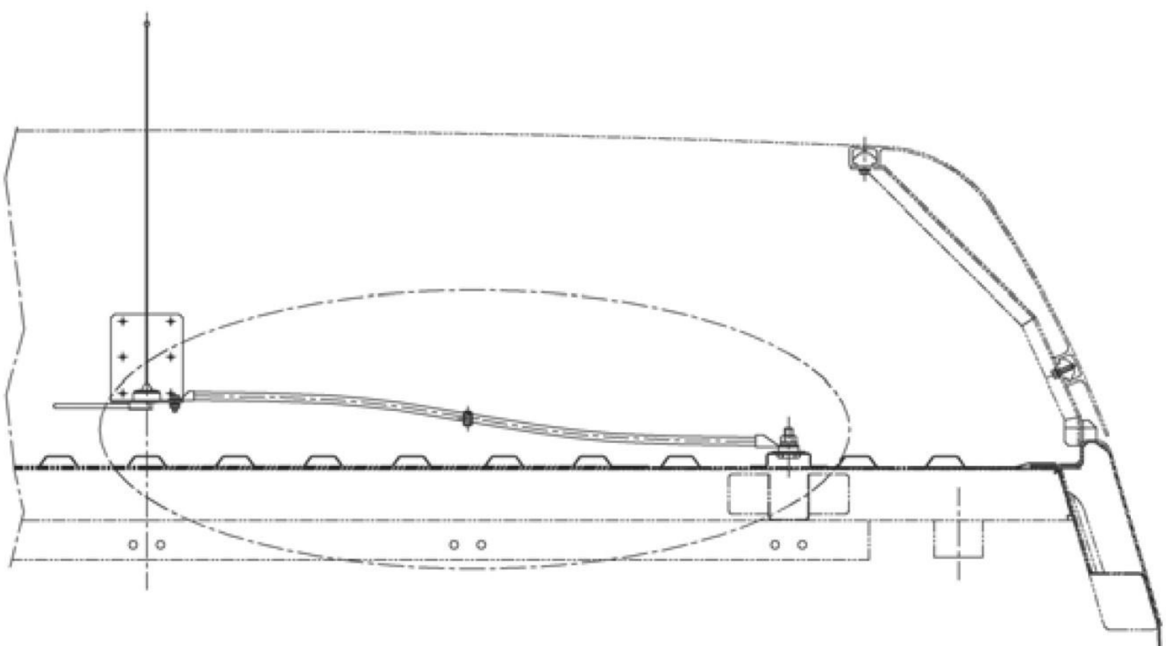


Figure 09-I-02.49 Antenna Ground Connection

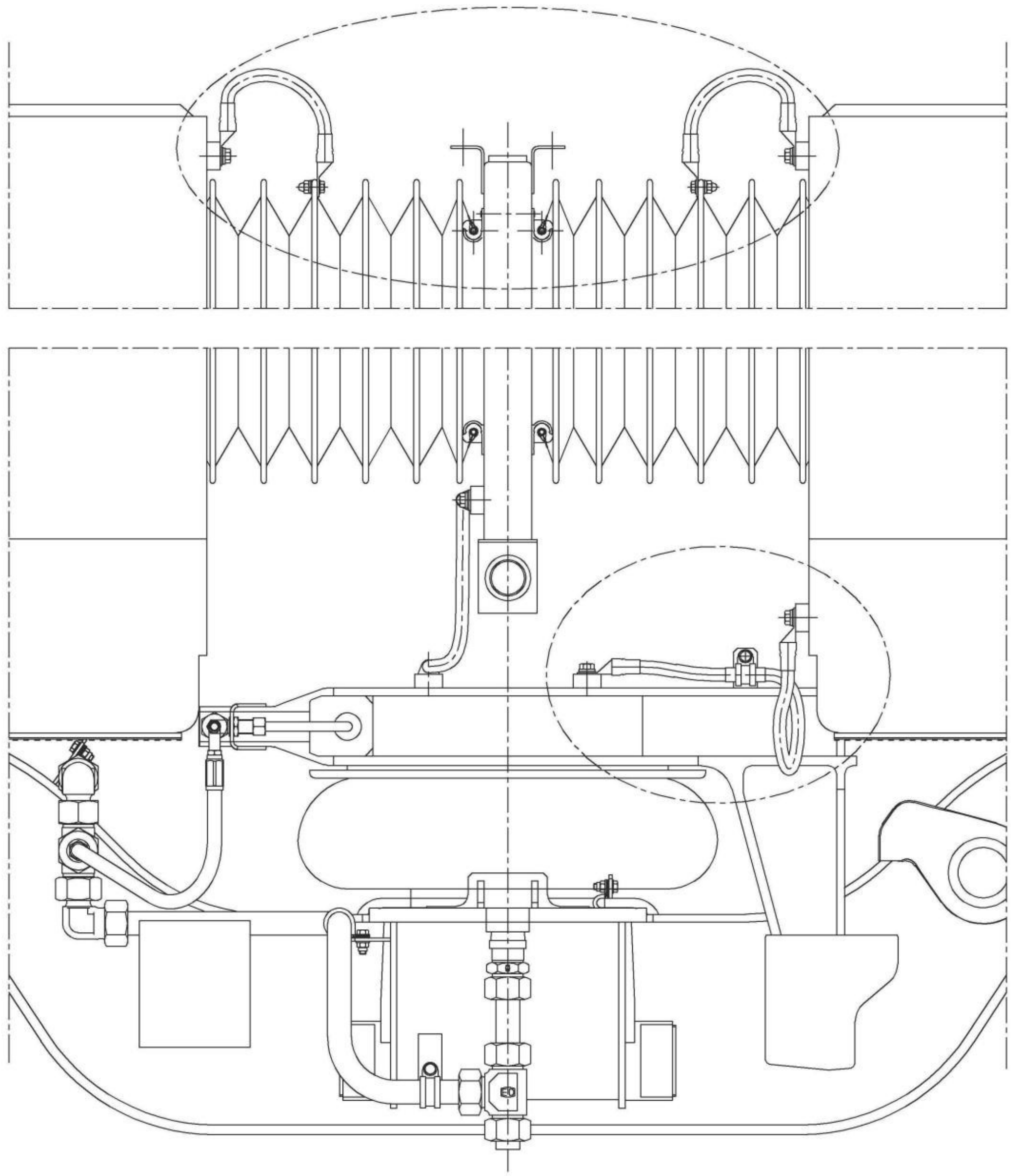


Figure 09-I-02.50 Ground Connection Car Body - Truck Bolster

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE AND SERVICE MANUAL

VOLUME M-01
PART II
TROUBLESHOOTING
SECTION 09 - HVDS

SECTION 09

HIGH VOLTAGE DISTRIBUTION SYSTEM

PART II

TROUBLESHOOTING

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SECTION 09

HIGH VOLTAGE DISTRIBUTION SYSTEM

09-II-01 INTRODUCTION

The Running Maintenance and Service Manual is divided into three Parts:

- Part I: Theory of Operation
- Part II: Troubleshooting
- Part III: Maintenance

Each Paragraph is numbered accordingly, to avoid that paragraphs of the same Section, pertaining to a different Part, have the same number.

Part I - Theory of Operation

Part I gives a thorough overview of the System structure and operation, by means of descriptions, figures, photos, schematics, block diagrams and flow charts, together with references to other documents or Sections when needed.

Part II - Troubleshooting

It gives the Maintenance Technicians a path to troubleshoot the System in every condition by means of the available tools:

- The PTU, equipped with the specific SW program
- The IDU
- The Fault Isolation Table

The Part III - Maintenance consists of:

- Preventive Maintenance
- Corrective Maintenance
- Consumable Materials
- Test Equipment, Tools, & Special Tools

09-II-01.a LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

The Abbreviations, Acronyms and Symbols commonly used throughout this manual are given below with their related meaning.

Abbreviation	Meaning
APS	Auxiliary Power Supply
ATP	Automatic Train Protection
BCU	Brake Control Unit
C/L	Centerline
CAN	Controller Area Network
CEMIPS	Conductive EMI Protection System
DSP	Digital Signal Processor
EDU	EMI Detector Unit
EMI	ElectroMagnetic Interference
FIR	Finite Impulse Response
FPGA	Field Programmable Gate Array
HSCMOS	High Speed Complementary Metal-Oxide Semiconductor
HCT	Harmonic Current Transducer
HSCB	High Speed Circuit Breaker
HVAC	Heating Ventilation & Air Conditioning
IDU	Integrated Diagnostic Unit
IGBT	Insulated Gate Bipolar Transistor
LBA	LonWorks Bus Adaptor
LH	Left Hand Side
LPF	Low-Pass Filter
LRV	Light Rail Vehicle
LV	Low Voltage
LVPS	Low Voltage Power Supply
MBL	Metro Blue Line
PCA	Driving Control Processor
PGL	Pasadena Gold Line
PTU	Portable Test Unit
R-C	Resistor - Capacitor
RH	Right Hand Side
TBS	To Be Supplied
TCU	Traction Control Unit
TWC	Train-to-Wayside Communication
WD	WatchDog

09-II-01.b LIST OF DEFINITIONS

The Definitions commonly used throughout this manual are given below with their related meaning.

Definition	Meaning
'A' body section	The section of an articulated vehicle containing the pantograph
'B' body section	The section of an articulated vehicle not containing the pantograph
AW0	Empty car operating weight
AW1	Full seated load plus AW0
AW2	Standees at 4 persons per square meter plus AW1
AW3	Standees at 6 persons per square meter plus AW1
AW4	Standees at 8 persons per square meter plus AW1
Front door	The door close to the Operator's Cab
Rear door	The door close to the Articulation Section
Pin-out	Relationship between Pin number and carried Signal

09-II-01.c LIST OF MEASUREMENT UNITS AND SYMBOLS

The Measurement Units commonly used throughout this manual are given below with their related meaning.Ω

Definition	Meaning
Ω	Ohm
°C	Celsius degree
°F	Fahrenheit degree
A	Ampere
AC	Alternate Current
DC	Direct Current
F	Farad
ft	Foot
gal	Gallon
H	Henry
Hz	Hertz
in	Inch
kg	Kilogram - approx 2.205 pounds
km	Kilometer - approx 0.621 miles
kN	Kilo-Newton - approx 224.809 pounds force
kVA	Kilo Volt Ampere
kW	Kilo Watt
Ib	Pound
Ib-ft	Pound force
Ips	Liters per Second
m	Meter - approx 3.28 feet
mH	Milli Henry
mm	Millimeter - approx 0.0394 inches
ms	Milli second
Pa	Pascal
rms	Root Mean Square Voltage
rpm	Revolution per Minute
V	Voltage
W	Watt

09-II-02 TROUBLESHOOTING

The tools that the maintenance personnel have available for troubleshooting a system and/or its equipment on the P2550 LRV are essentially two:

- The IDU (Integrated Diagnostic Unit)
- The PTU (Portable Test Unit)

The IDU interface is made up of a display located in both cabs of a vehicle.
The IDU can be accessed in two Modes:

- Operating Mode, for the operators
- Maintenance Mode, for maintenance personnel, accessible by means of a numeric password

The Operating Mode provides the essential information to help the operator start troubleshooting or to pass the information on to the ROC (Railway Operating Center)

In Maintenance Mode the IDU can display more detailed information, thus giving the Maintenance personnel the possibility to troubleshoot more in depth and more accurately.

In this Section the following systems/equipment will be taken into consideration for troubleshooting with the IDU and the PTU:

— EMI System
— HSCB
— Propulsion and APS/LVPS Grounding (repeated in the relevant Systems)

09-II-02.01 Troubleshooting with the IDU

09-II-02.01.01 EMI Detector Unit Status Screen

This Screen shows the most relevant information of the Conductive EMI Protection System.
In either the Operating Mode or the Maintenance Mode (refer to Figure 09-II-02.1) the only information about this system is its status: OK or FAULT.

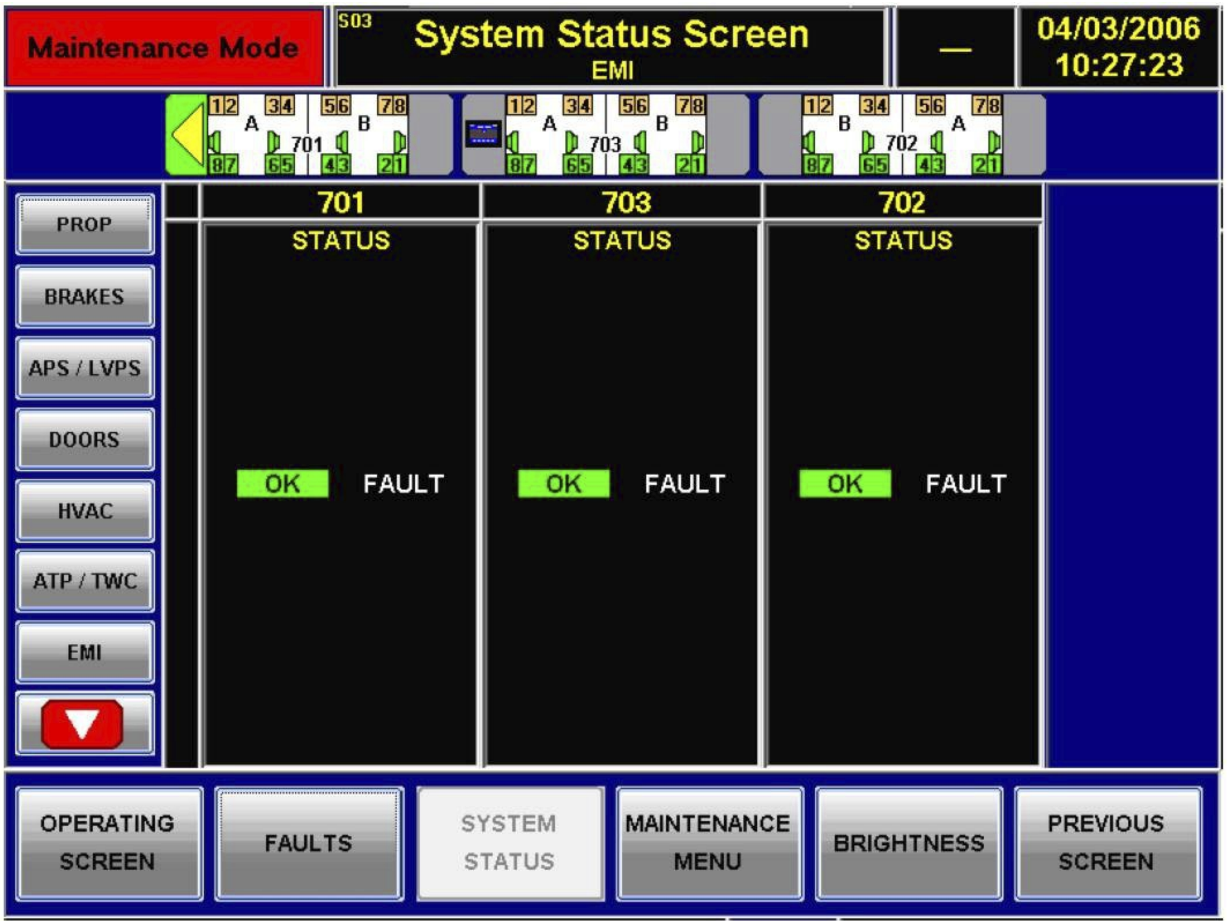

Figure 09-II-02.1 EMI System Status

09-II-02.01.02 Bus Control (Monitor - LONWorks Bus Screen)

While in Maintenance Mode, by touching the MONITOR button, the IDU monitor shows information related to the local vehicle and the train. LON Works Bus, MVB bus, Digital I/O and TRAIN LINES are monitored.

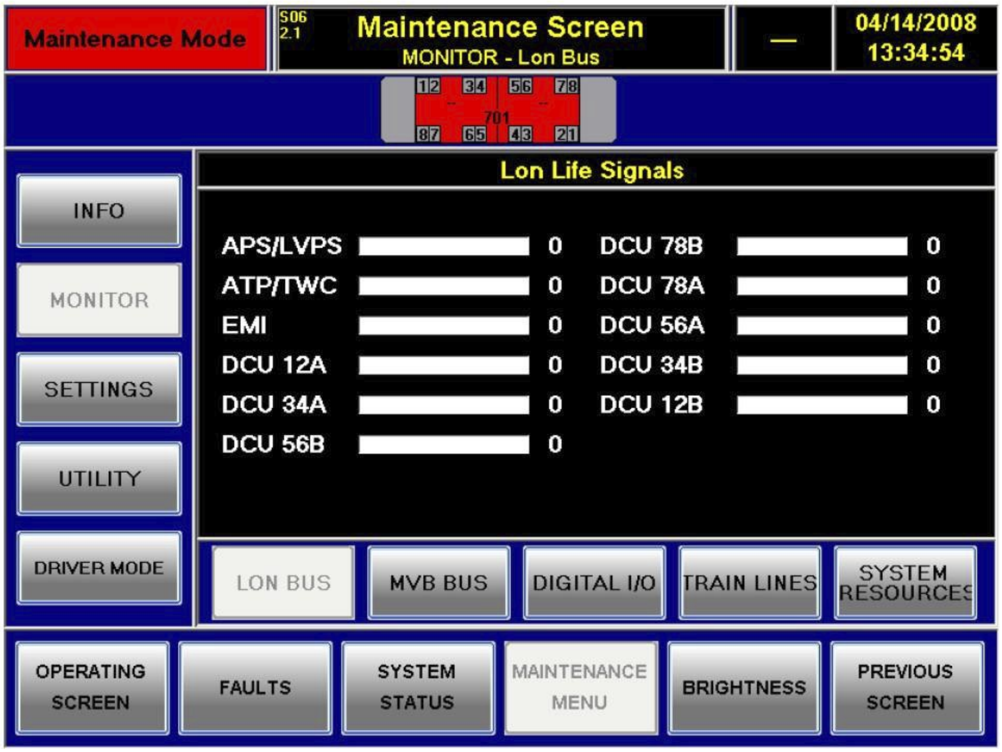

Figure 09-II-02.2 LonWorks Bus Life Signals

The IDU (refer to Figure 09-II-02.2) can show the Life Signals flow on the LONworks Bus.

Among these, also the EMI signals are shown on the screen, so that maintenance personnel can check if the EMI Detector Unit is communicating through the bus.

09-II-02.01.03 Troubleshooting with the IDU Fault List

With regard to the HV System related equipment, the IDU collects and displays on the monitor diagnostic signals coming from the EMI System and the HSCB.

A ground system fault related to the Propulsion and the APS/LVPS Grounding Systems can also be displayed.

Through the IDU, the operator has the indication of a fault and other information that may help with troubleshooting the system.

In Maintenance Mode the fault information is more detailed (for example, the A or B cab involved is indicated) and the troubleshooting can be more accurate.

The Tables in the following pages list the faults of the above mentioned HV systems/equipment that can be detected by the IDU, both in Operating and in Maintenance mode.

As soon as a fault occurs (fault “activated”), the Monitoring and Diagnostic System (MDS - refer to Section 18 for a more detailed description) saves the “image” of the fault in a file of the A-cab IDU memory (the B-cab IDU has no memory) named “LogFile.dat”.

The system saves an image of the activated fault every 100 ms for a period from 1 s before and 5 s after the activation.

The system saves a sample of each of the deactivated faults (faults that have cleared) but only the information that was present at the time that the fault actually occurred.

The following paragraphs describe, for each fault type, how to proceed with the troubleshooting of the Propulsion System by means of the IDU, both in the Operating and in the Maintenance Modes.

For each fault type, all related fault messages (taken from the “Faults” list) are listed in two tables: Operating and Maintenance Mode tables.

The Systems involved are listed, together with the Automatic Actions implemented by the system at fault occurrence.

The Maintenance Action (troubleshooting procedure) that follows, refers to the Fault List shown on the IDU “Faults Screen”. This list can be filtered by means of the system button (refer to Figure 09-II-02.3)

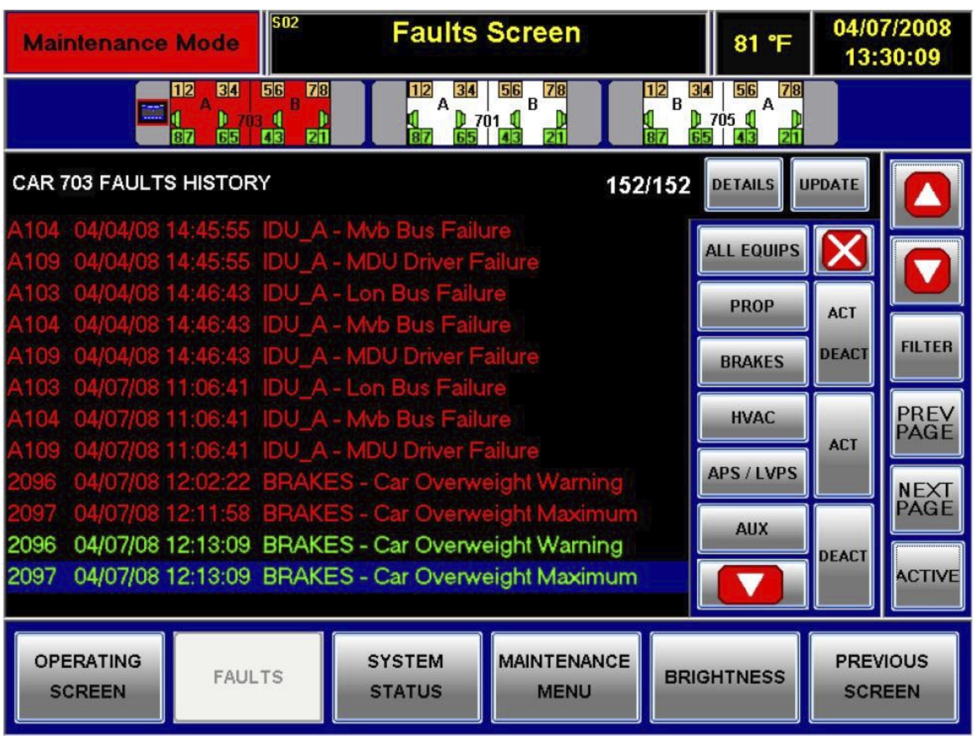

Figure 09-II-02.3 IDU Faults Screen

09-II-02.02 Troubleshooting with the PTU (Portable Test Unit)

Table 09-II-02.1 lists the diagnostic events logged by the Master PCA (LH)board. The recorded information can be downloaded by means of a PTU.

Table 09-II-02.1 Diagnostic Events

Event Code	Description
0x1101	Power-On PCA master
0x1102	Self-Test finished master
0x1103	By-pass activated master
0x1104	By-pass deactivated master
0x1201	I60 warning master
0x1202	I100 warning master
0x1203	I250 warning master
0x1401	I60 alarm master
0x1402	I100 alarm master
0x1403	I250 alarm master
0x1404	Hardware Failure detected master
0x1801	ITEST fail
0x1802	Master/Slave mismatch
0x2101	Power-On PCA slave
0x2102	Self-Test finished slave
0x2103	By-pass activated slave
0x2104	By-pass deactivated slave
0x2201	I60 warning slave
0x2202	I100 warning slave
0x2203	I250 warning slave
0x2401	I60 alarm slave
0x2402	I100 alarm slave
0x2403	I250 alarm slave
0x2404	Hardware Failure detected slave

If an event is detected, the following information will be logged in a dedicated “NonVolatile Memory” of the Master PCA board:

- Date and Time
- Event Code
- Status Words
- Measurement Harmonic Values

09-II-02.03 Fault Isolation / Repair Tables

The Fault Isolation / Repair Table lists the System's Malfunction Symptoms with the relevant Probable Causes and Corrective Actions to be accomplished to fix the Fault.

The Malfunction Symptoms are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSEMBLY and are provided by Unit / Component.

The Corrective Actions are provided with reference to the relevant Maintenance Sheets the Maintainer should refer to in order to have specific detailed Procedures to be followed.

NOTE: The Preventive and Corrective Maintenance Sheets are consistent, respectively, with the Preventive Maintenance Plan and the Corrective Maintenance Analysis (CMA) of the Vehicle.

For this reason, when, in the Fault Isolation / Repair Table, the Maintenance Sheet reference is " Blank ", it means that the relevant Corrective Action is not specifically indicated in the above AB Documentation and, consequently, that it is not specifically provided in any Maintenance Sheet.

Table 09-II-02.2 Fault Isolation/Repair

SUBSYSTEM / ASSY		HIGH SPEED CIRCUIT BREAKER & CIRCUITS		
Unit / Component	**Malfunction Symptom**	**Probable Cause**	**Corrective Action**	**Refer to Sheet**
HSCB	1.Vibrations. Noise	1. HSCB Box attaching parts defective / loose.	1. Inspect / fasten.	R-P-09-02-01-00/I-01
	2 .HSCB tripped	1 .Overcurrent	1 .Inspect	R-P-09-02-01-00/I-01
		2.HW protections listed in Table 09-I-02-10	1.Overhaul	H-P-09-02-01-00/OV-00
		3.SW protections listed in Table 09-I-02-11		
	3 .HSCB damaged	1 .Impact	1 .Replace	R-C-09-02-01-00/R-00
	4 .HSCB doesn't work properly	1 .Main Contact defective	1 .Replace	R-C-09-02-01-00/R-00
		2 .Closing Device defective	1 .Replace	R-C-09-02-02-00/R-00
		3 .Tripping Device defective	1 .Replace	R-C-09-02-03-00/R-00
		4 .Moving Contact defective	1 .Replace	R-C-09-02-04-00/R-00
		5 .Limit Switch defective	1 .Replace	R-C-09-02-05-00/R-00
		6 .Arc Chute defective	1 .Replace	R-C-09-02-06-00/R-00
		7 .Circuit Breaker Type S280 defective	1 .Replace	R-C-09-00-00-00/R-00
		8 .Relays defective	1 .Replace	R-C-09-00-00-00/R-01
		9 .Diodes defective	1 .Replace	R-C-09-00-00-00/R-02

(cont'd)

Table 09-II-02.2 Fault Isolation/Repair

SUBSYSTEM / ASSY		HIGH VOLTAGE DISTRIBUTION		
Unit / Component	**Malfunction Symptom**	**Probable Cause**	**Corrective Action**	**Refer to Sheet -**
AUXILIARY POWER SUPPLY (APS)	1. APS (2A01 - "B" Section) not supplied by 750 Vdc (See HV Functional Schematics AA03ATY, Sheet 007).	1. Fault in Pantograph	1. Inspect and service	Section 08 - Preventive Maintenance Sheets
			2 .Replace Pantograph assy	R-C-08-01-00-00/R-00
			3 Replace Pantograph Components	Section 08 - Corrective Maintenance Sheets
		2. Auxiliary Fuse faulty.	1. Replace	
		3. Knife Switch Defective / Shop Power Socket faulty.	1. Inspect	R-P-09-01-02-00/I-00
			2. Replace	R-C-09-01-02-00/R-00
	2. Propulsion System not supplied by 750 Vdc	1. Fault in Pantograph.	1. Inspect and service	Section 08 - Preventive Maintenance Sheets
			2 .Replace Pantograph assy	R-C-08-01-00-00/R-00
			3 Replace Pantograph Components	Section 08 - Corrective Maintenance Sheets
		2. Knife Switch Defective / Shop Power Socket faulty	1. Inspect	R-P-09-01-02-00/I-00
			2. Replace	R-C-09-01-02-00/R-00

SUBSYSTEM / ASSY		LINE VOLTAGE AND CURRENT PROTECTION		
Unit / Component	**Malfunction Symptom**	**Probable Cause**	**Corrective Action**	**Refer to -Sheet**
EMI DETECTOR SYSTEM	1 .The System doesn't work properly and /or causes the HSCB tripping and locking out	1 .EDU defective	1 .Inspect	R-P-09-01-03-00/I-00
		2 .Harmonic Current Transducer (HCT)	1 Inspect	R-P-09-01-03-00/I-00
		3 .EDUBoard defective	1 Replace	R-C-09-00-00-00/R-03
		4 .Harmonic Current Transducer (HCT) defective	1 Replace	R-C-09-01-03-01/R-00
LIGHTNING ARRESTER	1. Vibrations. Noise	1.Attaching parts defective / loose.	1.Inspect / fasten.	R-P-09-01-01-00/I-00
	2.Damage	1 .Lightning Strikes	1 Replace	R-C-09-01-01-00/R-00
KNIFE SWITCH	1 .APS and / or Propulsion and / or Shop Power not supplied by 750 Vdc	1 .Knife Switch Defective / Shop Power Socket faulty	1.Inspect	R-P-09-01-02-00/I-00
			2.Replace	R-C-09-01-02-00/R-00

09-II-03 APPENDIX

09-II-03.01 IDU Fault List

09-II-03.01.01 Operating Mode IDU Fault List

All faults related to the EMI Detector Unit, that the IDU can show in the Operating Mode, are listed in this paragraph. The relevant Operator Guide Actions are also shown..
The Operator Guide is shown on the IDU screen by touching the “Detail” Button and it refers to the selected fault on the list.

Refero to Table 09-II-03. 1 for Operating Mode Fault List

Refero to Table 09-II-03. 2 for Operating Mode Fault Details

Refero to Table 09-II-03. 4 for Operating Mode and Maintenance Mode Fault Relationship

Table 09-II-03.1 EMI Operating Mode Fault List

Code	Affected Subsystem	Description
8016	EMI	Performance Reduction
8017	EMI	High Speed Circuit Breaker Open
8018	EMI	Bypass Active

Table 09-II-03.2 EMI Operating Mode Fault Details

Fault#	Date	Time	Vehicle#	System	Description
8016	mm/dd/yy	hh:mm:ss	xxx	EMI	Performance Reduction
Operator Guide No actions are necessary. In case the fault doesn't clear then report this to ROC (if on the main line) and continue operating as per ROC's instructions.					

Fault#	Date	Time	Vehicle#	System	Description
8017	mm/dd/yy	hh:mm:ss	xxx	EMI	High Speed Circuit Breaker Open
Operator Guide Try to close the HSCB with the Propulsion Reset push button. If the HSCB won't close then get permission from ROC (if on the main line) to activate the EMI Bypass and then try to reset the HSCB. If the fault won't clear, then inform ROC and continue operating as per ROC's instructions.					

Table 09-Ii-03.2 EMI operating mode Fault details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
8018	mm/dd/yy	hh:mm:ss	xxx	EMI	Bypass Active
Operator Guide Check 3S09 Switch (Cab Panel Car A)					
Involved Components 3S09 Switch.					

09-II-03.01.02 Maintenance Mode IDU Fault List

All faults (related to the EMI Detector System) that the IDU can show when in the Maintenance Mode, along with the relevant Operator Guide Actions, are shown in this paragraph

The Operator Guide can be shown by touching the "Detail" Button on the screen and is referred to the fault of the list.

Refero to Table 09-II-03. 3 for Maintenance Mode Fault List

Refero to Table 09-II-03. 4 for Operating Mode and Maintenance Mode Fault Relationship

Refero to Table 09-II-03. 5 for Maintenance Mode Fault Details

Table 09-II-03.3 EMI Maintenance Mode Fault List

Code	Affected Subsystem	Description
8001	EMI	I60 warning
8002	EMI	I60 amplitude alarm
8003	EMI	I100 warning
8004	EMI	I100 amplitude alarm
8005	EMI	I250 warning
8006	EMI	I250 amplitude alarm
8007	EMI	Itest fail
8009	EMI	Safety relay 1 main contacts stuck open
8010	EMI	Safety relay 2 main contacts stuck open
8011	EMI	Safety relay 1 main contacts stuck closed
8012	EMI	Safety relay 2 main contacts stuck closed
8013	EMI	Sw Task LOGIC_FAST
8014	EMI	Sw Task LOGIC_SLOW
8015	EMI	Sw Task LOGIC_TESTGEN
8018	EMI	Bypass Active

Table 09-II-03.4 EMI Operating Mode and Maintenance Mode Faults Relationship

Operating Mode Fault Code	Maintenance Mode Fault Code			
8016	8001	8003	8005	
8017	8002	8004	8006	8007
	8009	8010	8011	8012
	8013	8014	8015	
8018	8018			

Table 09-II-03.5 EMI Maintenance Mode Fault Details

Fault#	Date	Time	Vehicle#	System	Description
8001	mm/dd/yy	hh:mm:ss	xxx	EMI	I60 warning
Operator Guide Effect: Performance reduction/ Reduction in Propulsion. Action: This event will occur for a detected 60 Hz EMI violation (1.0 Amps>I60>0.8 Amps) or in the case of a failure with the CEMIPS system.If the fault won't clear try lowering the pantograph to see if the fault clears. If the fault clears then the vehicle may be putting out unwanted EMI or the sensors may be faulty. If the fault doesn't clear then the problem could be a faulty EMI component such as the wiring/connectors between EDU and HCT transducer; and/or the. EDI board; and/or one of the PCA boards; and/or the HCT transducer.					
Involved Components Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.					

Fault#	Date	Time	Vehicle #	System	Description
8002	mm/dd/yy	hh:mm:ss	xxx	EMI	I60 amplitude alarm
Operator Guide Effect: HSCB Close. This event will occur for a detected 60 Hz EMI violation (I60>1.0 Amps) or in the case of a failure with the CEMIPS system. If the fault won't clear try lowering the pantograph to see if the fault clears. If the fault clears then the vehicle may be putting out unwanted EMI or the sensors may be faulty. If the fault doesn't clear then the problem could be a faulty EMI component such as the wiring/connectors between EDU and HCT transducer; and/or the. EDI board; and/or one of the PCA boards; and/or the HCT transducer.					
Involved Components Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.					

Table 09-II-03.5 EMI Maintenance Mode Fault Details (cont'd)

<table>
<tr><th>Fault#</th><th>Date</th><th>Time</th><th>Vehicle#</th><th>System</th><th>Description</th></tr>
<tr><td>8003</td><td>mm/dd/yy</td><td>hh:mm:ss</td><td>xxx</td><td>EMI</td><td>I100 warning</td></tr>
<tr><td colspan="6">Operator Guide
Performance reduction/ Reduction in Propulsion. Action: This event will occur for a detected 100 Hz EMI violation (1.0 Amps>I100>0.8 Amps) or in the case of a failure with the CEMIPS system. If the fault won't clear try lowering the pantograph to see if the fault clears. If the fault clears then the vehicle may be putting out unwanted EMI or the sensors may be faulty. If the fault doesn't clear then the problem could be a faulty EMI component such as the wiring/connectors between EDU and HCT transducer; and/or the. EDI board; and/or one of the PCA boards; and/or the HCT transducer.</td></tr>
<tr><td colspan="6">Involved Components
Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.</td></tr>
</table>

<table>
<tr><th>Fault#</th><th>Date</th><th>Time</th><th>Vehicle#</th><th>System</th><th>Description</th></tr>
<tr><td>8004</td><td>mm/dd/yy</td><td>hh:mm:ss</td><td>xxx</td><td>EMI</td><td>I100 amplitude alarm</td></tr>
<tr><td colspan="6">Operator Guide
Action: This event will occur for a detected 100 Hz EMI violation (I100>1.0 Amps) or in the case of a failure with the CEMIPS system. If the fault won't clear try lowering the pantograph to see if the fault clears. If the fault clears then the vehicle may be putting out unwanted EMI or the sensors may be faulty. If the fault doesn't clear then the problem could be a faulty EMI component such as the wiring/connectorsbetween EDU and HCT transducer; and/or the. EDI board; and/or one of the PCA boards; and/or the HCT transducer.</td></tr>
<tr><td colspan="6">Involved Components
Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.</td></tr>
</table>

<table>
<tr><th>Fault#</th><th>Date</th><th>Time</th><th>Vehicle#</th><th>System</th><th>Description</th></tr>
<tr><td>8005</td><td>mm/dd/yy</td><td>hh:mm:ss</td><td>xxx</td><td>EMI</td><td>I250 warning</td></tr>
<tr><td colspan="6">Operator Guide
Effect: Performance reduction/ Reduction in Propulsion. Action: This event will occur for a detected 250 Hz EMI violation (1.0 Amps>I250>0.8 Amps) or in the case of a failure with the CEMIPS system. If the fault won't clear try lowering the pantograph to see if the fault clears. If the fault clears then the vehicle may be putting out unwanted EMI or the sensors may be faulty. If the fault doesn't clear then the problem could be a faulty EMI component such as the wiring/connectors between EDU and HCT transducer; and/or the. EDI board; and/or one of the PCA boards; and/or the HCT transducer.</td></tr>
<tr><td colspan="6">Involved Components
Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.</td></tr>
</table>

Table 09-II-03.5 EMI Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
8006	mm/dd/yy	hh:mm:ss	xxx	EMI	I250 amplitude alarm
Operator Guide Effect: HSCB Open. Action: This event will occur for a detected 250 Hz EMI violation (I250>1.0 Amps) or in the case of a failure with the CEMIPS system. If the fault won't clear try lowering the pantograph to see if the fault clears. If the fault clears then the vehicle may be putting out unwanted EMI or the sensors may be faulty. If the fault doesn't clear then the problem could be a faulty EMI component such as the wiring/connectors between EDU and HCT transducer; and/or the. EDI board; and/or one of the PCA boards; and/or the HCT transducer..					
Involved Components Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.					

Fault#	Date	Time	Vehicle#	System	Description
8007	mm/dd/yy	hh:mm:ss	xxx	EMI	Itest fail
Operator Guide Effect: HSCB Open. Action: This event will occur in case of EMI violations or in case of CEMIPS failure. In case of permanent intervention with pantograph down (i.e. CEMIPS failure): check wiring connection between EDU and HCT transducer. Replace EDI board. Replace PCA master. Replace HCT transducer.					
Involved Components Wiring between HCT and EDU; EDI board, PCA boards; Motherboard; and/or HCT.					

Fault#	Date	Time	Vehicle#	System	Description
8009	mm/dd/yy	hh:mm:ss	xxx	EMI	Safety Relay 1 main contacts stuck open
Operator Guide Effect: HSCB Open. Action: Replace EDI board.					
Involved Components EDI board.					

Table 09-II-03.5 EMI Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
8010	mm/dd/yy	hh:mm:ss	xxx	EMI	Safety Relay 2 main contacts stuck open
Operator Guide Effect: HSCB Open. Action: Replace EDI board.					
Involved Components EDI board.					

Fault#	Date	Time	Vehicle#	System	Description
8011	mm/dd/yy	hh:mm:ss	xxx	EMI	Safety Relay 1 main contacts stuck closed
Operator Guide Effect: HSCB Open. Action: Replace EDI board.					
Involved Components EDI board.					

Fault#	Date	Time	Vehicle#	System	Description
8012	mm/dd/yy	hh:mm:ss	xxx	EMI	Safety Relay 2 main contacts stuck closed
Operator Guide Effect: HSCB Open. Action: Replace EDI board.					
Involved Components EDI board.					

Fault#	Date	Time	Vehicle#	System	Description
8013	mm/dd/yy	hh:mm:ss	xxx	EMI	Sw Task LOGIC FAST
Operator Guide Effect: HSCB Open. Action: Replace PCA master. Replace PCA slave					
Involved Components PCA boards.					

Table 09-II-03.5 EMI Maintenance Mode Fault Details (cont'd)

Fault#	Date	Time	Vehicle#	System	Description
8014	mm/dd/yy	hh:mm:ss	xxx	EMI	Sw Task LOGIC SLOW
Operator Guide					
Effect: HSCB Open. Action: Replace PCA master. Replace PCA slave					
Involved Components					
PCA boards.					

Fault#	Date	Time	Vehicle#	System	Description
8015	mm/dd/yy	hh:mm:ss	xxx	EMI	Sw Task LOGIC TESTGEN
Operator Guide					
Effect: HSCB Open. Action: Replace PCA master. Replace PCA slave					
Involved Components					
PCA boards.					

Fault#	Date	Time	Vehicle#	System	Description
8018	mm/dd/yy	hh:mm:ss	xxx	EMI	Bypass Active
Operator Guide					
Check 3S09 Switch (Cab Panel Car A)					
Involved Components					
3S09 Switch.					

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE
P2550

RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01
PART III
MAINTENANCE
SECT 09 HIGH VOLTAGE DISTRIBUTION SYSTEM

SECTION 09

HIGH VOLTAGE DISTRIBUTION SYSTEM

PART III

MAINTENANCE

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SECTION 09

HIGH VOLTAGE DISTRIBUTION SYSTEM

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SECTION 09

HIGH VOLTAGE DISTRIBUTION SYSTEM

09-III-01 INTRODUCTION

The High Voltage Distribution System(HVDS) Part III - Maintenance consists of:

- Preventive Maintenance
- Corrective Maintenance
- Consumable Materials
- Test Equipment & Special Tools

09-III-01.a List of Abbreviations, Acronyms & Symbols

The Abbreviations, Acronyms and Symbols commonly used throughout this Section are given below with their relevant meaning.

Abbreviation	Meaning
AB	AnsaldoBreda
AC	Alternate Current
APS	Auxiliary Power Supply
ASSY	Assembly
ATP	Automatic Train Protection
BCU	Brake Control Unit
BI	Board Inside
CAN	Controller Area Network
CEMIPS	Conductive EMI Protection System
DC	Direct Current
DSP	Digital Signal Processor
EDU	EMI Detector Unit
ELE	Electronic
EMI	Electro Magnetic Interference
FCF	Fuse Charging Filter
FIR	Finite Impulse Response
FPGA	Field Programmable Gate Array
FSB	Full Service Brake Mode
FWD	Forward
GTW	Gateway
HSCMOS	High Speed Complementary Metal-Oxide Semiconductor
H-CML	Heavy Consumable Material List
H-CMS	Heavy Corrective Maintenance Sheet
HCT	Harmonic Current Transducer
HSCB	High Speed Circuit Breaker
HV	High Voltage
HVAC	Heating Ventilation & Air Conditioning
HW	Hardware
IDU	Integrated Diagnostic Unit
IDU_A	Integrated Diagnostic Unit of the ‘A’ body section
IDU_B	Integrated Diagnostic Unit of the ‘B’ body section
LBA	LonWorks Bus Adaptor
IPC	Illustrated Parts Catalog
LH	Left-Hand Side
LON	Local Operative Network
LPF	Low-Pass Filter
LRV	Light Railway Vehicle
LV	Low Voltage
LVDC	Low Voltage Direct Current

(cont’d)

(cont'd)

Abbreviation	Meaning
LVPS	Low Voltage Power Supply
M	Power (Motor) Mode
MBL	Metro Blue Line
MC	Master Controller
OCS	Overhead Catenary System
PCA	Driving Control Processor
PGL	Pasadena Gold Line
PS	Power Supply
PTU	Portable Test Unit
R-C	Resistor - Capacitor
R-CML	Running Consumable Material List
R-CMS	Running Corrective Maintenance Sheet
RH	Right-Hand Side
RMSM	Running Maintenance & Service Manual
R-PMM	Running Preventive Maintenance Matrix
R-PMR	Running Preventive Maintenance Report
R-PMS	Running Preventive Maintenance Sheet
R-TESTL	Running Test Equipment, Tools & Special Tools List
SCPM	Safety Critical Preventive Maintenance
SYS	System
SW	Software
TBD	To Be Defined
TBS	To Be Supplied
TCU	Traction Control Unit
TCU_A	Traction Control Unit of the 'A' body section
TCU_B	Traction Control Unit of the 'B' body section
TOC	Table Of Content
TTEM	Tools & Test Equipment Manual
TWC	Train-to-Wayside Communication
VAC	Voltage Alternate Current
VDC	Voltage Direct Current
WD	WatchDog
W/	With
W/O	Without
WTB	Wired Train Bus

09-III-01.b List of Definitions

The Definitions commonly used throughout this Section are given below with their relevant meaning.

Definition	Meaning
’A’ body section	The section of an articulated vehicle containing the pantograph
’B’ body section	The section of an articulated vehicle not containing the pantograph
AW0	Empty car operating weight
AW1	Full seated load plus AW0
AW2	Standees at 4 persons per square meter plus AW1
AW3	Standees at 6 persons per square meter plus AW1
AW4	Standees at 8 persons per square meter plus AW1
Front door	The door close to the Operator’s Cab
Rear door	The door close to the Articulation Section
MC Handle	Master Controller Handle
“A” Cab (or Cab A)	Operator Cab in the A body section
“B” Cab (or Cab B)	Operator Cab in the B body section

09-III-01.c List of Measurement Units

The Measurement Units commonly used throughout this Section are given below with their relevant meaning.

Definition	Meaning	
ft	Foot	(Length)
gal	Gallon	(Volume)
in	Inch	(Length)
kg	Kilogram - approx 2.205 pounds	(Weight)
km	Kilometer - approx 0.621 miles	(Length)
lb	Pound	(Weight)
lb-ft	Pound force	(Force)
m	Meter - approx 3.28 feet	(Length)
mm	Millimeter - approx 0.0394 inches	(Length)
mph	Miles per hour	(Velocity)
Km/h	Kilometers per hour	(Velocity)
s	Seconds	(Time)
V	Volt	(Tension)
Vdc	Direct Voltage	(Tension)
Vac	Alternate Voltage	(Tension)
kVA	Kilo-Volt-Ampere	(Power)
kW	Kilo-Watt	(Power)
W	Watt	(Power)
F	Farad	(Capacity)
H	Henry	(Inductance)
W	Ohm	(Resistance)
°F	Fahrenheit	(Temperature)
°C	Celsius	(Temperature)
A	Ampere	(Current)
Hz	Hertz	(Frequency)
rpm	Revolution per Minute	(Frequency)
N	Newton	(Force)
Nm	Newton-Meter	(Torque)
mphps	Mile Per Hour Per Second	(Acceleration)

09-III-01.d References

Refer to Section 00 of this RMSM for details relevant to the following Topics:

Topic	Paragraph
MANUAL PURPOSE	*00-02*
MANUAL ARRANGEMENT	*00-03*
MANUAL APPLICABILITY	*00-04*
ACQUISITION OF COPIES, REVISIONS AND CHANGES	*00-05*
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UPDATING	*00-07*
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09-III-02 P2550 ANSALDOBREDA MAINTENANCE PLAN

The AB Preventive Maintenance Plan (PMP) has been designed in order to permit a 30-year Structural and Service Vehicle Life with the following basic assumptions:

•Yearly mileage		120,000 Miles
•Motor and Trailer Truck removal:	every 5 years.	(600,000 Miles)

The AB Preventive Maintenance Plan (PMP) provides the Preventive Maintenance Tasks to be performed according the following Mileage Intervals:

Running Maintenance		Heavy Maintenance	
Daily			
10,000	Miles		
30,000	Miles	600,000	Miles
60,000	Miles	1,200,000	Miles
120,000	Miles	1,800,000	Miles

In accordance with the Preliminary Version of the AB Preventive Maintenance Plan, the Scheduled Maintenance Tasks for the entire Vehicle Life have been grouped into:

- Running Preventive Maintenance
- Heavy Preventive Maintenance

In accordance with the AB Corrective Maintenance Analysis, the Corrective Maintenance Tasks for the entire Vehicle Life have been grouped into:

- Running Corrective Maintenance
- Heavy Corrective Maintenance

09-III-03 RUNNING -PREVENTIVE MAINTENANCE

09-III-03.01 Running -Preventive Maintenance Matrixes (R-PMM)

The High Voltage Distribution System(HVDS)Running -Preventive Maintenance Matrix (RPMM) provides the Preventive Maintenance Plan of the HVDS up to 120,000 Miles.

The High Voltage Distribution System(HVDS)(R-PMM) is provided in two different arrangements as follows:

- **R-PMM Component Based**

It lists the HVDS Running - Preventive Maintenance Tasks ordered by Subsystem /Assemblies / Component break down, followed by the PM Task Description and Scheduled Task Interval and linked to the relevant R-PM Sheet Code.

The R-PMM Component Based provides the Maintainer with the following data:

- SYSTEM/SUBSYSTEM /ASSEMBLY/UNIT/COMPONENT
- TASK
- SCPM
- INSPECTION INTERVAL
- SHEET CODE

- **R-PMM Mileage Based**

It lists the HVDS Running - Preventive Maintenance Tasks ordered by Scheduled Maintenance Interval and broken down into the related Subsystem /Assemblies/Component followed by the PM Task Description and Person Hours and linked to the relevant R-PM Sheet Code.

The R-PMM Mileage Based provides the Users with the following data:

- INSPECTION INTERVAL
- SYSTEM/SUBSYSTEM /ASSEMBLY/UNIT/COMPONENT
- TASK
- SCPM
- PERSON HOURS
- SHEET CODE

The data listed in this Matrix are the same of those listed in the R-PMM Component Based with the exception of the PERSON HOURS.

09-III-03.01.01 Definitions

The following definitions are applicable to both types of R-PMM

Tasks

Cleaning:	Methods and processes required (Step-By-Step Procedural Instructions) for cleaning specific parts or areas of the Vehicle.
Inspection:	Preventive Maintenance procedures such as those required to ascertain the serviceability of a Part, Assembly, System or the specific interrelationship of Parts that perform a functional operation.
Lubrication:	Provides component lubrication Instructions.
Replacement	Provides the Components / Assemblies and Subassemblies removal & installation in a logical sequential order. Maintenance procedures identified in this topic include Components that are replaced within a 4 hours window.
Service:	Operation performed to replenish Sand, Windshield Wiper Washer Fluid, HVAC Coolant, Gear and Compressor Oil, and Vehicle Lubrication.
Test:	Procedures and Parameters to evaluate the operational efficiency and integrity of a System /Subsystem/Component and the interrelationship of Parts performing functional operations.

09-III-03.01.02 Inspection Intervals

The Running - Preventive Maintenance Intervals for the P2550 LRV Fleet are scheduled as follows:

Daily 10,000 Miles 30,000 Miles 60,000 Miles 120,000 Miles

The marker ”●“ in the INSPECTIONS INTERVAL column, indicates the periodicity of the corresponding Task.

09-III-03.01.03 Safety Critical Preventive Maintenance (SCPM) Tasks

The marker “☑” in the SCPM column, indicates that the corresponding Task is a Safety Critical Preventive Maintenance (SCPM) Task, as per the results of the Safety Analyses performed, on Vehicle Subsystems, according to Vehicle Specification.

09-III-03.01.04 Sheet Code

The Sheet Code column, indicates the reference to Running -Preventive Maintenance Sheet where the Procedure to be performed is described and illustrated.

THE SHEET CODE IS THE EXPLICIT LINK BETWEEN R-PM MATRIXES, R-PMR /JOB CARDS AND R-PM SHEETS

Refer to Paragraph 09-III-03.03.01 for Running- Preventive Maintenance Sheet (R-PMS) Form for detailed explanation.

09-III-03.01.05 Person Hours

It indicates the time required to perform the corresponding Task with the basic assumption that the Vehicle is on an Inspection Pit or Stand Up Rail and the Consumables, Tools and Spare Parts needed to accomplish the Task are available at the Location of the Equipment to be maintained.

Refer to:

- Table 09-III-03.1 for Running - Preventive Maintenance Matrix (R-PMM) (Component Based)
- Table 09-III-03.2 for Running - Preventive Maintenance Matrix (R-PMM) (Mileage Based)

09-III-03.01.06 Running Preventive Maintenance Matrix (Component Based)

Table 09-III-03.1 Running Preventive Maintenance Matrix (Component Based)

SYSTEM 09 HIGH VOLTAGE DISTRIBUTION								
SUBSYSTEM ASSY/UNIT/COMPONENT	TASK	SCPM	INSPECTION INTERVAL MILES					SHEET CODE
			Daily	10K	30K	60K	120K	
-LINE VOLTAGE AND CURRENT PROTECTION								
--LIGHTNING ARRESTER (01F01)	INSPECTION				●			
--KNIFE SWITCH	INSPECTION				●			
--EMI DETECTOR SYSTEM	INSPECTION					●		
-HIGH SPEED CIRCUIT BREAKER & CIRCUITS								
--HSCB (HIGH SPEED CIRCUIT BREAKER)	INSPECTION				●			
--HSCB (HIGH SPEED CIRCUIT BREAKER)	INSPECTION					●		

09-III-03.01.07 Running Preventive Maintenance Matrix (Mileage Based)

Table 09-III-03.2 Running Preventive Maintenance Matrix (Mileage Based)

SYSTEM 09 HIGH VOLTAGE DISTRIBUTION

SUBSYSTEM	TASK	SCPM	PERSON HOURS	SHEET CODE
30,000 MILES				
-**LINE VOLTAGE AND CURRENT PROTECTION**				
--LIGHTNING ARRESTER (01F01)	INSPECTION		0.25	R-P-09-01-01-00/I-00
--KNIFE SWITCH	INSPECTION		0.25	R-P-09-01-02-00/I-00
-**HIGH SPEED CIRCUIT BREAKER & CIRCUITS**				
--HSCB (HIGH SPEED CIRCUIT BREAKER)	INSPECTION		0.25	R-P-09-02-01-00/I-00

SUBSYSTEM	TASK	SCPM	PERSON HOURS	SHEET CODE
60,000 MILES				
-**LINE VOLTAGE AND CURRENT PROTECTION**				
--EMI DETECTOR SYSTEM	INSPECTION		0.25	R-P-09-01-03-00/I-00
-**HIGH SPEED CIRCUIT BREAKER & CIRCUITS**				
--HSCB (HIGH SPEED CIRCUIT BREAKER)	INSPECTION		0.7	R-P-09-02-01-00/I-01

09-III-03.02 Running -Preventive Maintenance Reports (R-PMR/Job Cards)

This paragraph describes the contents of the HVDS Running -Preventive Maintenance Reports (R-PMR/Job Cards) for the Running - Preventive Maintenance Tasks.

09-III-03.02.01 R-PMR/Job Card Form Content

The R-PMR/JOB CARDS are broken down into two main topics:

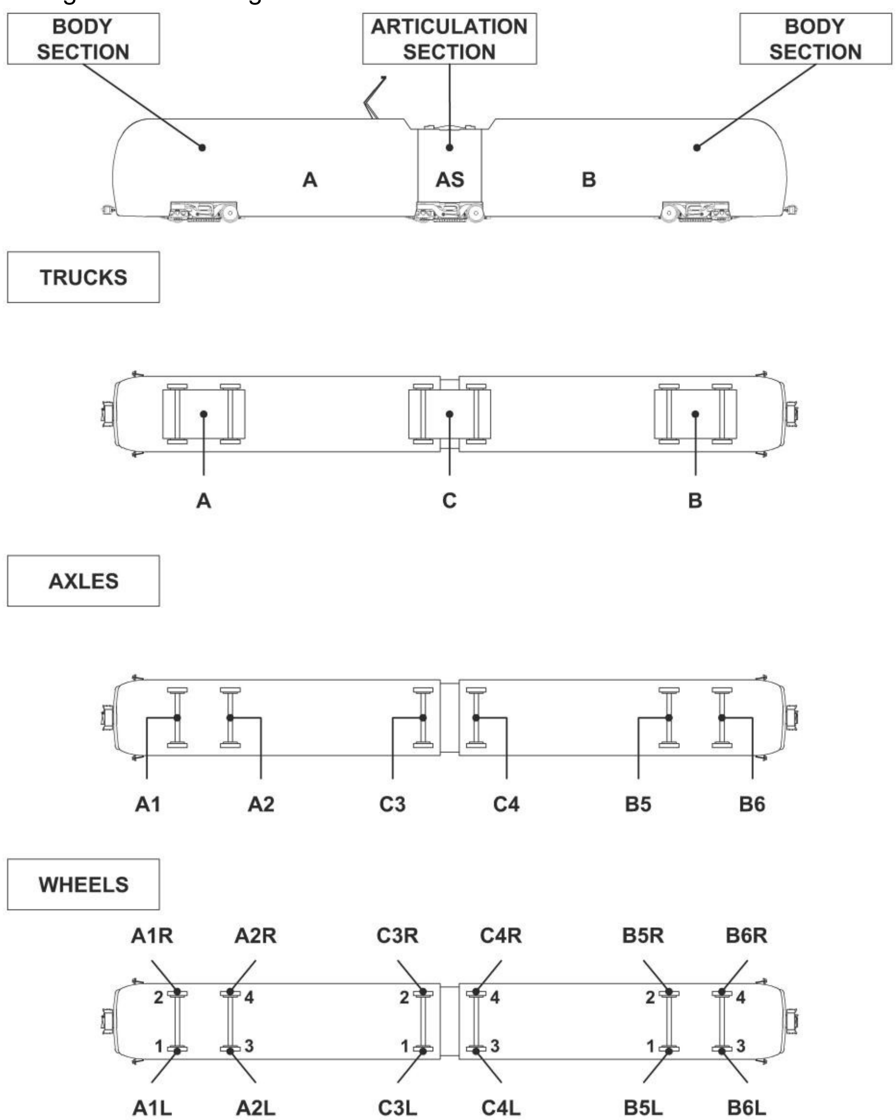
Specific Data and R-PM Data

Refer to Figure 09-III-03.1 for R-PMR/JOB CARD Form example

RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM		
SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER		
ITEM #	**TITLE**	**EXPLANATORY NOTE**
1	**VEHICLE #**	This field indicates the Vehicle Identification Number
2	**DATE**	This field indicates the Vehicle entering to Maintenance Shop
3	**RUNNING HOURS**	This field indicates the Date on which the Vehicle entered the Maintenance Shop
4	**MILES**	This field indicates the Vehicle Running Miles at the above Date.
5	**EMPLOYEE # & SIGNATURE**	This Field indicates the Employee # & Signature of the Maintainer(s) that perform the referred Task(s)
6	**STARTING DATE**	This field indicates the Starting Date of the referred Task(s).
7	**WORK HOURS**	This field indicates the Work duration to perform the referred Task(s).
8	**COMPLETION DATE**	This field indicates the Completion Date of the referred Task(s).
9	**DEFECT FOUND/COMMENTS**	This field indicates the result of the Task(s) execution and/ or note related to any items of the maintained Equipment requiring Corrective Maintenance
A	**P2550 RUNNING PREVENTIVE MAINTENANCE REPORT SYSTEM (Maintenance Interval) JOB CARD**	This field provides R-PMR Title. The R-PM Maintenance Intervals are the following: Daily; 10,000 Miles; 30,000 Miles; 60,000 Miles;120,000 Miles
B	**WORK AREA**	This column lists the On Vehicle Areas where the Equipment to be maintained is located The Work Areas are provided to optimize the jobs organization of the Preventive Maintenance tasks in order to: 1- respect the Safety Precautions to be followed 2- complete the preparation and the availability of the Consumables, Tools and Spare Parts, needed to perform the referred Task. 3- respect the time (PERSON HOURS) established to perform the referred Task (with the basic assumption that the Vehicle is on an Inspection Pit or Stand Up Rail and the Consumables, Tools and Spare Parts are available at the location of the Equipment to be maintained.) The On Vehicle Work Areas are the following: Exterior - Interior - Roof - Truck - Undercar - Vehicle (Vehicle as a whole)

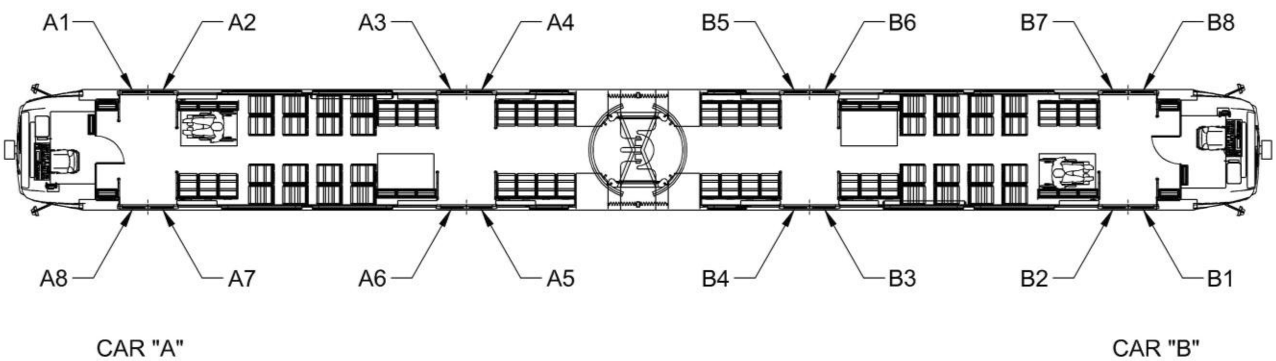
RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM

SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER

ITEM #	TITLE	EXPLANATORY NOTE
C	**ITEM**	This column lists the Subsystem/Assembly, Unit, Component to be maintained
D	**TASK**	This column lists the R-PM tasks to be performed for each Assembly/Unit/Component (i.e, Inspection, Test). The R-PM Tasks are the following: Cleaning - Inspection -Lubrication - Replacement - Service- Test
E	**LOCATION**	This column lists the On Board Vehicle Location of all Equipment to be maintained according to the following Location identification Codes 

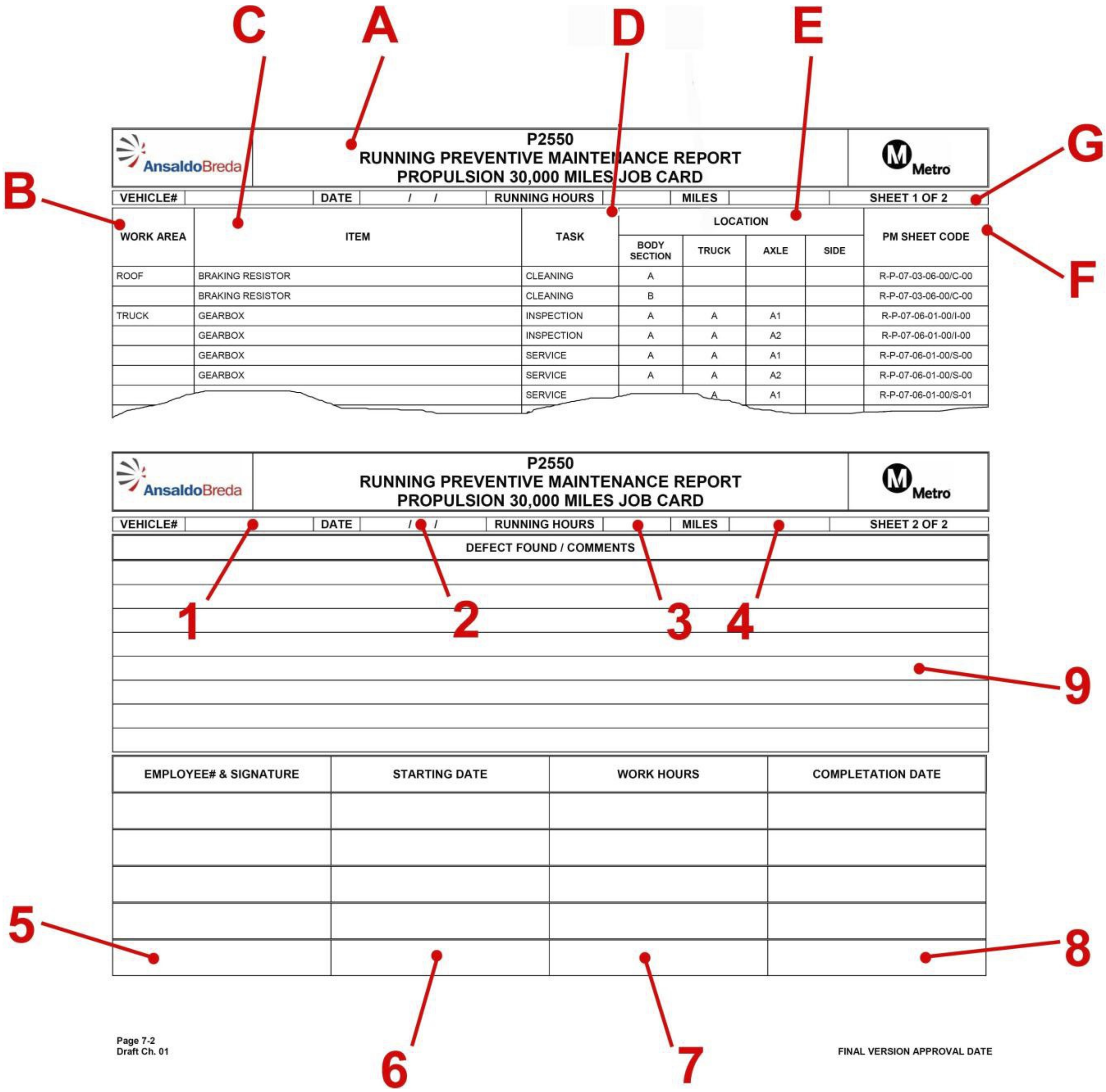
RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM	
SPECIFIC DATA TO BE FILLED IN BY THE MAINTAINER	
ITEM #	**TITLE**
E (cont'd)	**LOCATION (cont'd)**

EXPLANATORY NOTE



Door Numbering

ITEM #	TITLE	EXPLANATORY NOTE
F	**PM SHEET CODE**	This column lists the reference to Running-Preventive Maintenance Sheet where the Procedure to be performed is described and illustrated. Refer to Running-Preventive Maintenance Sheet (R-PMS) Form for detailed explanation.
G	**SHEET ….OF……**	This field indicates the progressive sheet page number of each. R-PMR/JOB CARD.



AnsaldoBreda | P2550 RUNNING PREVENTIVE MAINTENANCE REPORT PROPULSION 30,000 MILES JOB CARD | Metro

VEHICLE#		DATE	/ /	RUNNING HOURS		MILES		SHEET 1 OF 2

WORK AREA	ITEM	TASK	LOCATION				PM SHEET CODE
			BODY SECTION	TRUCK	AXLE	SIDE	
ROOF	BRAKING RESISTOR	CLEANING	A				R-P-07-03-06-00/C-00
	BRAKING RESISTOR	CLEANING	B				R-P-07-03-06-00/C-00
TRUCK	GEARBOX	INSPECTION	A	A	A1		R-P-07-06-01-00/I-00
	GEARBOX	INSPECTION	A	A	A2		R-P-07-06-01-00/I-00
	GEARBOX	SERVICE	A	A	A1		R-P-07-06-01-00/S-00
	GEARBOX	SERVICE	A	A	A2		R-P-07-06-01-00/S-00
		SERVICE		A	A1		R-P-07-06-01-00/S-01

AnsaldoBreda | P2550 RUNNING PREVENTIVE MAINTENANCE REPORT PROPULSION 30,000 MILES JOB CARD | Metro

VEHICLE#		DATE	/ /	RUNNING HOURS		MILES		SHEET 2 OF 2

DEFECT FOUND / COMMENTS

EMPLOYEE# & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETATION DATE

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FINAL VERSION APPROVAL DATE

Figure 09-III-03.1 R-PMR/Job Card Form -Example

09-III-03.02.02 R-PMR/Job Card Sequence

The R-PMR/JOB CARDS provided in this Section are grouped according to the following sequence:

Daily 10,000 Miles 30,000 Miles 60,000 Miles 120,000 Miles

09-III-03.02.03 Running -Preventive Maintenance Cycle & R-PMR/Job Card Content

The Running -Preventive Maintenance Cycle and the relevant R-PMR/JOB CARD content are as follows:

MAINTENANCE INTERVAL	PMR /JOB CARD TITLE	PMR /Job Card CONTENT
DAILY	DAILY JOB CARD	• List of Assemblies/Components and related Tasks to be performed **DAILY**
10,000 Miles	10,000 MILES JOB CARD	• DAILY Job Card content + List of Assemblies/Components and related Tasks to be performed at **10,000** Miles
30,000 Miles	30,000 MILES JOB CARD	• DAILY Job Card content + 10,000 Job Card content + List of Assemblies/Components and related Tasks to be performed at **30,000** Miles
60,000 Miles	60,000 MILES JOB CARD	• DAILY Job Card content + 10,000 Job Card content + 30,000 Job Card content + List of Assemblies/Components and related Tasks to be performed at **60,000** Miles
120,000 MILES	120,000 MILES JOB CARD	• DAILY Job Card content + 10,000 Job Card content + 30,000 Job Card content + 60,000 Job Card content + List of Assemblies/Components and related Tasks to be performed at **120,000** Miles

09-III-03.02.04 R-PMR/Job Card Data Presentation Sequence

The Subsystems / Assemblies / Units / Components listed in the ITEMS column of each R-PMR/JOB CARD are grouped by Work Area and Vehicle Systems' and sequenced, in alphabetical order, in conjunction with their On Vehicle Locations and Tasks to be performed.

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09-III-03.02.05 Running Preventive Maintenance Reports R-PMR/Job Cards

HIGH VOLTAGE DISTRIBUTION SYSTEM

Running - Preventive Maintenance Reports

R-PMR/JOB CARDS

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HIGH VOLTAGE DISTRIBUTION SYSTEM
RUNNING PREVENTIVE MAINTENANCE REPORT
30,000 MILES JOB CARD

VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 1

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
ROOF	H/V POWER DISTRIBUTION	LIGHTNING ARRESTER	INSPECTION	A				R-P-09-01-01-00/I-00
		MAIN CIRCUIT BREAKER HSCB	INSPECTION	A				R-P-09-02-01-00/I-00
UNDERCAR	H/V POWER DISTRIBUTION	HV SWITCH SECTIONING LINE 750VDC KNIFE SWITCH	INSPECTION	A				R-P-09-01-02-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

HIGH VOLTAGE DISTRIBUTION SYSTEM RUNNING PREVENTIVE MAINTENANCE REPORT 60,000 MILES JOB CARD

VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 1

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
INTERIOR)	H/V POWER DISTRIBUTION	EMI DETECTOR UNIT - EDU (ELE LOCKER)	INSPECTION	A				R-P-09-01-03-00/I-00
ROOF	H/V POWER DISTRIBUTION	EMI DETECTOR SYSTEM - HCT	INSPECTION	A				R-P-09-01-03-00/I-00
		LIGHTNING ARRESTER	INSPECTION	A				R-P-09-01-01-00/I-00
		MAIN CIRCUIT BREAKER HSCB	INSPECTION	A				R-P-09-02-01-00/I-00
		MAIN CIRCUIT BREAKER HSCB	INSPECTION	A				R-P-09-02-01-00/I-01
UNDERCAR	H/V POWER DISTRIBUTION	HV SWITCH SECTIONING LINE 750VDC KNIFE SWITCH	INSPECTION	A				R-P-09-01-02-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

HIGH VOLTAGE DISTRIBUTION SYSTEM RUNNING PREVENTIVE MAINTENANCE REPORT 120,000 MILES JOB CARD								
VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 1

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
INTERIOR	H/V POWER DISTRIBUTION	EMI DETECTOR UNIT - EDU (ELE LOCKER)	INSPECTION	A				R-P-09-01-03-00/I-00
ROOF	H/V POWER DISTRIBUTION	EMI DETECTOR UNIT - HCT	INSPECTION	A				R-P-09-01-03-00/I-00
		LIGHTNING ARRESTER	INSPECTION	A				R-P-09-01-01-00/I-00
		MAIN CIRCUIT BREAKER HSCB	INSPECTION	A				R-P-09-02-01-00/I-00
		MAIN CIRCUIT BREAKER HSCB	INSPECTION	A				R-P-09-02-01-00/I-01
UNDERCAR	H/V POWER DISTRIBUTION	HV SWITCH SECTIONING LINE 750VDC KNIFE SWITCH	INSPECTION	A				R-P-09-01-02-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

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09-III-03.03 Running -Preventive Maintenance Sheets (R-PMS)

Each R-PMS provides the following data consistent with Preventive Maintenance Plan (PMP), AB Design Documentation and Vehicle Systems Functional Tree:

- **R-PM Sheet Code**
- **SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT**, **Component** (Names)
- **SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT**, **Component** (Location)
- **Maintenance Interval** (Miles)
- **Maintenance Task**
- **Man Hours**, needed to perform the Task
- **SPARE PARTS**,needed to perform the Task

Each R-PMS provides also:

- **SAFETY PRECAUTIONS**, to be followed to safely accomplish the Task
- **TOOLS**, including Special Tools and Test Equipment, needed to accomplish the Task
- **CONSUMABLES**, required to accomplish the Task and consistent with those used by MTA
- **PROCEDURE**, consisting of **Preliminary Operations** and **Procedural Steps**, to be followed while performing Maintenance Tasks
- **Illustrations** and **Pictures** are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure

09-III-03.03.01 Running- Preventive Maintenance Sheet (R-PMS) Form

The R-PMS Form (refer to Figure 09-III-03.2) consists of several fields containing the following data/ information:

RUNNING -PREVENTIVE MAINTENANCE SHEET (RPMS) Form			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
1	**Card code**	**Sheet code**	The Sheet Code is an alphanumerical code that identifies each R-PM Sheet. **THE SHEET CODE IS THE EXPLICIT LINK BETWEEN R-PM MATRIXES, R-PMR /JOB CARDS AND R-PM SHEETS** The Sheet Code consists of letters R-P followed by an 11 digit code number as follows: **R-P-nn-mm-zz-ww/Y-kk** **R** = **R**unning **P**= **P**reventive **nn** may vary from 02 to 19, identifying the System/ Manual Section number. **mm-zz-ww** each one may vary from 00 to 99, according to AB System Functional Tree, allowing the identification of the Assembly/Unit/Component **Y** Maintenance Task Code. It may be one of the following: **C**=**C**leaning **I** =**I**nspection **L** = **L**ubrication **R**=**R**eplacement **S**=**S**ervice **T**=**T**est **kk** It may vary from 00 to 99. It is a progressive number allowing the explicit identification of RPMS when one of the following cases occur: 1- same Maintenance Task pertaining to vehicle as a whole or to the same System/Subsystem/Assembly to be performed at same Maintenance Interval in different Vehicle Area (i.e Vehicle as a Whole DAILY Exterior /Interior INSPECTION) 2- same Maintenance Task pertaining to the same Assembly/Unit/Component to be performed at different Maintenance Intervals and for this reason consisting of different Maintenance Procedure
2	**System**	**System name**	This field indicates the System to which the Assembly/Unit/Component belongs.
3	**Subsystem/ Assembly**	**Subsystem/ Assembly name**	This field indicates the Subsystem/Assembly to which the Unit/Component belongs.
4	**Unit**	**Unit name**	This field indicates the Unit to which the Component belongs.
5	**Component**	**Component name**	This field indicates the Component the Maintenance Task is referring to
6	**Maintenance Task**	**Maintenance Task name**	This field indicates the Maintenance Task to be performed.
7	**Interval Miles**	**Number**	This field indicates the maintenance Interval Miles. It may be DAILY, 10,000 Miles, 30,000 Miles, 60,000 Miles, 120,000 Miles

RUNNING -PREVENTIVE MAINTENANCE SHEET (RPMS) Form (cont'd)			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
8	**Man Hours**	**Number**	The Man Hour field indicates the time needed to perform the corresponding Maintenance Task, with the basic assumption that the Vehicle is staged on an Inspection Pit/Jacking tracks with the required Consumables, Tools And Materials Available.
9	**Sheet**	**Pages numbering**	This field indicates the progressive R-PMS sheet page number.
10	**LOCATION**	**Illustration**	This field indicates the On Board Location of the Equipment to be maintained The following Graphic Symbols are used for: Assembly/Unit/Component for System/Subsystem/Vehicle as a Whole
11	**R**	**Letter**	This field indicates that the Sheet pertains to Running Maintenance.
12	**P**	**Letter**	This field indicates that the Sheet pertains to Preventive Maintenance
13	**nn**	**Number**	This field indicates the System/Manual Section number to which the Sheet pertains. It may vary from 01 to 19
14	**rr**	**Number**	This field indicates the Sheet Revision number.
15	**Page ##**	**Page ##**	This field indicates the RMSM Section Page number.
16	**-#**	**Number**	This field indicates the RMSM Section Revision number.
17	**SAFETY PRECAUTIONS**	**Text**	This field presents the General and/or specific Safety Precautions to be followed to safely accomplish the relevant Maintenance Tasks.
18	**TOOLS**	**Text**	This field lists the description and the P/N of the Standard tools, Special Tools and Test Equipment needed to accomplish the Maintenance Task. Refer to the TTE Manual for the TE and Special Tools detailed descriptions and tools maintenance.
19	**CONSUMABLES**	**Text**	This field lists the Consumables Materials (consistent with those used by MTA with the related P/N.) needed to accomplish the Maintenance Task. Cleaning agents are included.
20	**SPARE PARTS**	**Text**	This field lists the Description and PN of Spare Parts (consistent with Illustrated Parts Catalog) needed to accomplish the Maintenance Task.
21	**PROCEDURE**	**Text**	The Procedure field provides Preliminary Operations and Procedural step by step Instructions to be followed while performing the Maintenance Task. Illustrations and Pictures are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure.

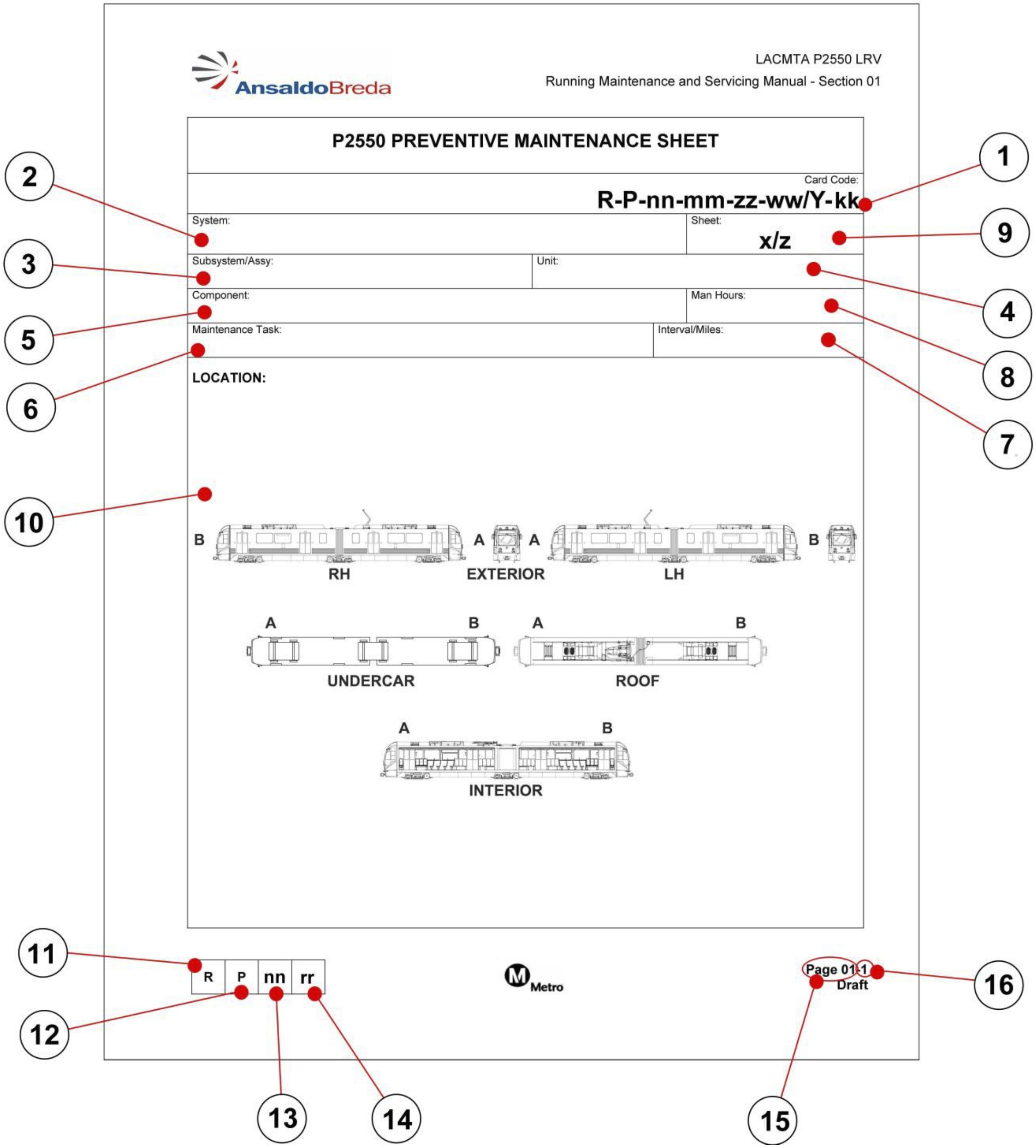
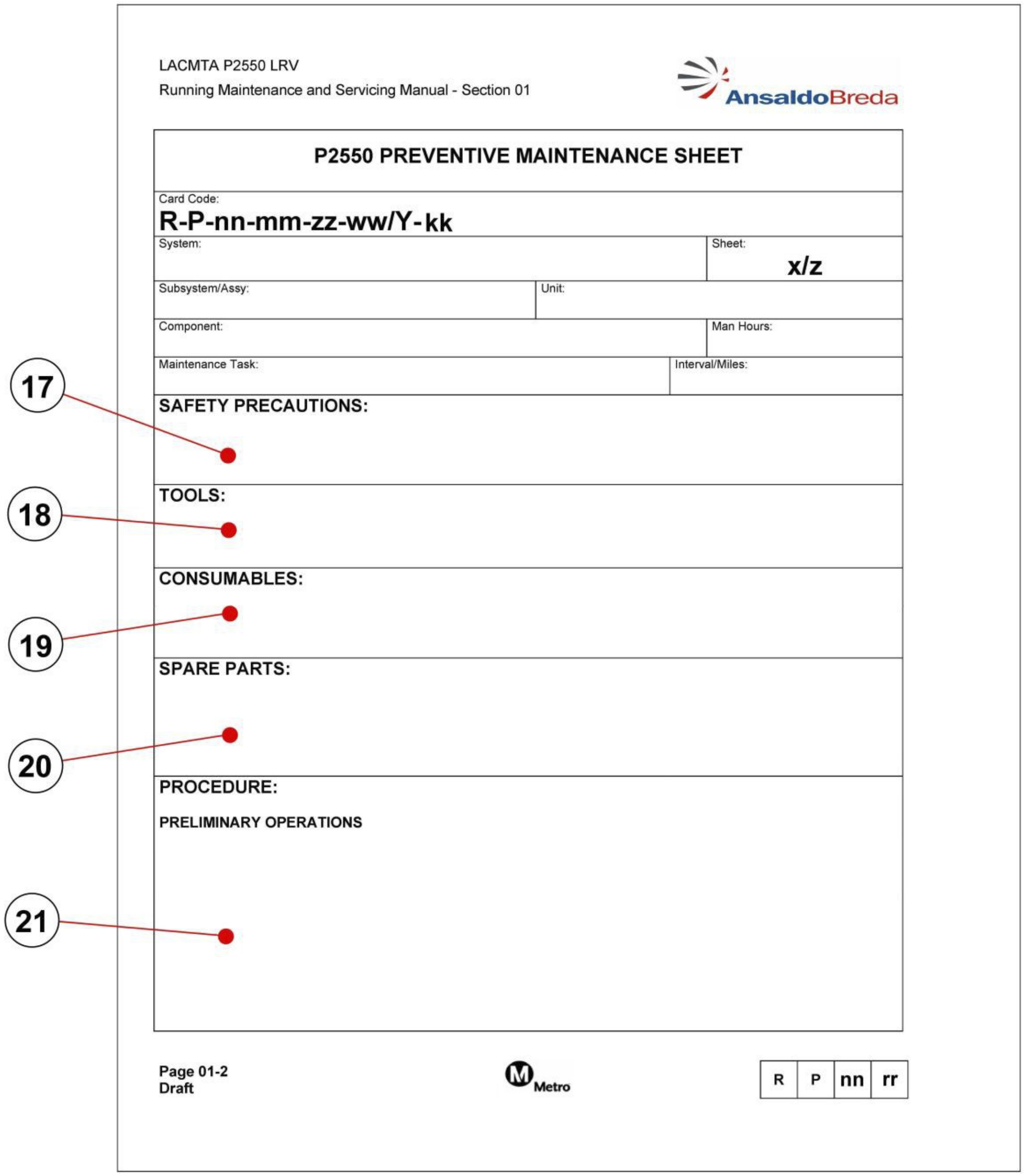


Figure 09-III-03.2 R-PMS Form
(Sheet 1 of 2)


LACMTA P2550 LRV
Running Maintenance and Servicing Manual - Section 01

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: R-P-nn-mm-zz-ww/Y-kk	
System:	Sheet: x/z
Subsystem/Assy:	Unit:
Component:	Man Hours:
Maintenance Task:	Interval/Miles:

SAFETY PRECAUTIONS:

TOOLS:

CONSUMABLES:

SPARE PARTS:

PROCEDURE:

PRELIMINARY OPERATIONS

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R	P	nn	rr

Figure 09-III-03.2 R-PMS Form
(Sheet 2 of 2)

09-III-03.03.02 How to Use the R-PM Sheets and R-PMR /Job Cards

To optimize the job organization, proceed as follows:

1. At Scheduled Preventive Maintenance Interval Expiration Date

a) Use the relevant (Maintenance Interval) R-PMR/JOB CARD where the Subsystems/Assemblies/Units/Components, listed in the ITEMS column, are grouped by Work Area and Vehicle System and sequenced, in alphabetical order, in conjunction with their On Vehicle Location and Task to be performed.

b) Select the Work Area and the System

c) Select the first Equipment listed in the ITEMS column and the Sheet Code listed in conjunction with the Task to be performed and gather the relevant Sheet

d) Read carefully the Sheet to fully understand the provided Data/Instructions.

e) Carefully read:

- The Safety Precautions to perform the Task safely
- The Preliminary Operations to set the Vehicle in safety conditions according to MTA Maintenance Shop Regulations
- The Tools, Consumables and Spare Parts listed in each Sheet which are needed to accomplish the Task, in order to have all of them available next to the location of the Equipment to be maintained before starting the activities

f) Fill the R-PMR/JOB CARD with the data required by the Maintainer at the start of the Maintenance Activities

2. Task Execution

a. Follow carefully the prescribed Safety Precautions and Maintenance Procedural Steps provided in the R-PM Sheet.

b. Perform the Maintenance Task Procedure on the first Equipment (listed in the ITEMS column of the relevant R-PMR /JOB CARD) at its On Vehicle LOCATION. as indicated in the LOCATION column of the R-PMR /JOB CARD.

c. After completing the Maintenance Task for the first Equipment, highlight (with a flag) its LOCATION field on the R-PMR / JOB CARD.

d. Note Equipment Defect Found and / or your Comments on the End Page of the R-PMR / JOB CARD

e. Proceed to perform the same Task on the second (same) Equipment listed in the R-PMR / JOB CARD at its On Vehicle LOCATION, (different from the previous one) as indicated in the LOCATION column of the R-PMR /JOB CARD.

f. Proceed as above to perform the same Task on every Equipment (to which the same Sheet Code refers) listed in the ITEMS column of the relevant (Maintenance Interval) R-PMR /JOB CARD.

g. During Task execution, note any Areas / Items of the Assembly / Unit/ Component under Preventive Maintenance Process requiring Corrective Maintenance.

h. Gather as much information about the Equipment as is practical to increase your Equipment knowledge (i.e.; knowledge about the malfunction in terms of correctly operating and incorrectly operating equipment processes).

3. At every Task Completion

a) Follow carefully the prescribed Safety Precautions before restoring Electrical Power to Vehicle.

b) Check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

c) Perform this check on the IDU "A "as follows:

NOTE: Through the IDU you can check if all Systems are exchanging data through the MVB or LonWorks Bus and the Trainlines Status.
The IDU Display also shows in real time the Status of all Vehicle Systems.
Reading the IDU Fault List it is possible to immediately detect a fault.
Using the IDU in the Operating Mode the Fault Indications are generic.
Using the IDU in Maintenance Mode the same Fault has a detailed description.

For more in depth troubleshooting use the PTU connected to the relevant system that requires further troubleshooting.

1. On IDU "A" access to the Maintenance Menu first and then to the "Faults" Screen by selecting, in sequence, the relevant icons.
2. Check, On IDU "A" through the list of the Current Active Faults shown in the "Faults" Screen, for "Fault" Codes related to the Subsystem to which the maintained Equipment pertains.

   Refer to Section 18 of RMSM for Fault Signals Details.
3. As per "Fault" Codes check results proceed as follows:

- **No Faults are listed in the "Faults" Screen**

  a) Key OFF the Vehicle.

  b) Record Service and Test results on the Defect Report Card for administrative and maintenance planning.

  c) Fill the R-PMR /JOB CARD with the data required from the Maintainer at the completion of the Maintenance Activities and include your comments

- **Fault Codes are listed in the "Faults" Screen**

a) Investigate/troubleshoot the Equipment previously maintained first and then the System/Subsystem/Assembly/Unit for Fault Probable Causes

b) Gather as much information about the failure symptoms as is practical.

c) Refer to Section 18 of RMSM for Fault Signals Details

d) Try to identify the malfunction in terms of correctly operating and incorrectly operating equipment processes.

e) Identify which equipment signals or parameters will best help you to localize the failure.

f) Identify the source of the problem.

g) Repair or replace the defective component.

h) Verify that the repair is effective in eliminating all of the failure symptoms.

i) Evaluate whether or not the defective component was the root cause of the failure.

j) Once the Fault Codes are not found in the "Faults" Screen perform steps from 3-a through 3-c (previous subparagraph **"No Faults are listed in the "Faults" Screen)**

09-III-03.03.03 Running- Preventive Maintenance Sheet (R-PMS) List

The HVDS Running- Preventive Maintenance Sheets (R-PMS) List is provided in the following pages.

The R-PM Sheets are listed by Subsystem / Assembly / Unit / Component and sequenced by Maintenance Interval in conjunction with their Sheet Codes and Tasks (including SCPM flag) to be performed.

Table 09-III-03.3 Running Preventive Maintenance Sheets List

SYSTEM 09 HIGH VOLTAGE DISTRIBUTION					
SUBSYSTEM/ ASSY	**ASSY /UNIT/ COMPONENT**	**SCPM**	**TASK**	**MAINTEN. INTERVAL (MILES)**	**SHEET CODE**
LINE VOLTAGE AND CURRENT PROTECTION	LIGHTNING ARRESTER (01F01)		INSPECTION	30,000	R-P-09-01-01-00/I-00
LINE VOLTAGE AND CURRENT PROTECTION	KNIFE SWITCH		INSPECTION	30,000	R-P-09-01-02-00/I-00
LINE VOLTAGE AND CURRENT PROTECTION	EMI DETECTOR SYSTEM		INSPECTION	60,000	R-P-09-01-03-00/I-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB (HIGH SPEED CIRCUIT BREAKER)		INSPECTION	30,000	R-P-09-02-01-00/I-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB (HIGH SPEED CIRCUIT BREAKER)		INSPECTION	60,000	R-P-09-02-01-00/I-01

09-III-03.03.04 Running- Preventive Maintenance Sheets (R-PMS)

HIGH VOLTAGE DISTRIBUTION SYSTEM

Running - Preventive Maintenance Sheets

R-PMS

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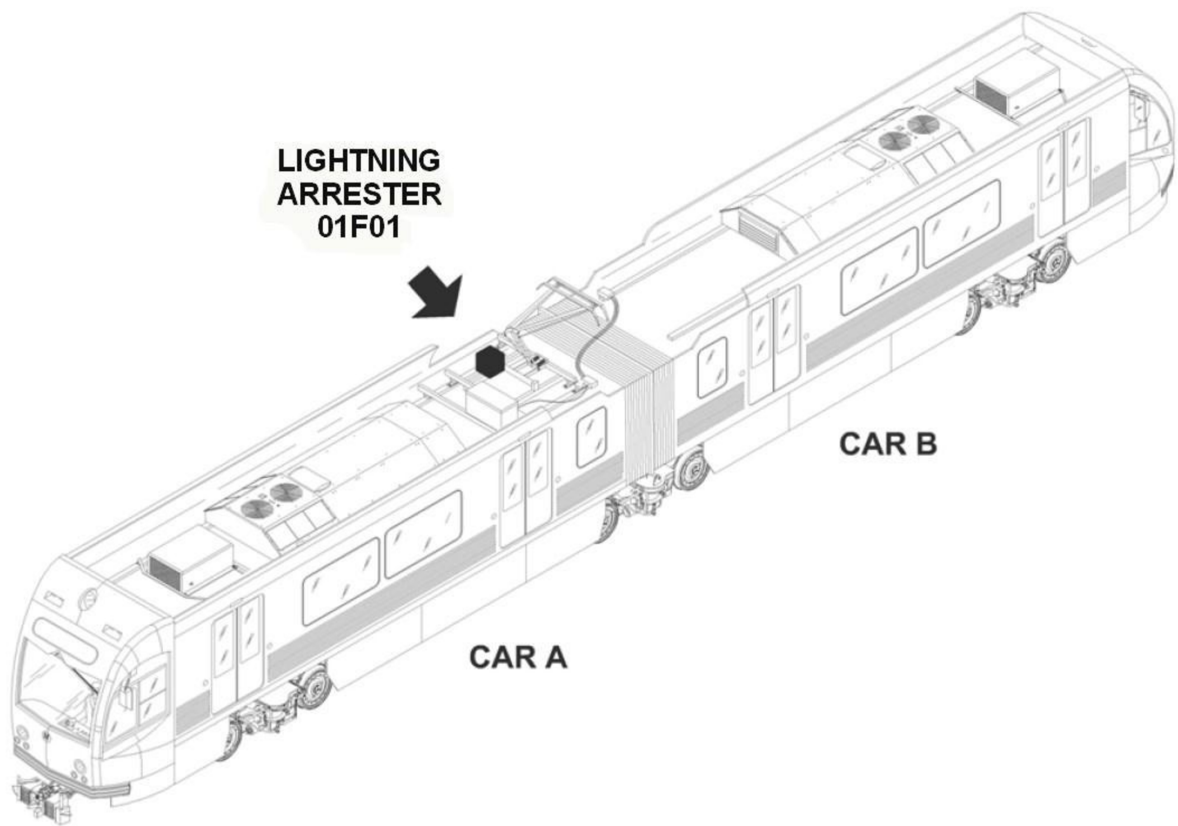
P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-09-01-01-00/I-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **LIGHTNING ARRESTER (01F01)**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-01-01-00/I-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **LIGHTNING ARRESTER (01F01)**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

**WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER.(750 V). ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.
DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.**

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.
External Scaffold

CONSUMABLES:

Soy Foam

SPARE PARTS:

NA

P2550 PREVENTIVE MAINTENANCE SHEET		
Card Code: **R-P-09-01-01-00/I-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **3/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **LIGHTNING ARRESTER (01F01)**	
Component:		Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **30,000**

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

INSPECTION (Refer to Figure 1)

To inspect the Lightning Arrester proceed as follows:

1. Inspect Lightning Arrester for general conditions, cracks, burns or damage.

2. Check the Fixing Bolts **(19 mm)**for loosening / missing parts. Torque to **52 ft-lb**.

3. Check the High Voltage Copper Wire for visible damage, fraying, loosening / missing parts, and signs of overheating.

4. Note any areas / items requiring Corrective Maintenance.

5. Clean accurately the Lightning Arrester Polyester Glass Shell with Soy Foam.

P2550 PREVENTIVE MAINTENANCE SHEET		
Card Code: **R-P-09-01-01-00/I-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **LIGHTNING ARRESTER (01F01)**	
Component:		Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **30,000**

PROCEDURE:

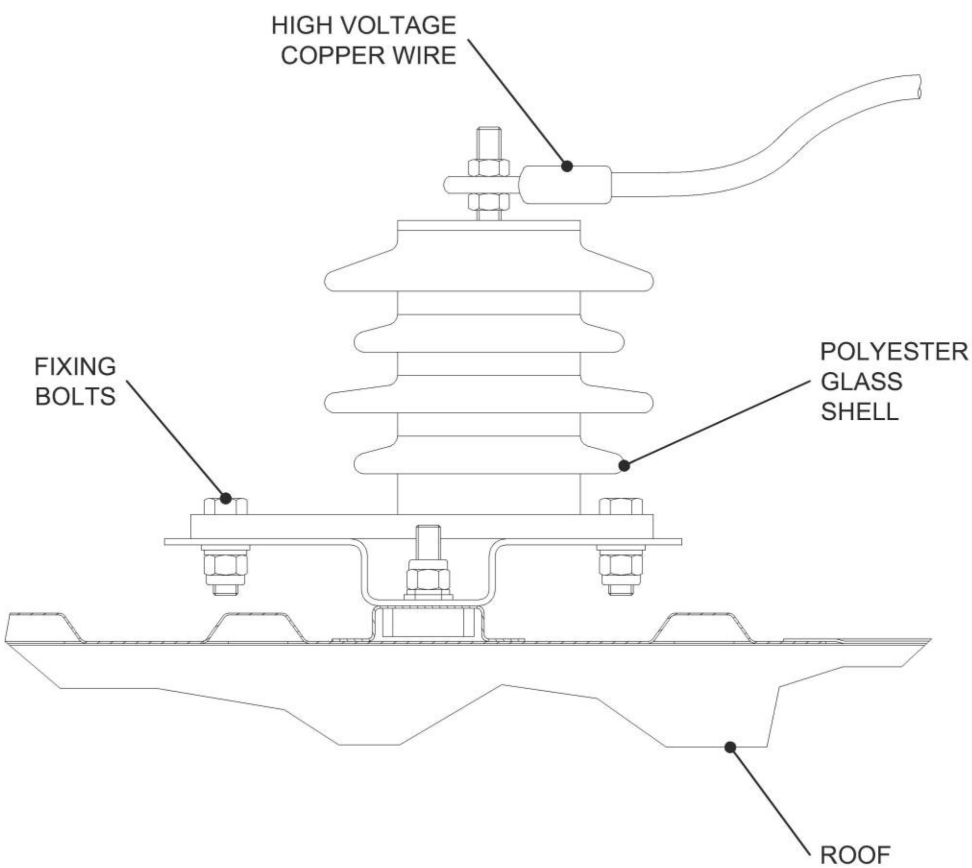
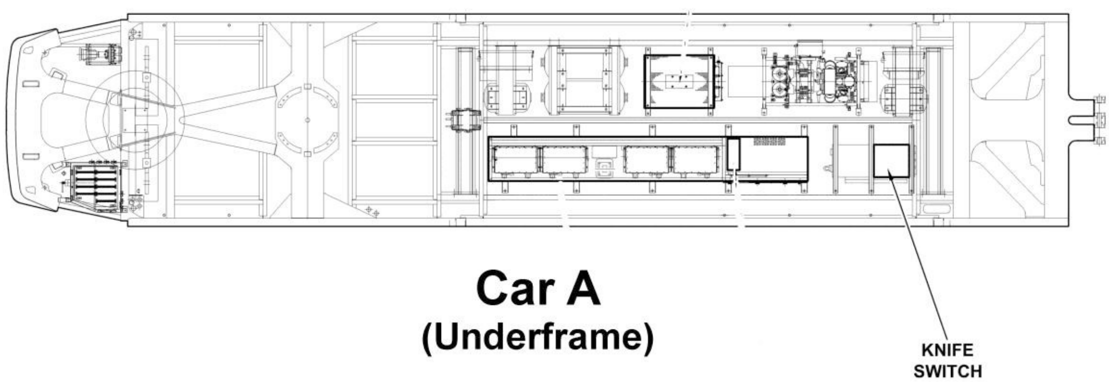


Figure 1 - LIGHTNING ARRESTER

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-09-01-02-00/I-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

LOCATION:



Car A
(Underframe)

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: R-P-09-01-02-00/I-00		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **2/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**	
Component:		Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **30,000**

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT. REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: HIGH VOLTAGE IS PRESENT ON THE INVERTER GROUP. AFTER REMOVING ALL POWER FROM THE VEHICLE, WAIT A MINIMUM OF 1 MINUTE PRIOR TO REMOVING OR OPENING MAIN INVERTER GROUP,SINCE THE CAPACITORS DISCHARGE TIME IS 10 SECONDS.
FAILURE TO COMPLY WITH SAFETY REGULATIONS COULD RESULT IN SERIOUS INJURY OR EVEN DEATH IF NOT FOLLOWED.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

CAUTION: THE INTERNAL PART OF THE KNIFE SWITCH COVER IS SHAPED IN SUCH A WAY THAT IT IS NOT POSSIBLE TO CLOSE IT IF THE SWITCH IS NOT IN "NORMAL" POSITION.
FORCING IT CLOSED COULD RESULT SWITCH / COVER DAMAGE.

CAUTION: PAY ATTENTION TO NOT DAMAGE THE BOX WATERTIGH GLANDS.
FAILURE TO COMPLY CAN CAUSE HEAVY DAMAGE TO THE EQUIPMENT / VEHICLE.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.

CONSUMABLES:

CRC 2000 Contact Cleaner

CRC Industrial - Precision Cleaner M3 PN 147535

SPARE PARTS:

Knife Switch Box Gasket PN 63520005

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-01-02-00/I-00**

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**3/4**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**KNIFE SWITCH**

Component:	Man Hours:
	0.25

Maintenance Task:	Interval/Miles:
INSPECTION	**30,000**

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

INSPECTION (Refer to figure 1)

1. Check Knife Switch Box for loose / missing hardware. Tighten as per check result.
2. Check on the Cover Safety Shaped Plate for loose / missing Label.Replace as needed.
3. Inspect Knife Switch Box Exterior and Cover for sign of damage /deformation.
4. Check the Cable Bushings for damage / loose missing parts.
5. Inspect the Knife Switch Box Interior for dirt and / or water penetration.
6. Check the Knife Switch Box Gasket for damage, deformation. Replace as necessary.
7. Inspect the Knife Switch Components for sign of damage, cracks, overheating and/or, loose / missing hardware.
8. Inspect the Knife Switch Blades and Power Clips for signs of wear.Repair/replace as needed.
9. Verify that the knife switch can be moved freely from NORMAL position to any other positions (AUXILIARY, OFF and SHOP) and vice versa.
10. Clean the Knife Switch Blades and Power Clips with Contact cleaner and clean lint-free rag.
11. Ensure the Knife Switch Handle in "NORMAL" position and install the Cover.

CAUTION: THE INTERNAL PART OF THE KNIFE SWITCH COVER IS SHAPED IN SUCH A WAY THAT IT IS NOT POSSIBLE TO CLOSE IT IF THE SWITCH IS NOT IN "NORMAL" POSITION.
FORCING IT CLOSED COULD RESULT SWITCH / COVER DAMAGE.

P2550 PREVENTIVE MAINTENANCE SHEET			
Card Code: **R-P-09-01-02-00/I-00**			
System: **HIGH VOLTAGE POWER DISTRIBUTION**			Sheet: **4/4**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**		
Component:			Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **30,000**	

PROCEDURE (CONT'D):

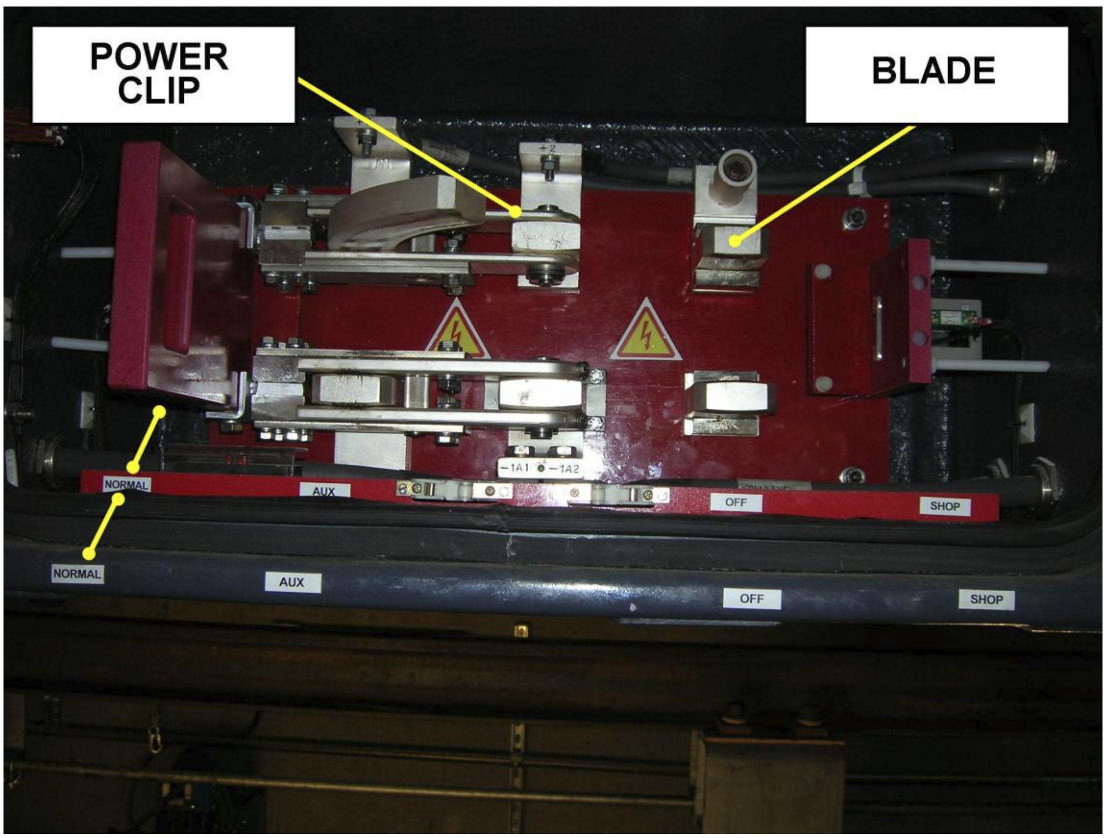
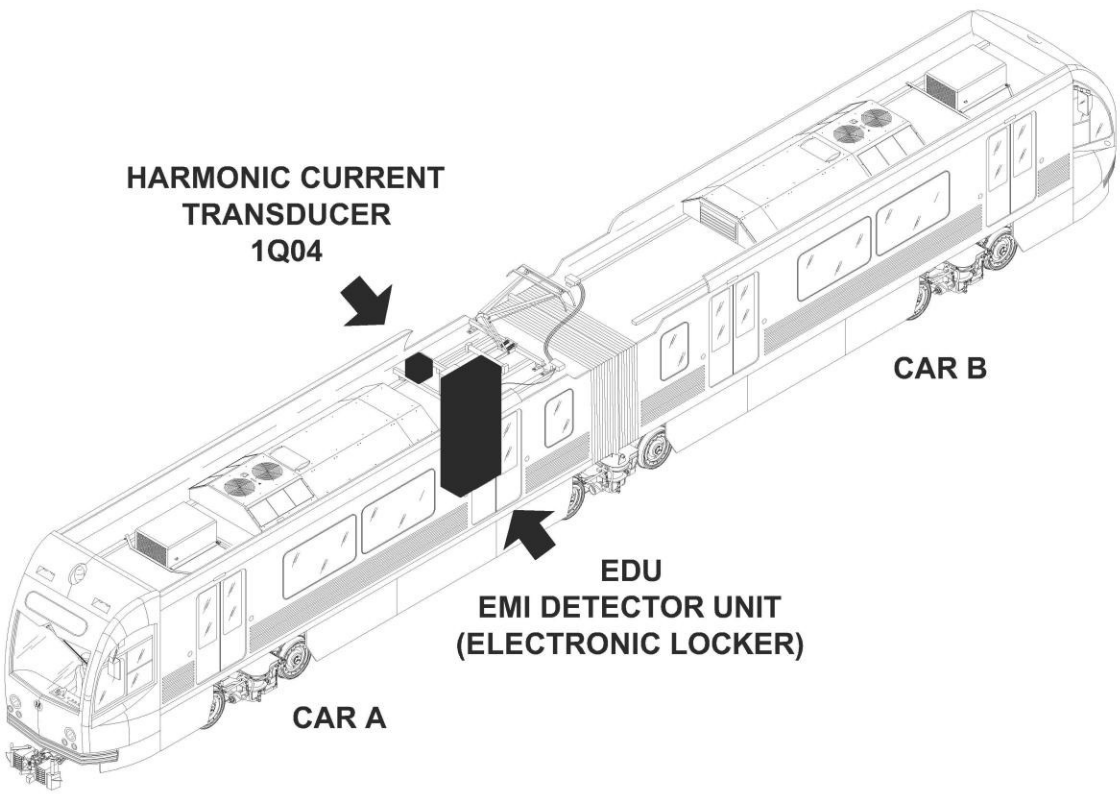


Figure 1 - KNIFE SWITCH - NORMAL POSITION

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-09-01-03-00/I-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-01-03-00/I-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

SAFETY PRECAUTIONS:

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WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT. REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.

CONSUMABLES:

CRC Industrial - Precision Cleaner M3 PN 147535

Dry Compressed Air for Electronic Equipment (commercial)

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-09-01-03-00/I-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

INSPECTION

To perform the task, proceed as follows:

HCT Inspection (Refer to Figure 1)

1. Inspect HCT Assembly and Frame for general conditions and visible damages.
2. Check HCT Assembly frame Fixing Bolts for loose / missing hardware. Tighten as per check result.
3. Check High Voltage Wires Clamps for loose / missing hardware. Tighten as per check result.
4. Inspect LV Cable for correct installation and / or burns. Check that the Connector is tight.
5. Remove the HCT Cover.
6. Remove the PCB Junction Box Cover and inspect the wiring and PCB for any signs of damage, broken, loose connections or overheating.
7. Check HCT for visible damage, signs of overheating. Replace as per check results.
8. Clean the HCT using recommended cleaner and a lint-free rag.
9. Note any areas / items requiring corrective maintenance.
10. Re-install the HCT Cover and the PCB Junction Box Cover.
11. Record Inspection result on the Defect Report Card for administrative and maintenance planning.

EDU Inspection (Refer to Figure 2)

1. Inspect EDU for damage and missing or loose circuit boards.
2. Inspect Cables for proper installation and /or burns. Check that the Connector is tight.

P2550 PREVENTIVE MAINTENANCE SHEET			
Card Code: **R-P-09-01-03-00/I-00**			
System: **HIGH VOLTAGE POWER DISTRIBUTION**			Sheet: **4/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**		
Component:			Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**	

PROCEDURE (CONT'D):

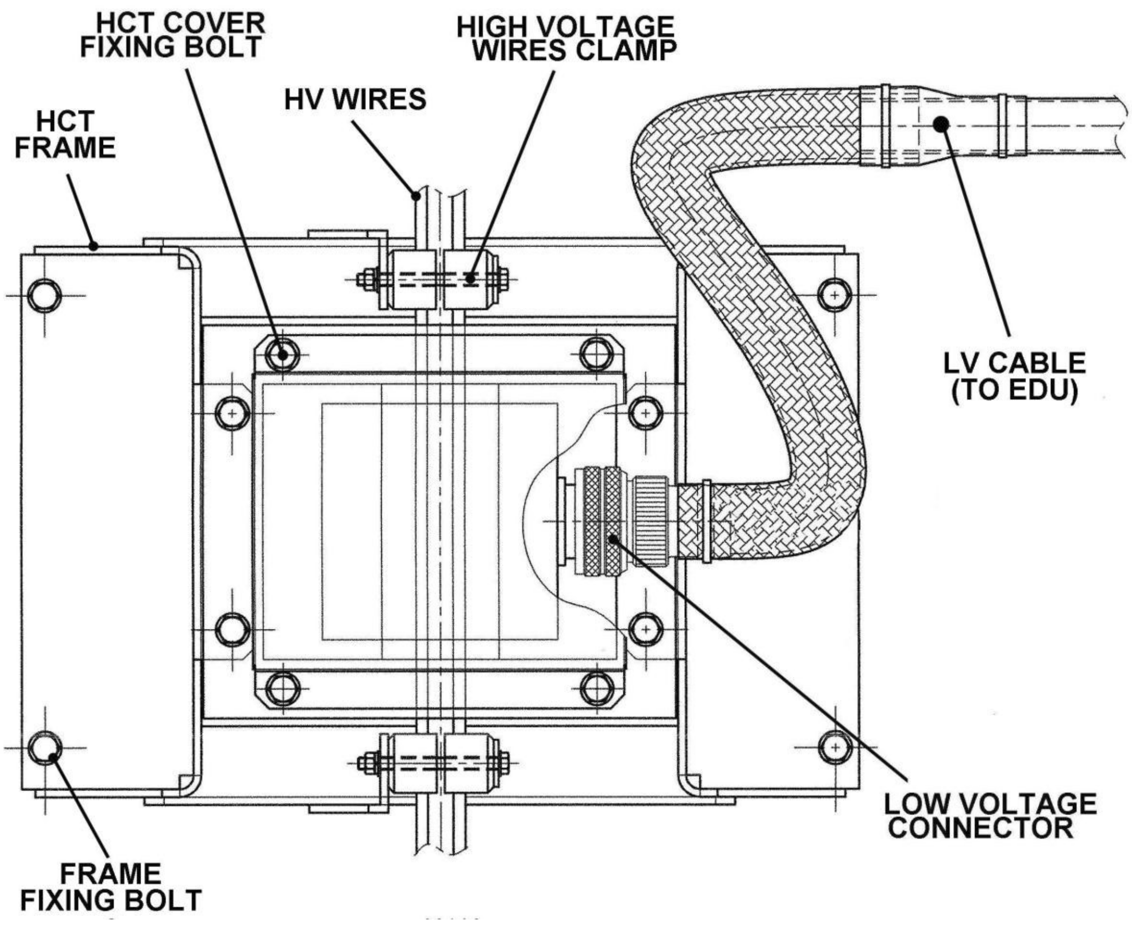


Figure 1 - HARMONIC CURRENT TRANSDUCER (HCT)

P2550 PREVENTIVE MAINTENANCE SHEET		
		Card Code: **R-P-09-01-03-00/I-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **5/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**	
Component:		Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**

PROCEDURE (CONT'D):

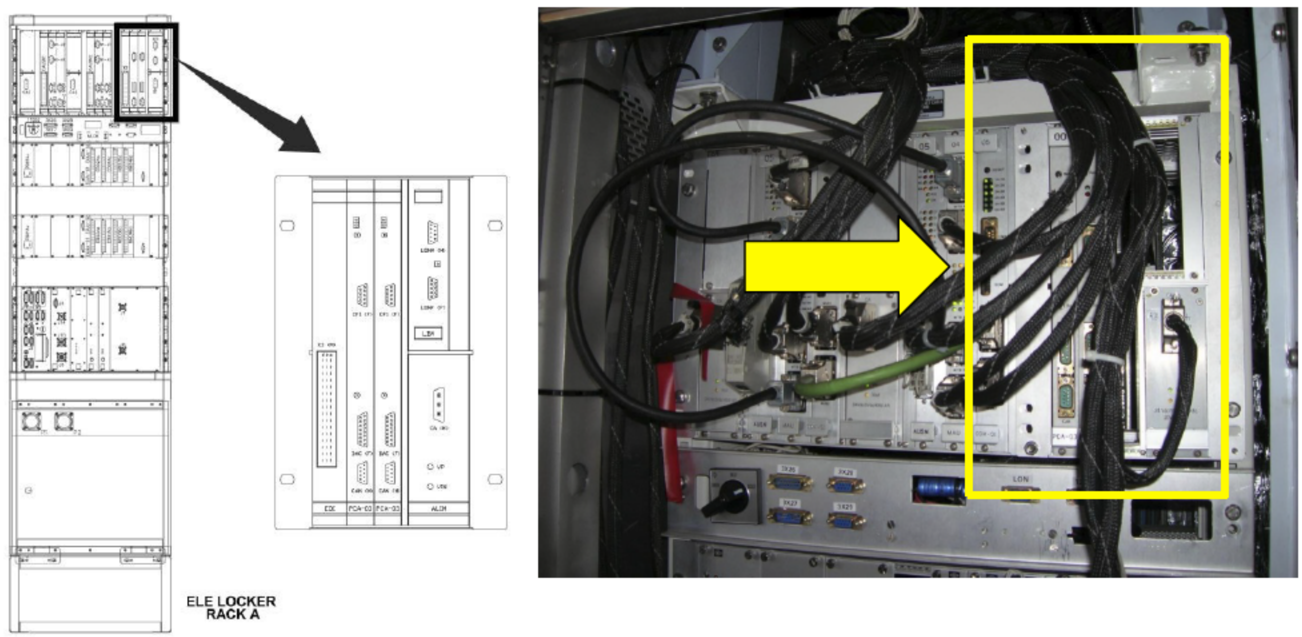


Figure 2 - EMI DETECTOR UNIT FRONT VIEW

P2550 PREVENTIVE MAINTENANCE SHEET

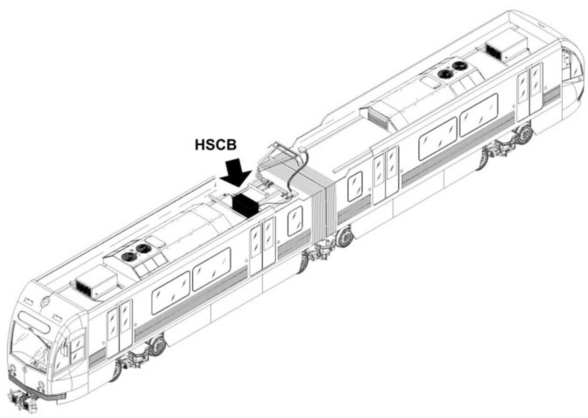
Card Code: **R-P-09-01-03-00/I-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

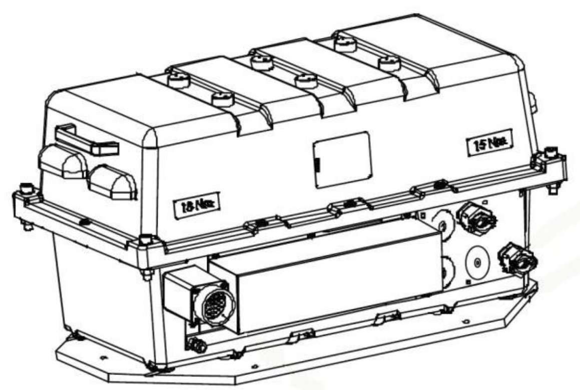
**INTENTIONALLY
LEFY BLANK**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

LOCATION:





P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **2/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**	
Component:		Man Hours: **0.25**
Maintenance Task: **INSPECTION**		Interval/Miles: **30,000**

SAFETY PRECAUTIONS:

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IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF. ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-09-02-01-00/I-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**3/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB (HIGH SPEED CIRCUIT BREAKER)**

Component:	Man Hours:
	0.25

Maintenance Task:	Interval/Miles:
INSPECTION	**30,000**

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.

Vacuum Cleaner

CONSUMABLES:

Contact Cleaner

Multi-Purpose Abrasive Rubber Fine Grade 0 or Scotch Brite.

Denatured alcohol (for polyester parts)

SPARE PARTS:

N.A

P2550 PREVENTIVE MAINTENANCE SHEET	
Card Code: **R-P-09-02-01-00/I-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **4/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

PROCEDURE (CONT'D):

INSPECTION

To perform the Task proceed as follows:

HSCB FIRE BOX VISUAL INSPECTION (Refer to Figure 1)

1. Gain access to the Vehicle Roof according to LACMTA regulations.
2. Inspect HSCB Fire Box (Upper Shell, Lower Shell and Coil Control Box) for general condition, damage, loose / missing parts.
3. Check the HSCB Fire Box Frame Fixing Bolts (Lock Nut 17mm ; Hex Screw 5/16”) for correct torque value of **12.5ft-lb**. Torque as per check result.
4. Check the Grounding Cable and relevant Connections for damage, fraying, loose / missing parts and signs of overheating.
5. Check High Voltage Cable Bushings and LV VEAM Connector for damage and loose / missing parts,
6. Disconnect the LV VEAM Connector and inspect both male and female connectors for damage to pins or missing pins.
7. Inspect LV and HV Cables for correct installation and / or burns.

HSCB COMPONENTS & FIRE BOX CLEANING (Refer to Fig 2).

To perform the Task proceed as follows:
1. Remove the Fire Box Upper Shell.
2. Lift and overturn the Fire Box Upper Shell and position it to have the Arc Chute Plate at the top and available for maintenance.
3. Clean the HSCB Components and Connectors using recommended cleaner.
4. Brush the Arc Chute Plate, the Deflectors and the Frame around the Baffle Plates using recommended Multi-Purpose Abrasive Rubber.or Scotch Bride.
5. Clean the Arc Chute and Arc Chute Plate using Vacuum cleaner and clean lint - free rags.
6. Vacuum Clean the Fire Box Lower Shell Interior.
7. Clean the Fire Box Upper & Lower Shells exterior using recommended agent.

HSCB INSPECTION FINAL OPERATIONS
1. Reinstall the Fire Box Upper Shell onto its position. Torque the Upper Shell Screws to **12.5 ft-lb.**
2. Restore Power.
3. Test the HSCB proper operation with the PROPULSION RESET Pushbutton.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-09-02-01-00/I-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB (HIGH SPEED CIRCUIT BREAKER)**

Component:	Man Hours:
	0.25

Maintenance Task:	Interval/Miles:
INSPECTION	**30,000**

PROCEDURE (CONT'D):

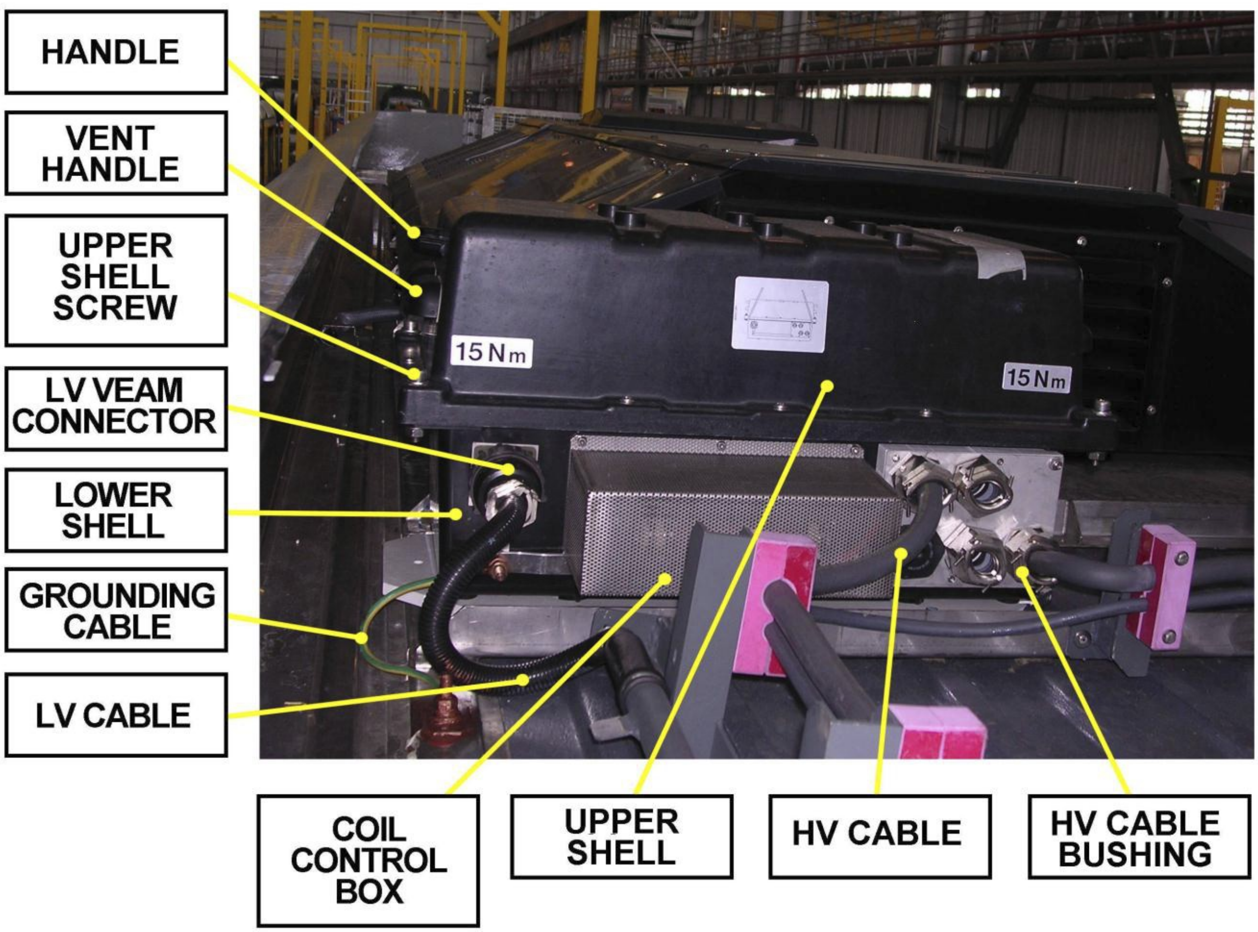


Figure 1 - HSCB - FIRE BOX -

P2550 PREVENTIVE MAINTENANCE SHEET	
Card Code: **R-P-09-02-01-00/I-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

PROCEDURE (CONT'D):

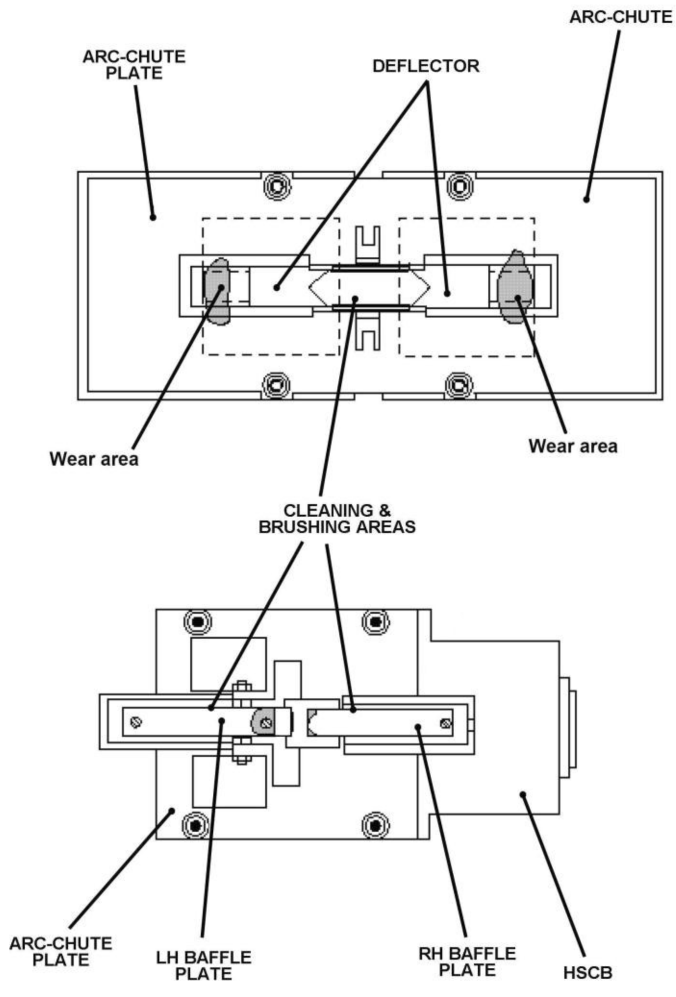


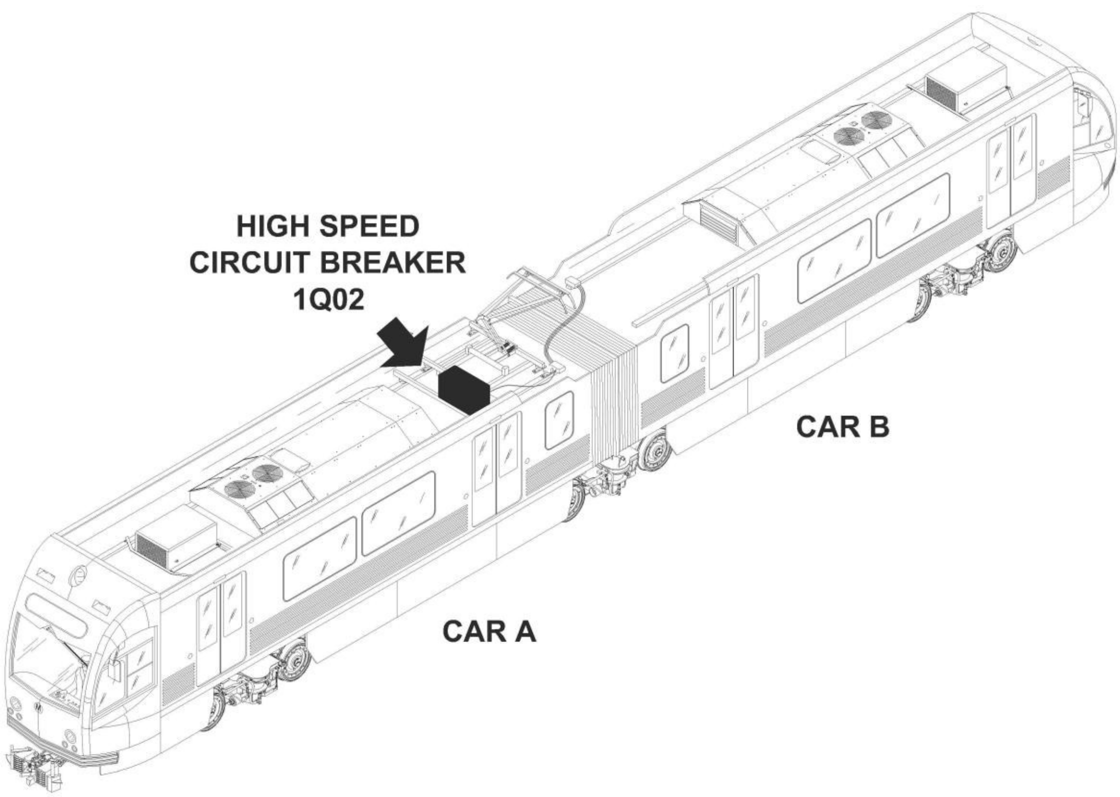
Figure 2 - HSCB - CLEANING

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-09-02-01-00/I-01

System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**			
System: **HIGH VOLTAGE POWER DISTRIBUTION**			Sheet: **2/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**		
Component:			Man Hours: **0.7**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**	

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

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WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:	**R-P-09-02-01-00/I-01**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.
Vacuum Cleaner
Arc Chute Gauge (3,14 x 7,86 Inch) (P/N SG 100029)
Special Flexible 0.5 mm Thickness Gauge (20 x 300 mm), (P/N SG 100029 P2)
Contact Depth Gauge W-6 (P/N HSBA 431494P0001)
Cylindrical Gauge **3 mm** (e.g. a pin remover)

CONSUMABLES:

Contact Cleaner
Multi-Purpose Abrasive Rubber Fine Grade 0 or Schotch Brite
Denatured alcohol or Solution of liquid soap diluted in water (for polyester parts)
Litéa 806-12 (Aseol Bern) Grease or Molycote Longterm W2 (for mechanical moving parts)
Litoplex 1043 (Aseol Bern) (for stainless steel parts)
Sealing lacquer (type F-900, manuf. Organic Products Co., Irving - TX

SPARE PARTS:

LH Baffle Plate (P/N HSBT 431153 P0001)

LH Baffle Plate (P/N HSBT 431136 P0001)

Screw for Baffle Plates (P/N 9ADA 196-34)

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **4/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

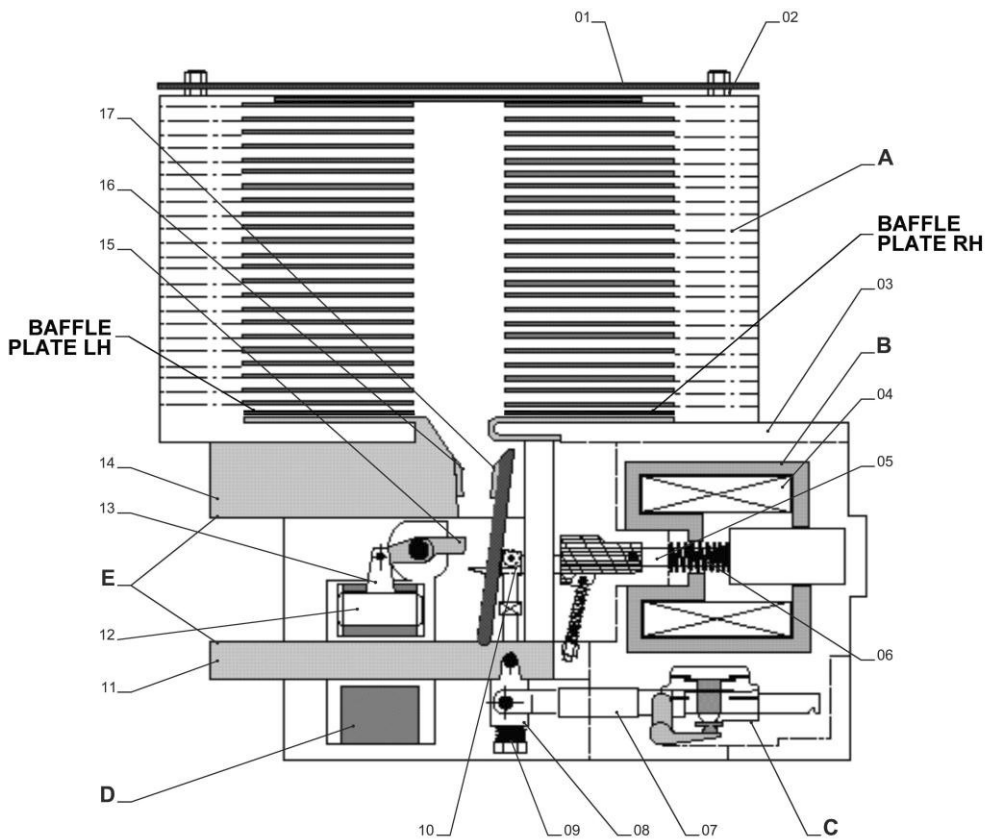
PROCEDURE (CONT'D):

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

A. ARC CHUTE
B. CLOSING DEVICE
C. AUXILIARY CONTACTS
D. TRIPPING DEVICE
E. MAIN CIRCUIT

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. PRESSURE SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. PIVOT SOCKET SPRING
10. FORK
11. LOWER CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. UPPER CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT



F

iFigure 1 - HSCB - SCHEMATIC COMPONENTS LAY OUT

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **5/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

INSPECTION

This task consists of :

1. PRELIMINARY OPERATIONS.
2. HSCB ARC CHUTE BAFFLE PLATES CHECKING.
3. HSCB ARC CHUTE DEFLECTORS CHECKING.
4. HSCB MAIN CONTACT CHECKING AND MECHANICAL COMPONENTS INSPECTION.
5. HSCB MECHANICAL COMPONENTS LUBRICATION.
6 HSCB CLOSING DEVICE "X" CLEARANCE CHECKING.
7 HSCB TRIPPING CURRENT DEVICE ADJUSTMENT.
8. FINAL OPERATIONS.

1. PRELIMINARY OPERATIONS.

To perform the Task proceed as follows:

a. Remove the Fire Box Upper Shell.
b. Lift and overturn the Fire Box Upper Shell and position it to have the Arc Chute Plate at the top and available for Inspection.

2. HSCB ARC CHUTE BAFFLE PLATES CHECKING (Refer to Figure 2).

NOTE: This check requires the use of the SG100029P2 gauge or an 20x300x0.5 mm flexible made of spring steel or polyester.

a. Check, on HSCB Lower Shell, the Breaker (LH & RH) Baffle Plates for wear the Gauge
b. Perform the check according to the following criteria:

HSCB ARC CHUTE BAFFLE PLATES INSPECTION CRITERIA	
INSPECTION RESULT	MAINTENANCE ACTION
The LH Baffle Plate section (at the screw area) is half of the original section (20 mm x 3mm)	Replace the LH Baffle Plate and the relevant Screws according to Sheet R-C -09-02-02-00 / R-00
The RH Baffle Plate section (at the crimped area) is half of the original section (20 mm x 3mm)	Replace the RH Baffle Plate according to Sheet R-C -09-02-02-00 / R-00

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

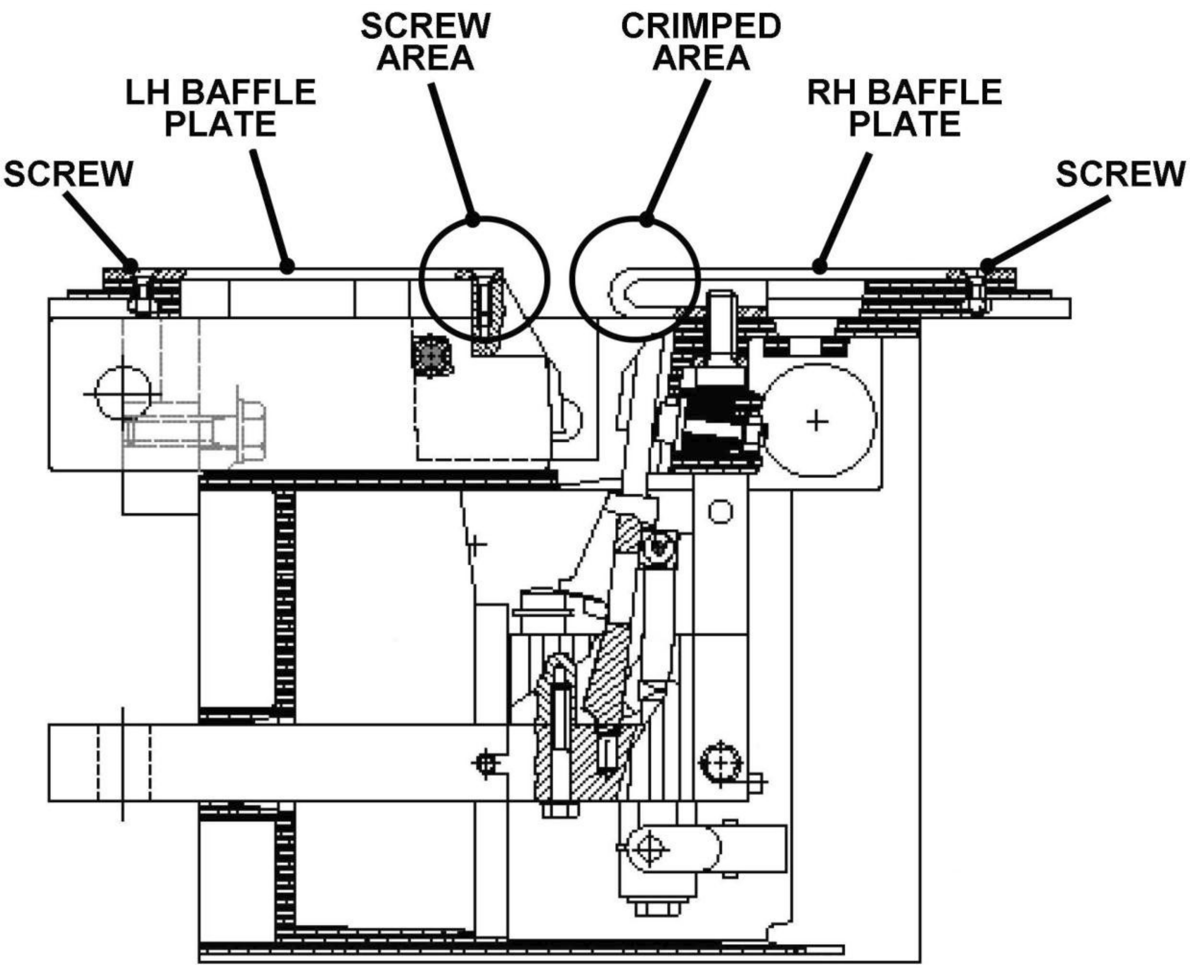


Figure 2 - HSCB - ARC CHUTE-BAFFLE PLATES INSPECTION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-09-02-01-00/I-01

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**7/14**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB (HIGH SPEED CIRCUIT BREAKER)**

Component:	Man Hours:
	0.7

Maintenance Task:	Interval/Miles:
INSPECTION	**60,000**

PROCEDURE (CONT'D):

3 HSCB ARC CHUTE DEFLECTORS CHECKING (Refer to Figure 3).

NOTE: This check requires the use of the SG100029P2 gauge (2) or an 20x300x0.5 mm flexible made of spring steel or polyester.

a. To check the Deflectors (1), push the Gauge (2) through the Intermediate Plate (3) and then successively between the Deflectors (1) on all sides of each of the Arc Chute Chamber. Move the Gauge over the entire surface of the Deflectors.

b. If the Gauge (2) can no longer be inserted between the 3 first Deflectors, the Arc Chute must be disassembled and the worn Deflectors (1) changed according to Sheet H-P-09-02-01-00/OV-00 Step 3.1.1.2 & 3.3.1.1.

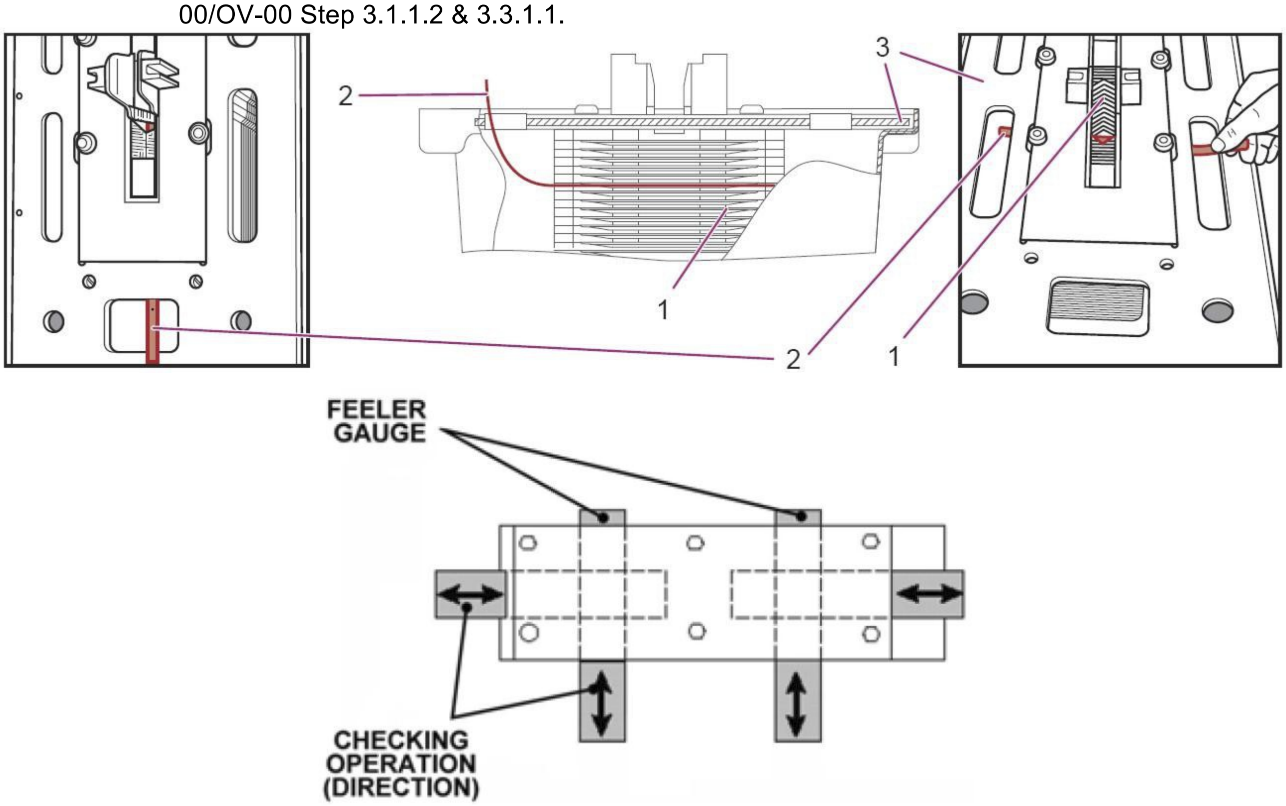


Figure 3 - HSCB - ARC CHUTE- DEFLECTORS INSPECTION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **8/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.25**
Maintenance Task: **INSPECTION**	Interval/Miles: **30,000**

PROCEDURE (CONT'D):

4 HSCB MAIN CONTACT CHECKING AND MECHANICAL COMPONENTS INSPECTION

4.1 HSCB MAIN CONTACT CHECKING (Refer to Figures 4, 5, 6):

To perform the task proceed as follows

NOTE: It is assumed that HSCB Fire Box Upper Shell is still removed and the LV VEAM connector is still unplugged.

a. Apply a Jumper to the pin "M" and the pin "N" of VEAM Connector Socket (HSCB side)

b. Connect a cable from HSCB VEAM Connector at pin "R" (+) and pin "S" (-) to HSCB VEAM Connector at pin "R" (+) and pin "S" (-)to energize (with Low Voltage +37,5 VDC), through the Jumper, the Closing Device Coil in order to close the HSCB Moving Contact.

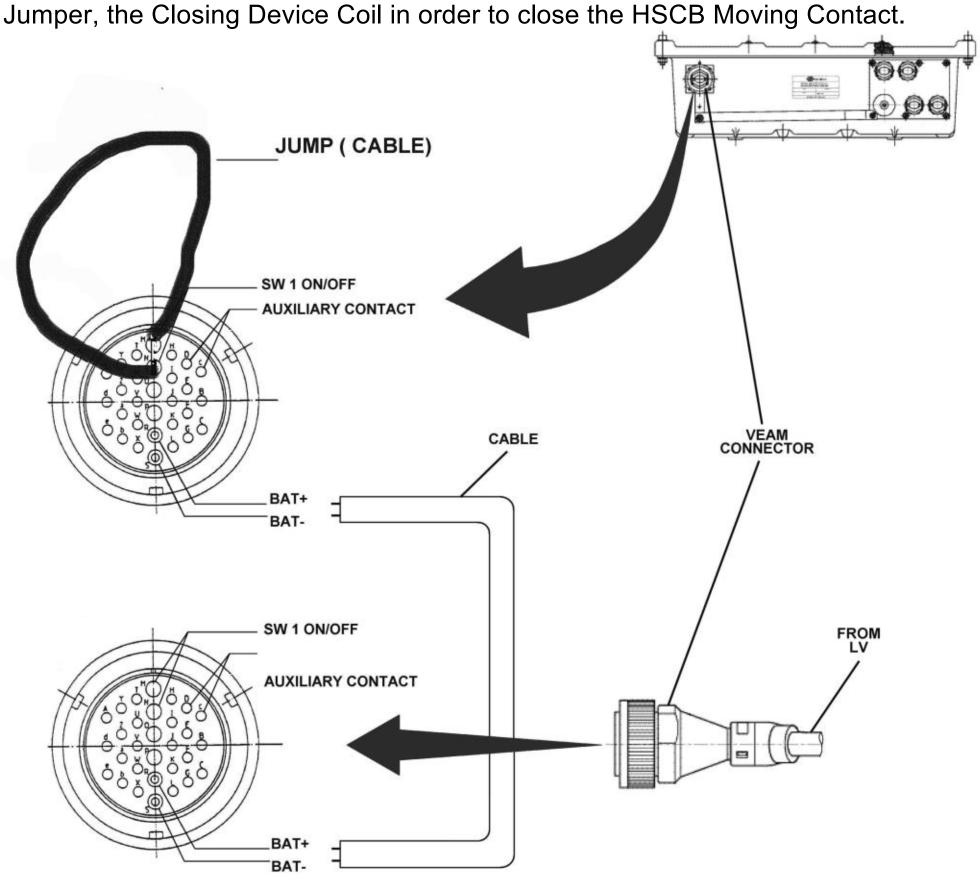


Figure 4 - SETTING THE HSCB MAIN CONTACT TO CLOSE

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:
R-P-09-02-01-00/I-01

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**9/14**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB (HIGH SPEED CIRCUIT BREAKER)**

Component:	Man Hours:
	0.7

Maintenance Task:	Interval/Miles:
INSPECTION	**60,000**

PROCEDURE (CONT'D):

4.1 HSCB MAIN CONTACT CHECKING (CONT'D)

c. Turn the Transfer Switch to "LOCAL" (or "ON").
d. Make sure that the CB 4F02 (LV Locker) and 3F17 (Battery Box) are positioned to "ON".
e. Verify that HSCB Moving Contact is closed.
f. Check the Main Contact as follows:
   1. Insert a **3 mm** cylindrical gauge (e.g. a pin remover) between the Moving Contact (4), the Upper Contact (5) and the Upper Connection (6) half way up the Contact Plates.
   2. If the insertion is impossible, the Mobile Contact (4), the Upper Connection (6) and the Connections (7,8) must be changed according to Sheet R-C -09-02-02-00 / R-00.

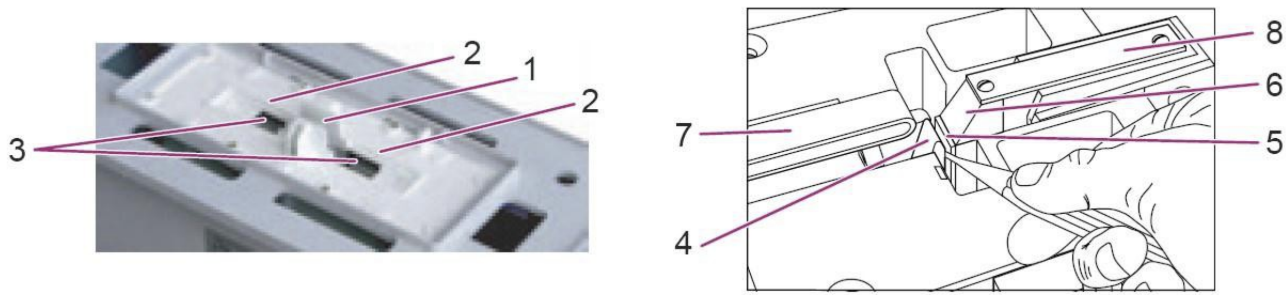


Figure 5 - HSCB -CHECKING THE MAIN CONTACT

g. Check the Main Contact Wear as follows:

NOTE: This check requires the use of Sécheron Contact Depth Gauge W-6 (1)

   1. Insert the Gauge W-6 (1) through the Cover (2) until it touches the Screw (3).
   2. If the Gauge surface (4) touches the Cover (2) or is close (K ≤ **0.5 mm** or W = **15** $^{+0.5}_{0}$ **mm**) to the Cover (2), the Main Contact and the Horns must be replaced according to. R-C -09-02-02-00 / R-00.

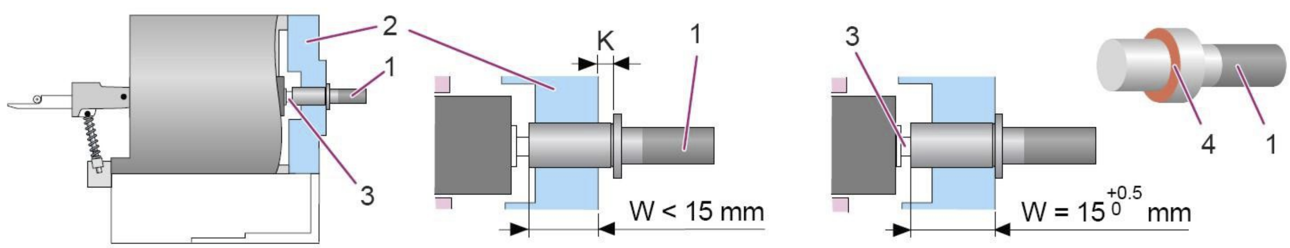


Figure 6 - HSCB - MEASURING THE MAIN CONTACTS WEAR

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **10/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

4.2 HSCB MECHANICAL COMPONENTS INSPECTION (Refer to Figure 7)

NOTE: This inspection must be performed with the circuit-breaker closed according to previous Step 4.1 a. trough e.

a. Check the HSCB mechanical components for damage / deformation and wear.
b. Note any areas / items requiring Corrective Maintenance.
c. Visually or by hand, check that the Spring Rings (1) of the Fork (7) are present: if one of the Spring Rings (1) is not in its groove (2), replace it according to Sheet R-C-09-02-03-00/R-00.
d. Check the position of the Washer (3): its Lower Face (8) shall be flush with the Lower Edge (4) or completely inserted inside the Pivot Socket (5): otherwise, tighten the Screw (6) to a torque of **8 Nm**.

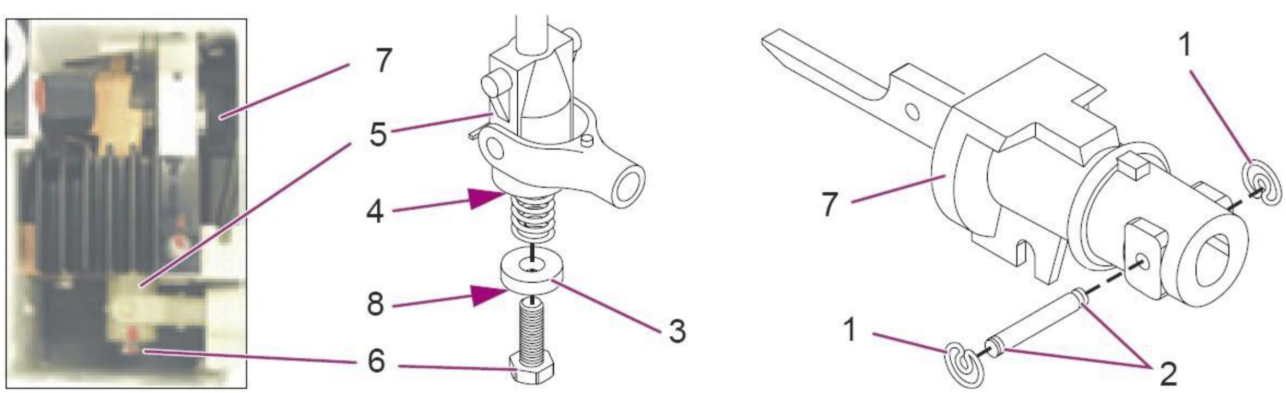


Figure 7 - HSCB - MECHANICAL COMPONENTS INSPECTION

4.3 FINAL OPERATIONS

a. Disconnect the Low Voltage (+37,5 VDC) Power Supply cable from HSCB (pin "R" (+) and pin "S" (-) of the VEAM Connector to de-energize the Closing Device Coil in order to open the Moving Contact.
b. Verify that the HSCB Moving Contact is open.
c. Remove the Jumper from the pin "M" and the pin "N" of VEAM Connector.
d. Set the CB 4F02 (LV Locker) and 3F17 (Battery Box) to OFF position.
e. Turn the Transfer Switch to "OFF".

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-09-02-01-00/I-01**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **11/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

5 HSCB MECHANICAL COMPONENTS LUBRICATION (Refer to Fig 8)

To perform the Task proceed as follows:

NOTE: It is assumed that HSCB is still removed and the LV VEAM Connector is still unplugged.

a. Manually check that the Lever (1) moves freely.
b. Check the set point of the Maximum Current Release (Id): the Indicator (2) should be on the required value **(1,700 A)** and the Screw (3) tightened.(refer to next Step 7 for Tripping Current Value Adjustment).
c. Check that the bolts of the Main Connections (4) are tightened to a torque is **35 Nm.**
d. Lightly grease the Slot of the Guide (5) and the Fork (6) using recommended Grease.

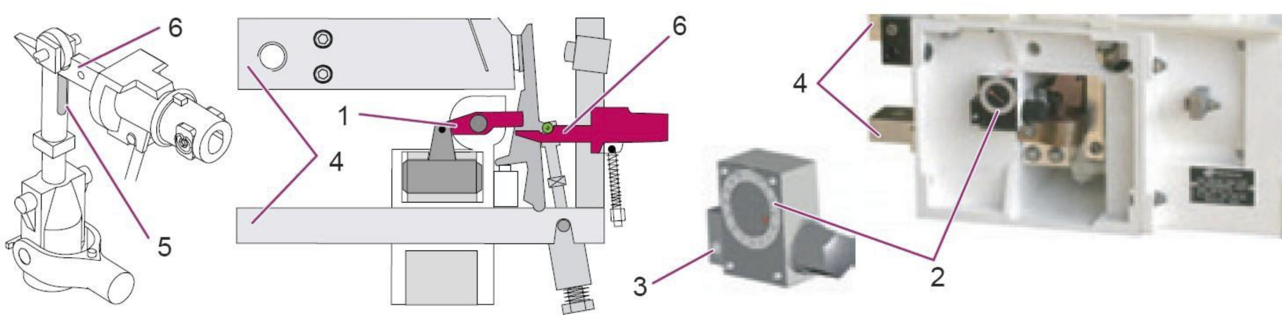


Figure 8 - HSCB - MECHANICAL COMPONENTS LUBRICATION

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-09-02-01-00/I-01**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **12/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

6 HSCB CLOSING DEVICE "X" CLEARANCE CHECKING (Refer to Fig 9)

The **X** Clearance is the distance between the Fork (1) and the Roller (2).
Requirement: X = 0,7± 0,3 mm
To Check the **"X"** Clearance proceed as follows.

a. Introduce the Sécheron Depth Gauge W-6 (8) into the Cover (3).
b. Make two measures of the distance between the Cover (3) and the Tool (8) by means of the Depth Gauge W-6 (8):
c. Measure **X1** without moving the core assembly.
d. Completely push (7) the core assembly in order to close the **X** clearance and measure **X2**.
e. Determinate the **"X"** clearance as the difference between X2 and X1 (X2 - X1).
f. Adjust the **"X"** clearance by adding or removing the setting washers (10).

CAUTION : NEVER TIGHTEN OR UNTIGHTEN THE MOVING CORE SCREW (4)

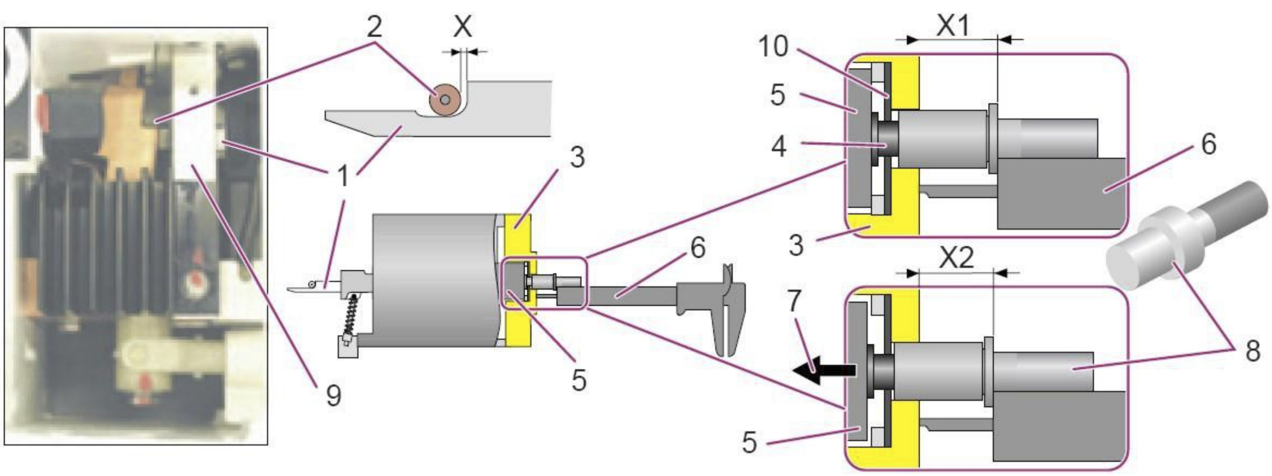


Figure 9 - HSCB - CLOSING DEVICE -CHECK OF "X" CLEARANCE

P2550 PREVENTIVE MAINTENANCE SHEET

	Card Code: **R-P-09-02-01-00/I-01**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **13/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**
Component:	Man Hours: **0.7**
Maintenance Task: **INSPECTION**	Interval/Miles: **60,000**

PROCEDURE (CONT'D):

7 HSCB TRIPPING CURRENT DEVICE ADJUSTMENT (refer to Fig 10)

a. Verify that the Red Arrow of the Tripping Indicator Knob coincides with the number **7,2** on the Circular Graduated Plate, corresponding to a Tripping Current Value of about **1,700 A**.

b. If not, proceed the as follows:
   1. Locate the Tripping Current Regulation Device
   2. Remove the existing sealing lacquer on the regulation device taking care that any eventual residual will not remain inside the HSCB.
   3. Rotate the Knob until the Movable Reference Mark (red arrow) of the Tripping Indicator coincides with the number **7,2** on the Circular Graduated Plate, corresponding to a Tripping Current Value of about **1,700 A**.
   4. Apply the sealing lacquer (type F-900, manuf. Organic Products Co., Irving - TX) on the Knob.
   5. Install the HSCB cover and tighten the screws to **15 Nm.**

8 FINAL OPERATIONS

a. Reinstall the Fire Box Upper Shell onto its position.
b. Torque the relevant Upper Shell Screws to **12.5 ft-lb**.
c. Reconnect LV VEAM Connector to HSCB.
d. Remove all Tools /Rags that were used, from the Vehicle Roof.
e. Leave the Vehicle Roof according to MTA procedures.
f. Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.
g. Restore Electrical Power to the Vehicle.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

Refer to **HOW TO USE THE R-PM SHEETS**(para 09-III-03-03-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 PREVENTIVE MAINTENANCE SHEET

Card Code:			
R-P-09-02-01-00/I-01			
System: **HIGH VOLTAGE POWER DISTRIBUTION**			Sheet: **14/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB (HIGH SPEED CIRCUIT BREAKER)**		
Component:			Man Hours: **0.7**
Maintenance Task: **INSPECTION**		Interval/Miles: **60,000**	

PROCEDURE (CONT'D):

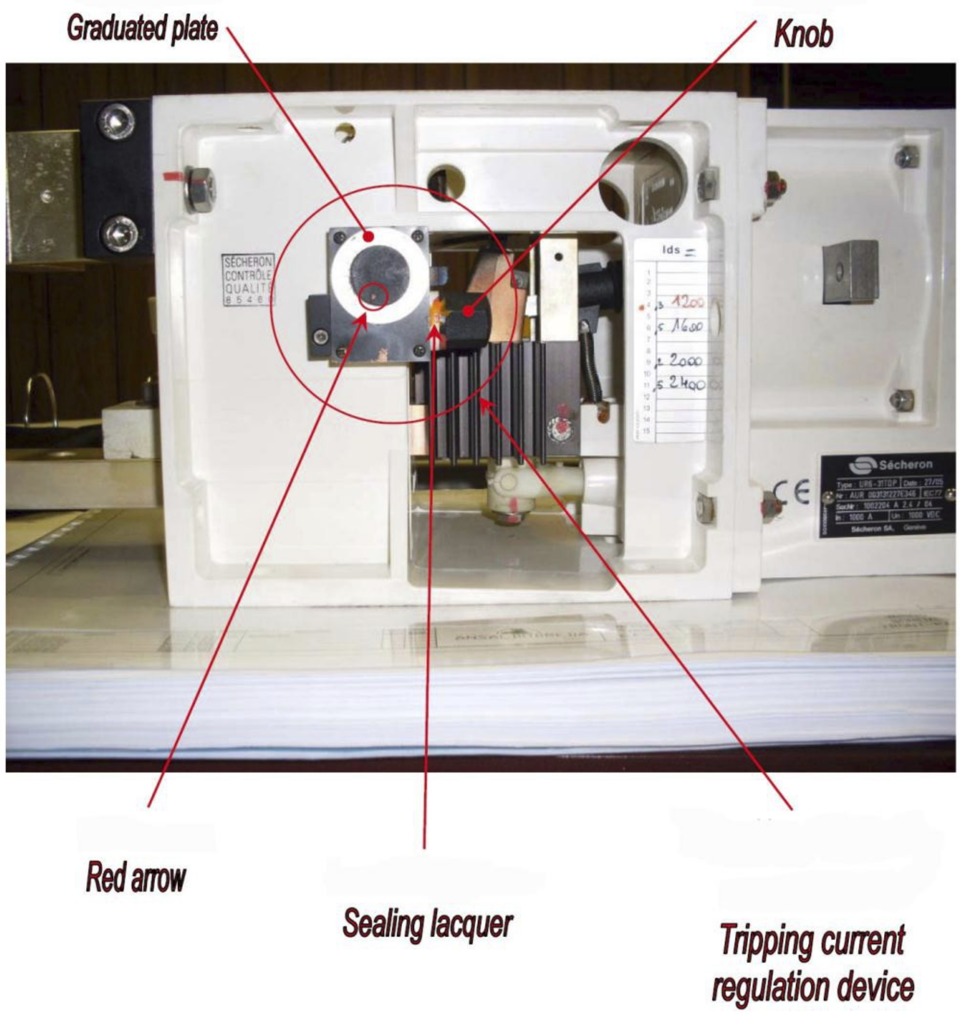


FIGURE 10 -HSCB TRIPPING DEVICE ADJUSTMENT

09-III-04 RUNNING -CORRECTIVE MAINTENANCE

09-III-04.01 Running -Corrective Maintenance Sheets (R-CMS)

Each R-CMS provides the following data consistent with Corrective Maintenance Analysis (CMA), AB Design Documentation and Vehicle Systems Functional Tree:

- R-CM Sheet Code
- SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT, Component (Names)
- SYSTEM, SUBSYSTEM /ASSEMBLY, UNIT, Component (Location)
- Maintenance Task

The following definitions are applicable to the R-CM Tasks

Inspection:	Maintenance procedures such as those required to ascertain the serviceability of a Part, Assembly, System or the specific interrelationship of Parts that perform a functional operation.
Leveling:	Procedure to adjust the distance between the Vehicle Floor to the Top Of Rail and the designated Vehicle Height.
Replacement:	Provides the Components / Assemblies and Subassemblies removal & installation in a logical sequential order.
Re-Profiling:	Provides the procedure to maintain the safe and proper "wheel Profile."
Repair:	Provides detailed procedures for the repair of a specific Equipment / Component .
Service:	Operation performed to replenish Sand, Windshield Wiper Washer Fluid, HVAC Coolant, Gear and Compressor Oil, and Vehicle Lubrication.

- **Man Hours,** needed to perform the Task
- **SPARE PARTS,** needed to perform the Task

Each R-CMS also provides:

- **SAFETY PRECAUTIONS,** to be followed to safely accomplish the Task
- **TOOLS,** including Special Tools and Test Equipment, needed to accomplish the Task
- **CONSUMABLES,** required to accomplish the Task and consistent with those used by MTA
- **PROCEDURE,** consisting of Preliminary Operations and Procedural Steps, to be followed while performing Maintenance Tasks
- **Illustrations and Pictures** are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure

Each R-CM Sheet refers to one Task and consists of several pages where Safety Precautions and Maintenance Instructions to perform safely the Task are provided by Procedural Steps in conjunction with Illustrations and Pictures.

09-III-04.01.01 Running- Corrective Maintenance Sheet (R-CMS) Form

The R-CMS Form (refer to Figure 09-III-04.1) consists of several fields containing the following data/ information:

RUNNING -CORRECTIVE MAINTENANCE SHEET (R-CMS) Form			
ITEM #	**TITLE**	**CONTENT**	**EXPLANATORY NOTES**
1	**Card code**	**Sheet code**	The Sheet Code is an alphanumerical code that identifies each R-CM Sheet. **THE SHEET CODE IS EXPLICIT** The Sheet Code consists of letters **R-C** followed by an 11 digit code number as follows: **R-C-**nn-mm-zz-ww/Y-kk **R = Running** **C= Corrective** **nn** may vary from 02 to 19, identifying the System/ Manual Section number. **mm-zz-ww** each one may vary from 00 to 99, according to AB System Functional Tree, allowing the identification of the Assembly/Unit/Component **Y** Maintenance Task Code. It may be one of the following: **I** = **I**nspection **LL** =**L**eveling **R** = **R**eplacement **RP**= **R**e-**P**rofiling **RR** = **R**epair **S** = **S**ervice **SP** = **S**afety **P**recautions **kk** It may vary from 00 to 99. It is a progressive number allowing the explicit identification of R-CMS **NOTE:** The code R-C-nn-00-00-00-R-kk identifies a Typical Replacement Procedure The TypicalReplacement Procedure is provided for the following items: Board,Circuit Breaker, Diode, Indicator Lamp, Main Contactor,Switch & Relays.
2	**System**	**System name**	This field indicates the System to which the Assembly/Unit/Component belongs.
3	**Subsystem/ Assembly**	**Subsystem/ Assembly name**	This field indicates the Subsystem/Assembly to which the Unit/Component belongs.
4	**Unit**	**Unit name**	This field indicates the Unit to which the Component belongs.
5	**Component**	**Component name**	This field indicates the Component the Maintenance Task is referring to
6	**Maintenance Task**	**Maintenance Task name**	This field indicates the Maintenance Task to be performed.
7	**Man Hours**	**Number**	The Man Hour field indicates the time needed to perform the corresponding Maintenance Task. with the basic assumption that the Vehicle is staged on an Inspection Pit/Jacking tracks with the required Consumables, Tools and Materials available.

RUNNING -CORRECTIVE MAINTENANCE SHEET (R-CMS) Form (cont'd)

ITEM #	TITLE	CONTENT	EXPLANATORY NOTES
8	Sheet	Pages numbering	This field indicates the progressive R-CMS sheet page number.
9	LOCATION	Illustration	This field indicates the On Board Location of the Equipment to be maintained The following Graphic Symbols are used for: Assembly/Unit/Component for System/Subsystem/Vehicle as a Whole
10	R	Letter	This field indicates that the Sheet pertains to Running Maintenance.
11	C	Letter	This field indicates that the Sheet pertains to Corrective Maintenance.
12	nn	Number	This field indicates the System/Manual Section number to which the Sheet pertains. It may vary from 01 to 19.
13	rr	Number	This field indicates the Sheet Revision number.
14	Page ##	Page ##	This field indicates the RMSM Section Page number.
15	-#	Number	This field indicates the RMSM Section Revision number.
16	SAFETY PRECAUTIONS	Text	This field presents the General and/or specific Safety Precautions to be followed to safely accomplish the relevant Maintenance Tasks.
17	TOOLS	Text	This field lists the description and the P/N of the Standard tools, Special Tools and Test Equipment needed to accomplish the Maintenance Task. Refer to the TTE Manual for the TE and Special Tools detailed descriptions and tools maintenance.
18	CONSUMABLES	Text	This field lists the Consumables Materials (consistent with those used by MTA with the related P/N.) needed to accomplish the Maintenance Task. Cleaning agents are included.
19	SPARE PARTS	Text	This field lists the Description and PN of Spare Parts (consistent with Illustrated Parts Catalog) needed to accomplish the Maintenance Task.
20	PROCEDURE	Text	The Procedure field provides Preliminary Operations and Procedural step by step Instructions to be followed while performing the Maintenance Task. Illustrations and Pictures are inserted in the text to facilitate the understanding of the topics and/or to explain step-by-step procedure.

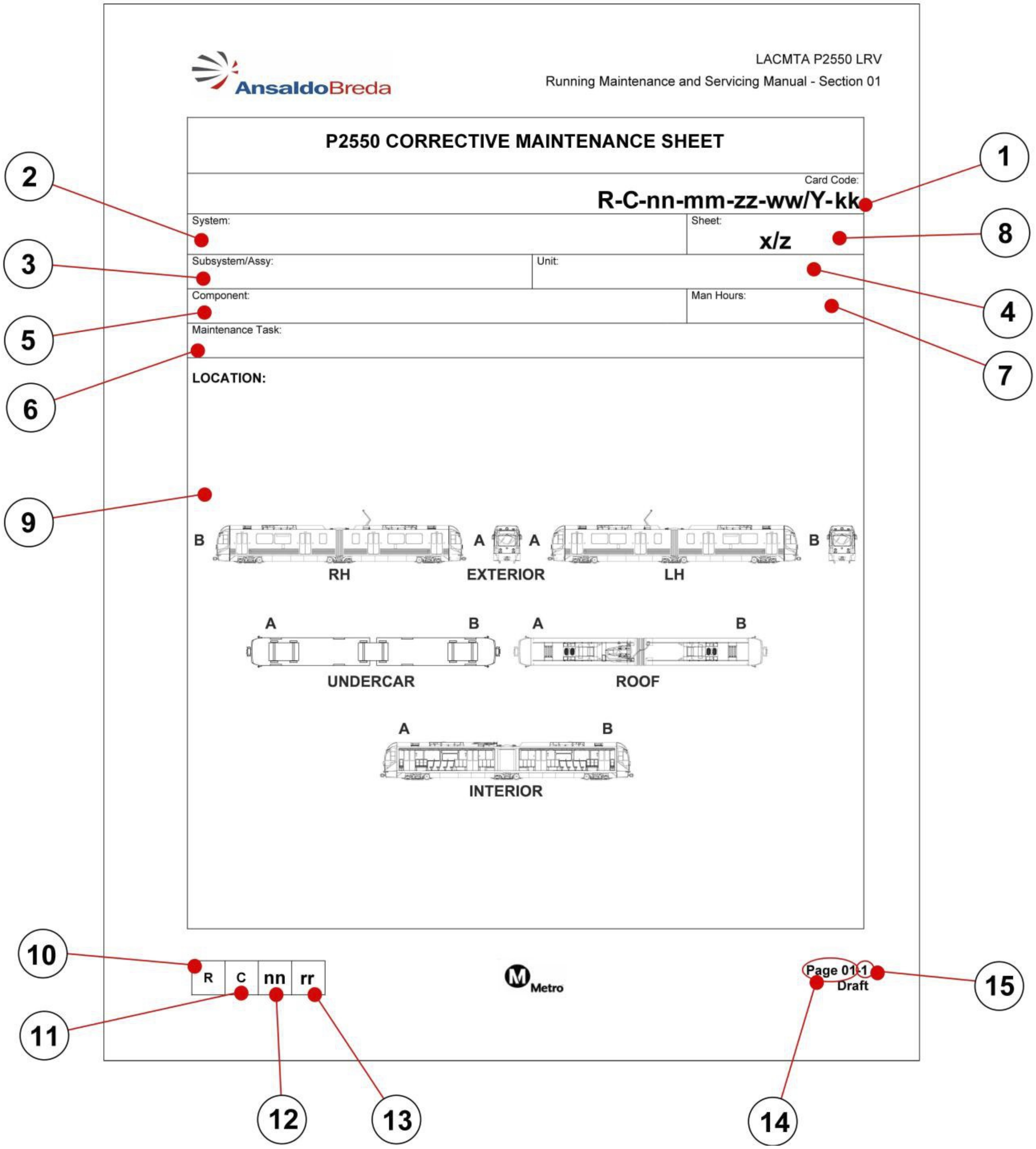
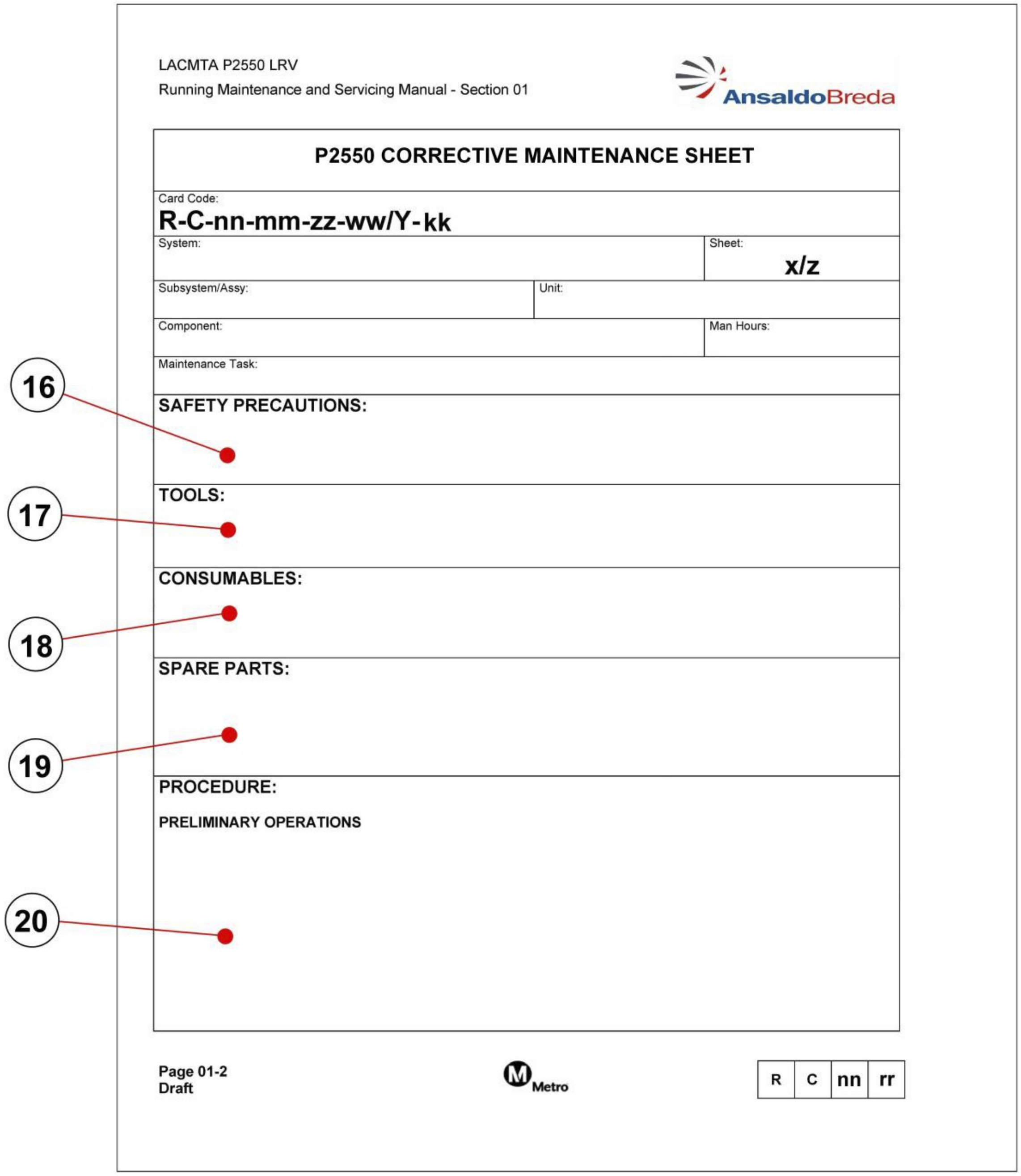


Figure 09-III-04.1 R-CMS Form
(Sheet 1 of 2)


LACMTA P2550 LRV
Running Maintenance and Servicing Manual - Section 01

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-nn-mm-zz-ww/Y-kk

System:	Sheet: x/z
Subsystem/Assy:	Unit:
Component:	Man Hours:
Maintenance Task:	

SAFETY PRECAUTIONS:

TOOLS:

CONSUMABLES:

SPARE PARTS:

PROCEDURE:

PRELIMINARY OPERATIONS

Page 01-2
Draft

Metro

R	C	nn	rr

Figure 09-III-04.1 R-CMS Form
(Sheet 2 of 2)

09-III-04.01.02 How to Use the R-CM Sheets

To optimize the job organization it is suggested to proceed as follows:

1. Before Task Execution

a) Carefully read the sheets to ensure that you fully understand all safety precautions, preliminary conditions required, warnings, notes & procedures that will be followed

b) Particularly read

- The Safety Precautions to perform safely the Task
- The Preliminary Operations to set the Vehicle in safety conditions according to MTA Maintenance Shop Regulations
- The Tools, Consumables and Spare Parts listed in each Sheet that are needed to accomplish the Task and to have all of them available next the location of the Equipment to be maintained before starting the activities.

2. During Task Execution

a) Follow accurately the prescribed Safety Precautions and Maintenance Procedural Steps

b) Note any Areas/Items of the Assembly/Unit/Component under Corrective Maintenance Process requiring further Corrective Maintenance

c) Gather as much information about the Equipment as is practical

(i e knowledge about the malfunction in terms of correctly operating and incorrectly operating equipment processes) to increase your equipment knowledge.

3. At every Task Completion

a) Carefully follow the prescribed Safety Precautions before restoring the Electrical Power to Vehicle.

b) Check the correct operation and/or functions of the Subsystem to which the maintained Equipment pertains.

c) It is suggested to perform this check on the IDU "A "as follows:

NOTE: Through the IDU you can check if all Systems are exchanging data by MVB or LonWorks Bus and the Trainlines Status.
The IDU Display also shows in real time the Status of all Vehicle Systems.
Reading the IDU Fault List it is possible to immediately detect a fault
Using the IDU in the Operating Mode the Fault Indications are generic,
Using the IDU in Maintenance Mode the same Fault has a detailed description.

For more in depth troubleshooting use the PTU connected to the relevant system that requires further troubleshooting.

1. On IDU "A" access to the Maintenance Menu first and then to the "Faults" Screen by selecting, in sequence, the relevant icons
2. Check, On IDU "A" through the list of the Current Active Faults shown in the "Faults" Screen, for Fault Codes related to the Subsystem to which the maintained Equipment pertains.

   Refer to Section 18 of RMSM for Fault Signals Details
3. As per "Fault" Codes check results proceed as follows:

- **No Faults are listed in the "Faults" Screen**

a) Key OFF the Vehicle

b) Record Service and Test results on the Defect Report Card for administrative and maintenance planning.

- **Fault Codes are listed in the "Faults" Screen**

a) Investigate/troubleshoot the Equipment previously maintained first and then the System/Subsystem/Assembly/Unit for Fault Probable Causes

b) Gather as much information about the failure symptoms as is practical. Refer to Section 18 of RMSM for Fault Signals Details

c) Try to identify the malfunction in terms of correctly operating and incorrectly operating equipment processes.

d) Identify which equipment signals or parameters will best help you to localize the failure.

e) Identify the source of the problem.

f) Repair or replace the defective component.

g) Verify that the repair is effective in eliminating all of the failure symptoms.

h) Evaluate whether or not the defective component was the root cause of the failure.

i) Once the Fault Codes are not found in the "Faults" Screen perform steps from 3-a through 3-b (previous subparagraph **"No Faults are listed in the "Faults" Screen)**

09-III-04.01.03 Running- Corrective Maintenance Sheet (R-CMS) List

The HVDS Running- Corrective Maintenance Sheets (R-CMS) List is provided in the following Table 09-III-04.1

The R-CM Sheets are listed by Subsystem / Assembly / Unit / Component and sequenced by Sheet Codes and Tasks to be performed

Table 09-III-04.1 Running Corrective Maintenance Sheets List

SYSTEM 09 HIGH VOLTAGE DISTRIBUTION				
SUBSYSTEM / ASSY	**UNIT**	**COMPONENT**	**TASK**	**SHEET CODE**
HIGH SPEED CIRCUIT BREAKER & CIRCUITS		CIRCUIT BREAKER TYPE S280	REPLACEMENT (TYPICAL)	R-C-09-00-00-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS		RELAY	REPLACEMENT (TYPICAL)	R-C-09-00-00-00/R-01
HIGH SPEED CIRCUIT BREAKER & CIRCUITS		DIODE	REPLACEMENT (TYPICAL)	R-C-09-00-00-00/R-02
LINE VOLTAGE AND CURRENT PROTECTION	EMI DETECTOR	BOARD	REPLACEMENT (TYPICAL)	R-C-09-00-00-00/R-03
LINE VOLTAGE AND CURRENT PROTECTION	LIGHTNING ARRESTER (01F01)		REPLACEMENT	R-C-09-01-01-00/R-00
LINE VOLTAGE AND CURRENT PROTECTION	KNIFE SWITCH		REPLACEMENT	R-C-09-01-02-00/R-00
LINE VOLTAGE AND CURRENT PROTECTION	EMI DETECTOR SYSTEM	HARMONIC CURRENT TRANSDUCER (HCT)	REPLACEMENT	R-C-09-01-03-01/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB		REPLACEMENT	R-C-09-02-01-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB	MAIN CONTACT	REPLACEMENT	R-C-09-02-02-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB	CLOSING DEVICE	REPLACEMENT	R-C-09-02-03-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB	TRIPPING DEVICE	REPLACEMENT	R-C-09-02-04-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB	MOVING CONTACT	REPLACEMENT	R-C-09-02-05-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB	LIMIT SWITCH	REPLACEMENT	R-C-09-02-06-00/R-00
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	HSCB	ARC CHUTE	REPLACEMENT	R-C-09-02-07-00/R-00

09-III-04.01.04 Running- Corrective Maintenance Sheets (R-CMS)

HIGH VOLTAGE DISTRIBUTION SYSTEM

Running - Corrective Maintenance Sheets

R-CMS

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P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-00

System:
HIGH VOLTAGE POWER DISTRIBUTION

Sheet:
1/8

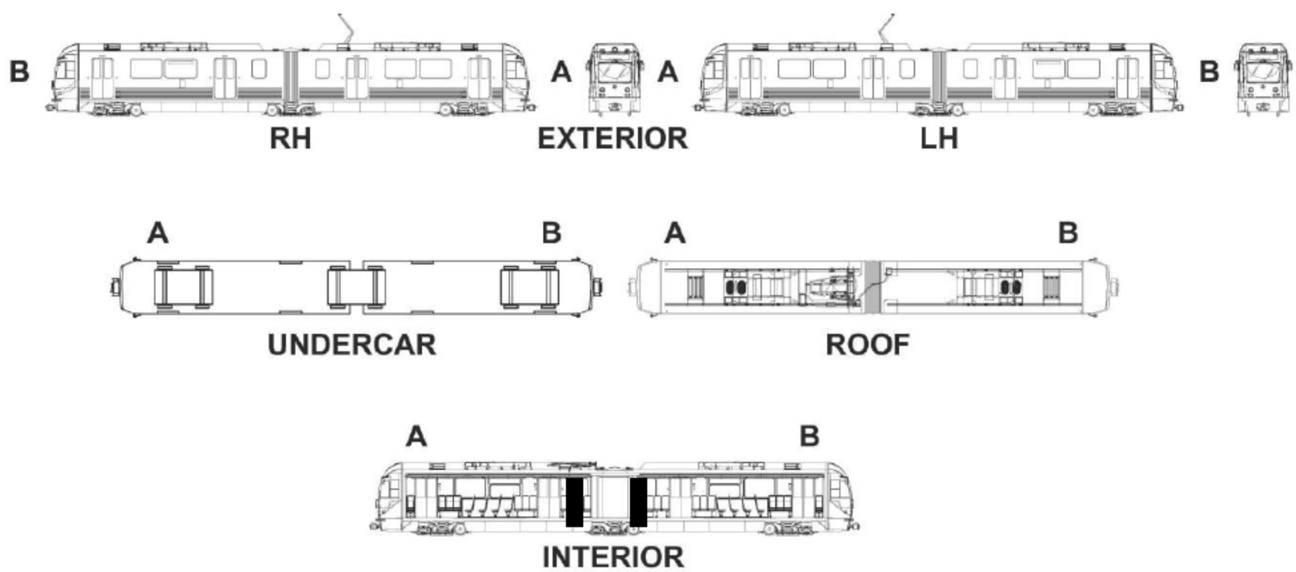
Subsystem/Assy:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS

Unit:

Component:
CIRCUIT BREAKER TYPE S280

Man Hours:
0.5

Maintenance Task:
REPLACEMENT (TYPICAL)



This Replacement procedure is applicable to the following Equipment:

LABEL	DESCRIPTION	TYPE	P/N	CAR	LOCATION	FUNCTIONAL DIAGRAMS	
						SCHEMATICS	SHEET#
4F01	HSCB CONTROL C.B.	S281 C 6A	211EK22984B01	A - B	LV LOCKER	LV	45
4F02	1Q02 HOLD COIL SWITCH (HSCB)	S281 C 16A	211EK22984B04	A	LV LOCKER	LV	46

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-00-00-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety Rules & Regulations

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

CRC 2000 Contact Cleaner

SPARE PARTS:

4F01	HSCB CONTROL C.B.	TYPE S281 C 6A	PN:	211EK22984B01
4F02	1Q02 HOLD COIL SWITCH (HSCB)	TYPE S281 C 16A	PN:	211EK22984B04

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-00

System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle in the Maintenance Shop.
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).
4. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.
7. Lock out and tag out the Switch in accordance with all LACMTA Safety Rules, Regulations, Policies, and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**4/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **0.5**

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE:
(Refer to Figures 1 through 5)
REMOVAL

To perform the Task proceed as follows:

1. Gain access to the Circuit Breakers Rack installed in the “A “ & “ B “ LV Lockers, by opening the relevant LV Locker Door using the Maintenance Key.
2 Locate the Circuit Breaker to be replaced.

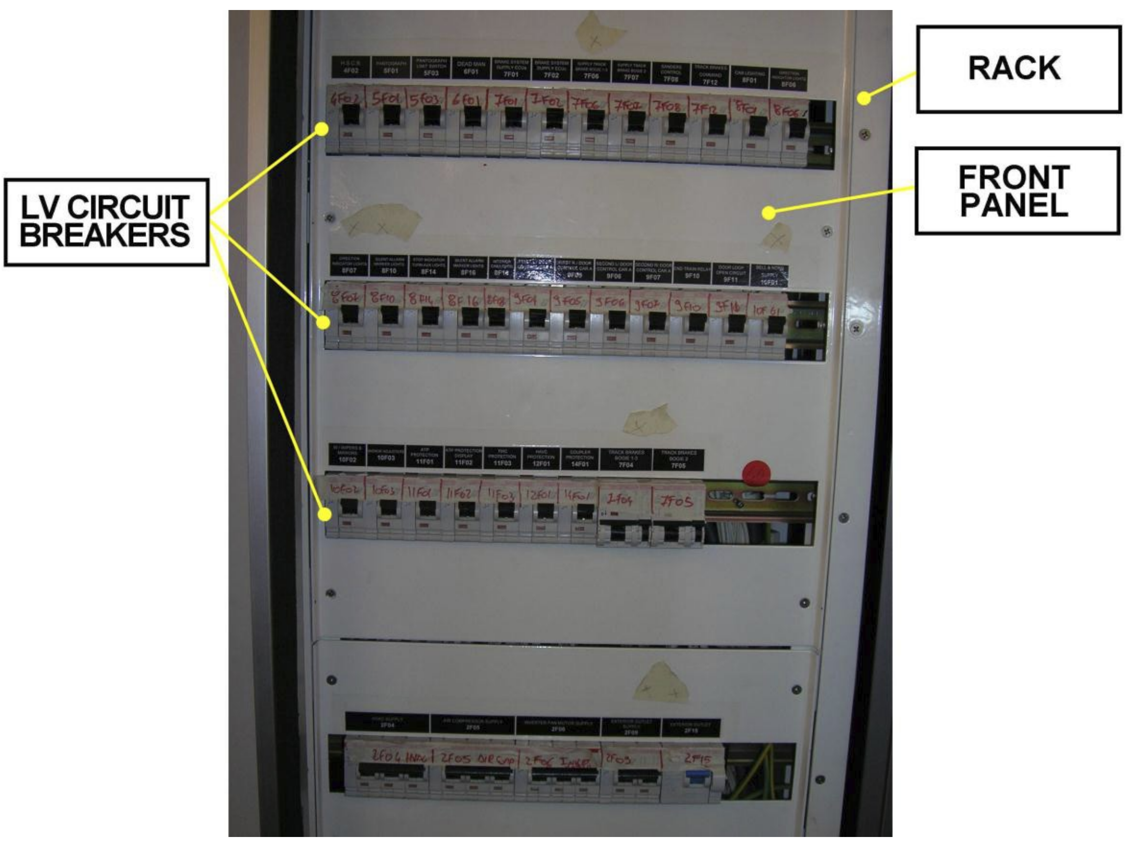


Figure 1 - LV LOCKER -CIRCUIT BREAKERS RACK

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	

Component:	Man Hours:
CIRCUIT BREAKER TYPE S280	**0.5**

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE:

3 Remove the Circuit Breakers Front Panel by loosening relevant Fixing Screws. Retain them for later use.

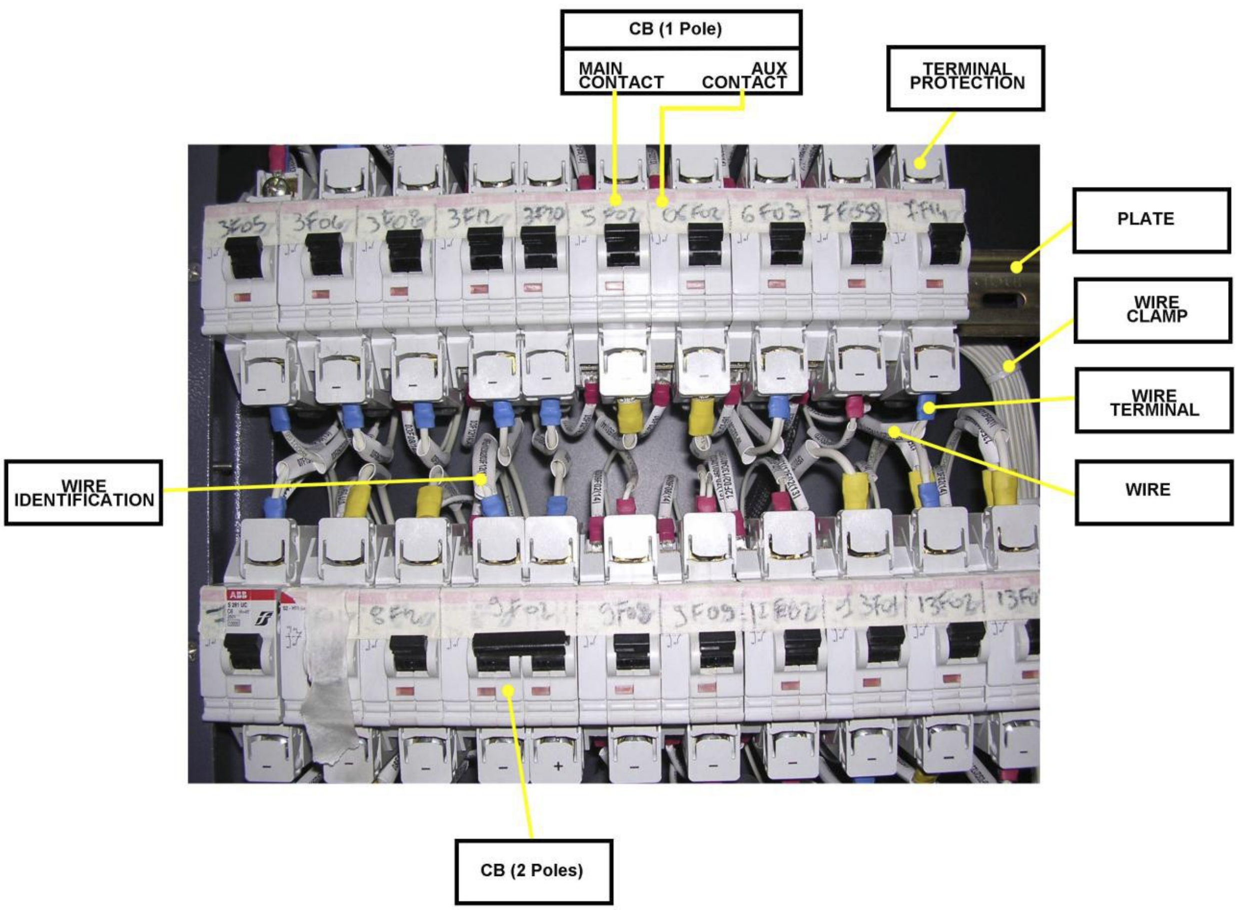


Figure 2 - LV LOCKER -CIRCUIT BREAKERS FRONT PANEL REMOVED

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-00

System:
HIGH VOLTAGE POWER DISTRIBUTION

Sheet:
6/8

Subsystem/Assy:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS

Unit:

Component:
CIRCUIT BREAKER TYPE S280

Man Hours:
0.5

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE:

4 Locate the Circuit Breaker to be replaced.

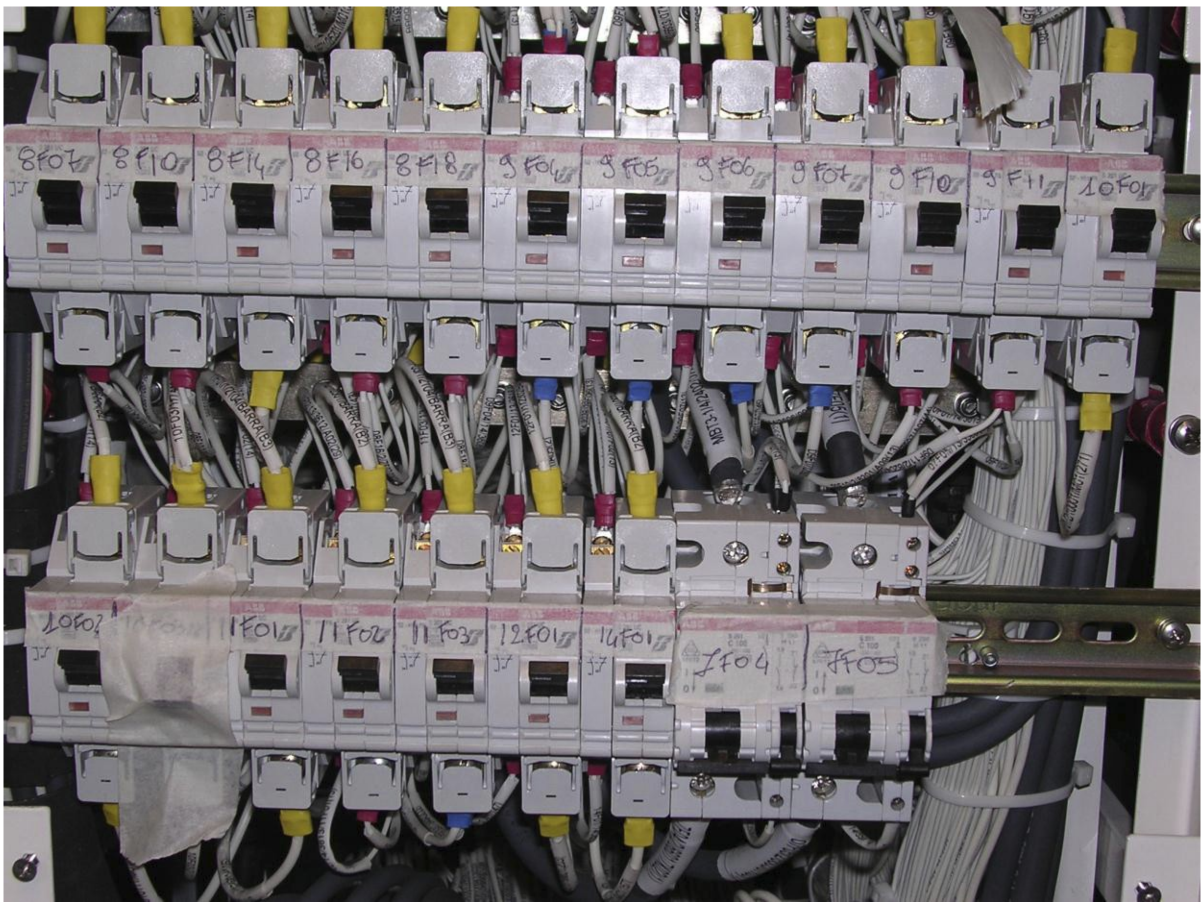


Figure 3 - LV LOCKER -CIRCUIT BREAKERS LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-09-00-00-00/R-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **7/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **CIRCUIT BREAKER TYPE S280**	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

5 Remove and discard the Circuit Breaker according to the instructions provided in the following figure 4.

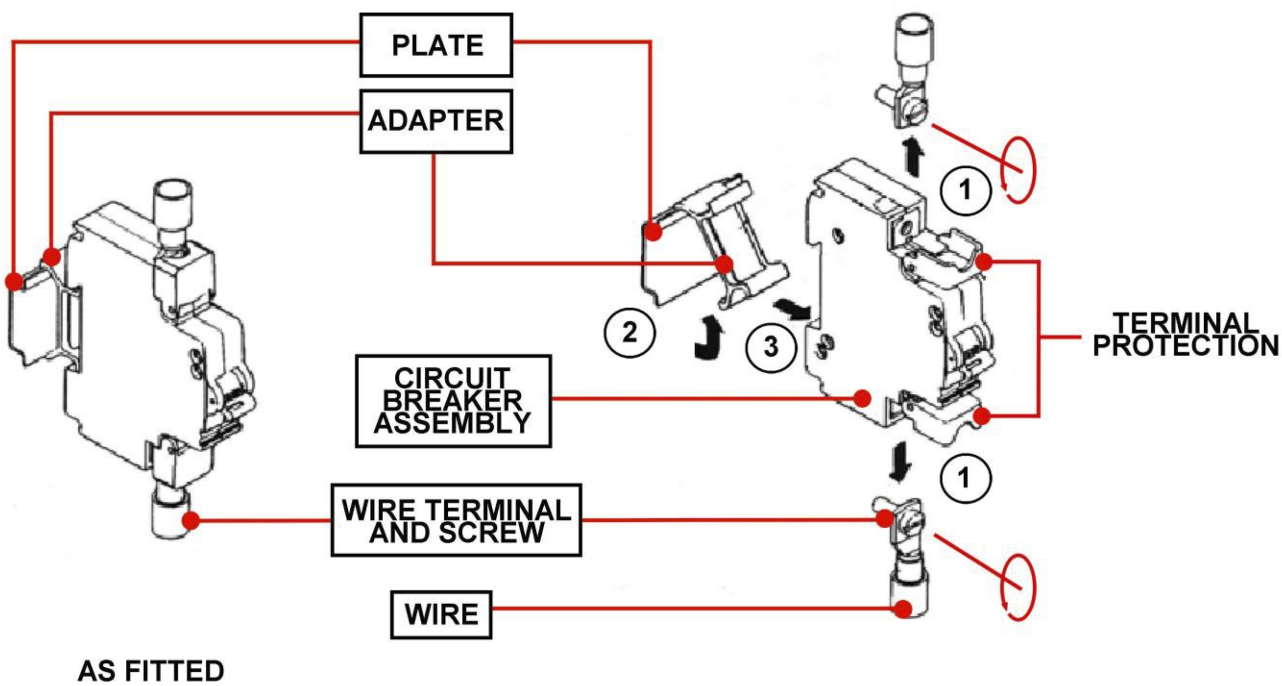


Figure 4 - LV LOCKER -CIRCUIT BREAKER REMOVAL

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-00-00-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **8/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:	
Component: **CIRCUIT BREAKER TYPE S280**		Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**		

PROCEDURE:

INSTALLATION

6 Install the Circuit Breaker according to the instructions provided in the following figure 5.

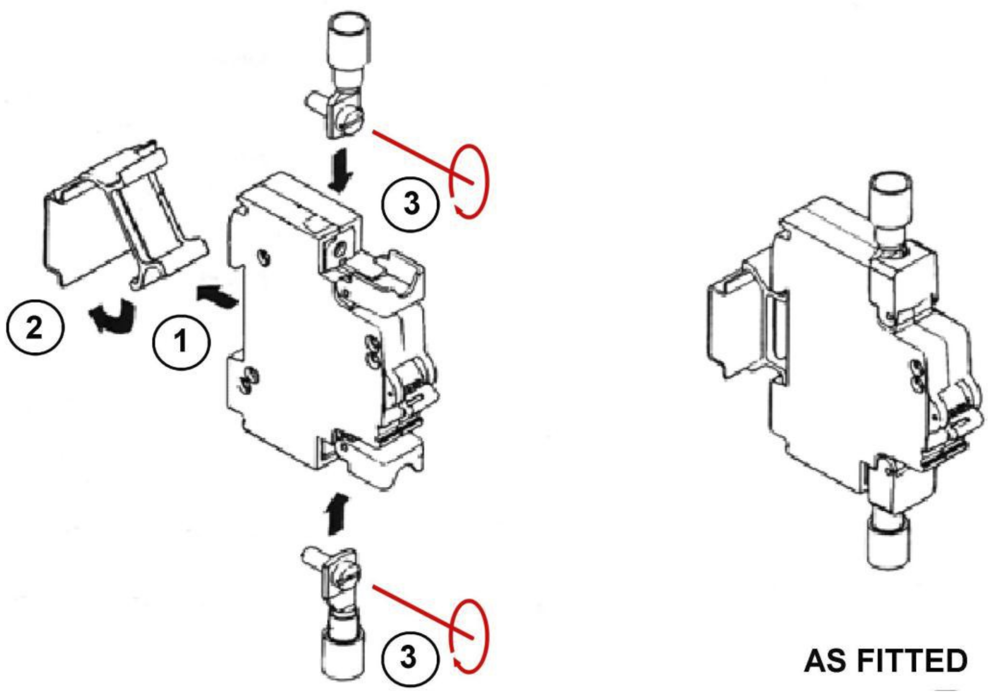


Figure 5 - LV LOCKER -CIRCUIT BREAKER INSTALLATION

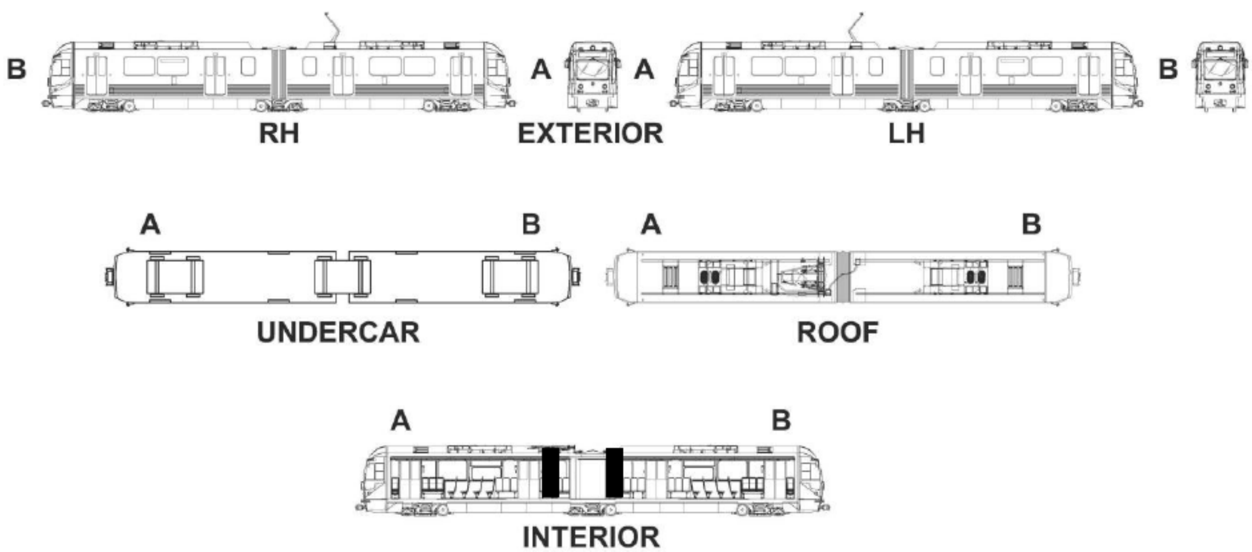
7 Install the Circuit Breakers Front Panel and secure it by installing and tightening the relevant Fixing Screws.
8 Close and secure the LV Locker Door using the Maintenance Key.
9 Restore Electrical Power.
10 Record Task Result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS**(para 09-III-04-01-02 of this Section)and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-00-00-00/R-01**

System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **RELAY**	Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**	



This(Typical)Replacement procedure is applicable to the following Equipment:

LABEL	DESCRIPTION	TYPE	P/N	CAR	LOCATION	FUNCTIONAL DIAGRAMS	
						SCHEMATICS	SHEET#
4K01	HSCB OPEN CONTROL RELAY	04-42	211VK01374B0801	A	LV LOCKER	LV	45
4K02	HSCB CLOSING RELAY	04-42	211VK01374B0801	A	LV LOCKER	LV	45
4K03	HSCB OPEN RELAY	04-42	211VK01374B0801	A	LV LOCKER	LV	45

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-01

System:
HIGH VOLTAGE POWER DISTRIBUTION

Sheet:
2/6

Subsystem/Assy:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS

Unit:

Component:
RELAY

Man Hours:
1

Maintenance Task:
REPLACEMENT (TYPICAL)

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety Rules & Regulations

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

NOALOX Electrical Contact Grease or equivalent used by MTA

CRC 2000 Contact Cleaner

SPARE PARTS:

4K01	HSCB OPEN CONTROL RELAY	TYPE: 04-42	PN:	211VK01374B0801
4K02	HSCB CLOSING RELAY	TYPE: 04-42	PN:	211VK01374B0801
4K03	HSCB OPEN RELAY	TYPE: 04-42	PN:	211VK01374B0801

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:

R-C-09-00-00-00/R-01

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**3/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	

Component:	Man Hours:
RELAY	**1**

Maintenance Task:

REPLACEMENT (TYPICAL)

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle in the Maintenance Shop.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock out and tag out the Switch in accordance with all LACMTA Safety Rules, Regulations, Policies, and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-00-00-00/R-01**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:	
Component: **RELAY**		Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**		

PROCEDURE:
To perform the Task proceed as follows:

REMOVAL
1. Gain access to the Relays Rack installed in the "A " & " B " LV Lockers, by opening the relevant LV Locker Door using the Maintenance Key.
2. Locate the Relay to be replaced.

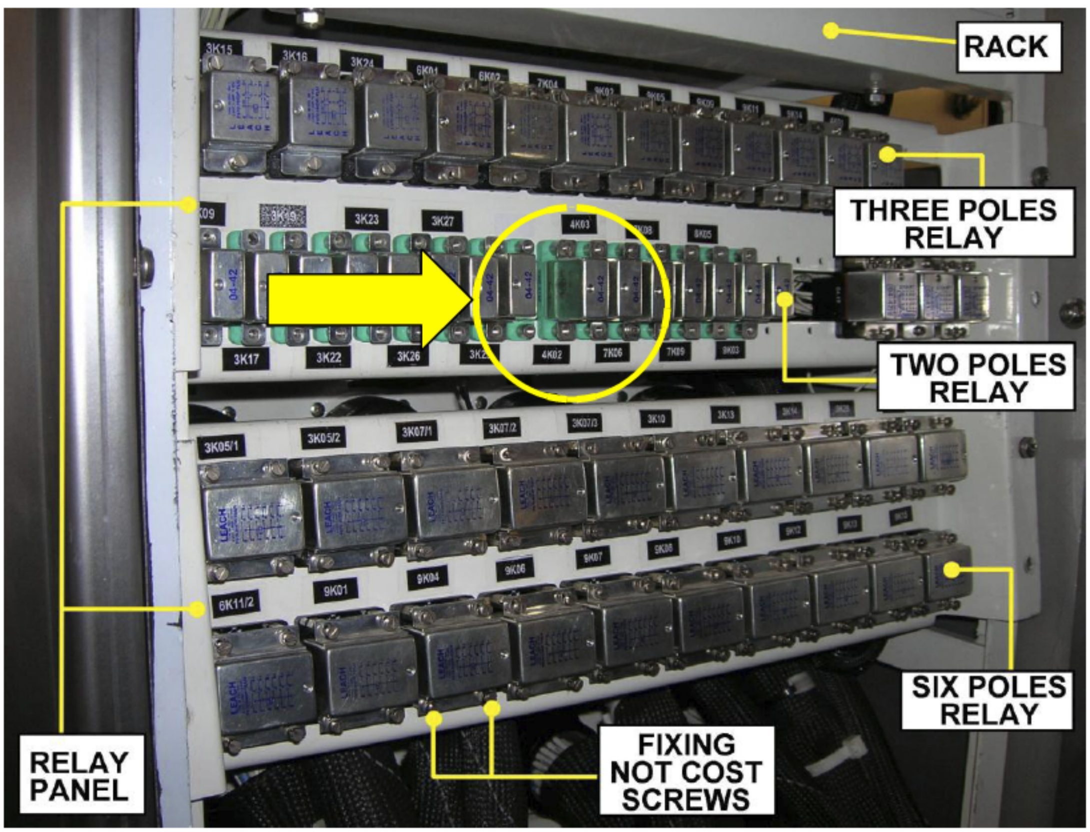


Figure 1 - LV LOCKER -RELAYS REPLACEMENT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-01

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	

Component:	Man Hours:
RELAY	**1**

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE:

REMOVAL(cont'd)

3. Loose and remove the Self Locking Nuts & Washers fixing the Relay to the Rack.
4. Retain them for later use.
5. Slide out the Relay in order to gain access to the relevant Wiring and Terminals connections.
6. Take note of Wiring Color Codes and relevant positions on Relay Terminals.
7. Disconnect the Wiring Cable from Relay Terminals.
8. Remove and discard the Relay.

INSTALLATION

1. Connect the Wiring to the Relay Terminals according to their position and Color Codes previously Noted.
2. Tighten as required.
3. Install the Relay in its position.
4. Install the Relay attaching Washers and Self Locking Nuts.Tighten as required.
5. Leave the LV Locker and close the LV locker Door using the Maintenance Key.
6. Restore Electrical Power.
7. Record Task results on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS**(para 09-III-04-01-02 of this Section)and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-00-00-00/R-01**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **6/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:	
Component: **RELAY**		Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**		

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P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-02

System:
HIGH VOLTAGE POWER DISTRIBUTION

Sheet:
1/6

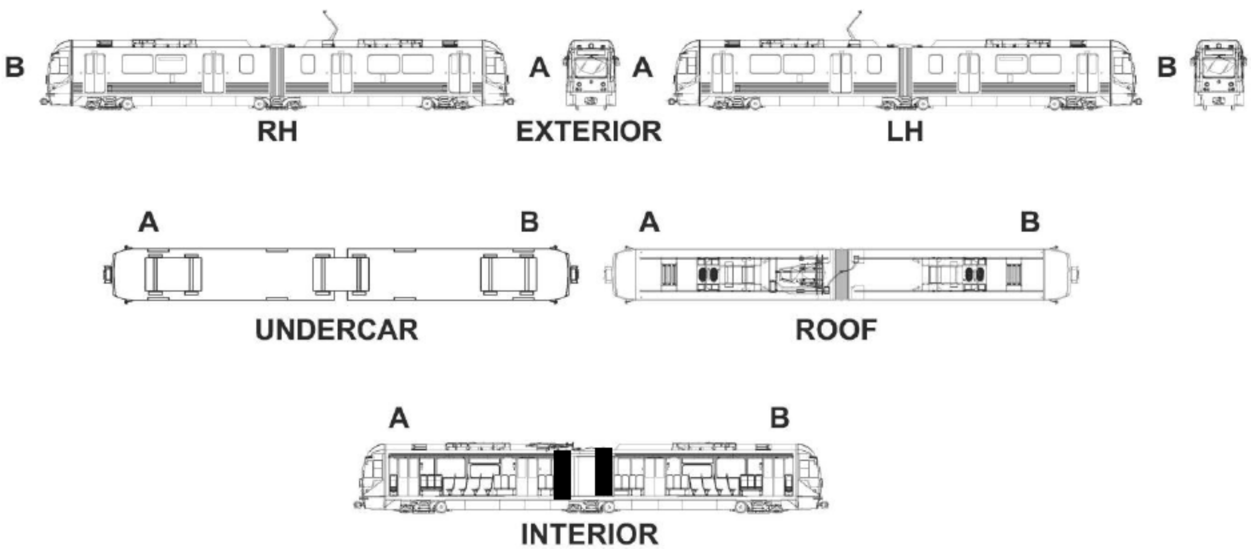
Subsystem/Assy:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS

Unit:

Component:
DIODE

Man Hours:
0.5

Maintenance Task:
REPLACEMENT (TYPICAL)



This Replacement procedure is applicable to the following Equipment:

LABEL	DESCRIPTION	TYPE	P/N	CAR	LOCATION	FUNCTIONAL DIAGRAMS	
						SCHEMATICS	SHEET#
4V01	HSCB CLOSING DIODE	DSEI 2X61 36 A	211VV01044B	A - B	LV LOCKER	LV	45
4V02	HSCB CLOSING DIODE	DSEI 2X61 36 A	211VV01044B	A - B	LV LOCKER	LV	45
4V03	HSCB CLOSING DIODE	DSEI 2X61 36 A	211VV01044B	A	LV LOCKER	LV	45

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-02

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**2/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	

Component:	Man Hours:
DIODE	**0.5**

Maintenance Task:
REPLACEMENT (TYPICAL)

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety Rules & Regulations

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

CRC 2000 Contact Cleaner

SPARE PARTS:

4V01	HSCB CLOSING DIODE	TYPE: COMMERCIAL	PN:	211VV01044B
4V02	HSCB CLOSING DIODE	TYPE: COMMERCIAL	PN:	211VV01044B
4V03	HSCB CLOSING DIODE	TYPE: COMMERCIAL	PN:	211VV01044B

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-02

System: HIGH VOLTAGE POWER DISTRIBUTION	Sheet: 3/6
Subsystem/Assy: HIGH SPEED CIRCUIT BREAKER & CIRCUITS	Unit:
Component: DIODE	Man Hours: 0.5
Maintenance Task: REPLACEMENT (TYPICAL)	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle in the Maintenance Shop.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock out and tag out the Switch in accordance with all LACMTA Safety Rules, Regulations, Policies, and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-00-00-00/R-02**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **4/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **DIODE**	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

To perform the Task proceed as follows:

REMOVAL(refer to figures 1 & 2)

1. Gain access to the Diodes Section on the side of the Rack installed in the "A " & " B " LV Lockers, by opening the relevant LV Locker Door using the Maintenance Key.
2. Locate the Diode to be replaced.

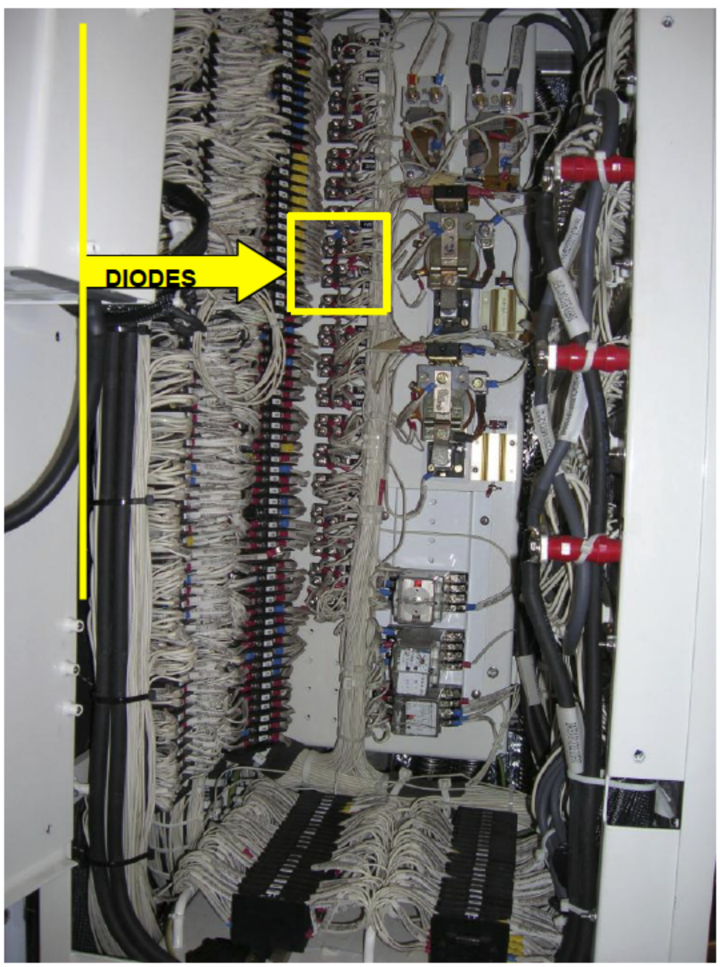


FIGURE 1 DIODES LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-02

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	

Component:	Man Hours:
DIODE	**0.5**

Maintenance Task:
REPLACEMENT (TYPICAL)

PROCEDURE:

3. Take note of Wiring Color Codes and relevant positions on Diode Terminals.
4. Disconnect the Wiring from Diode Terminals by loosening and removing the relevant Screws on 4 Diode Terminals.Retain them for later use.
5. Loose and remove the Diode Locking Screws & Washers.Retain them for later use.
6. Remove the Diode and discard it.

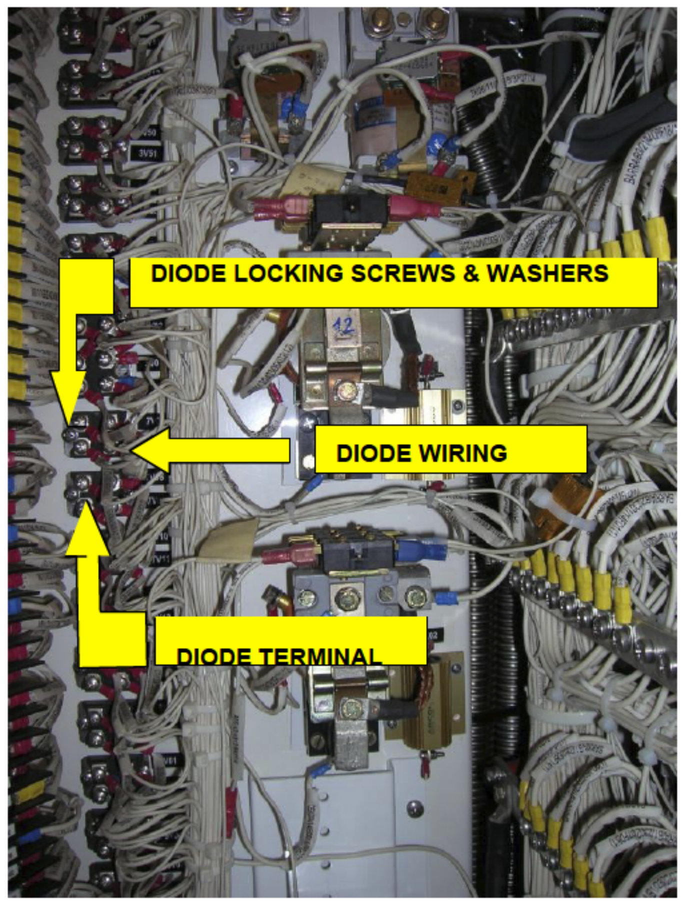


FIGURE 2 DIODE REPLACEMENT

INSTALLATION

1. Install the Diode in position.
2. Install Diode Locking Screws & Washers. Tighten as required.
3. Connect the Wiring to the Diode Terminals according to their position and Color Codes previously noted.Tighten as required.
4. Leave the LV Locker and close the LV locker Door using the Maintenance Key.
5. Restore Electrical Power.
6. Record Task resultson the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS**(para 09-III-04-01-02 of this Section)and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-09-00-00-00/R-02**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit:
Component: **DIODE**	Man Hours: **0.5**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

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P2550 CORRECTIVE MAINTENANCE SHEET

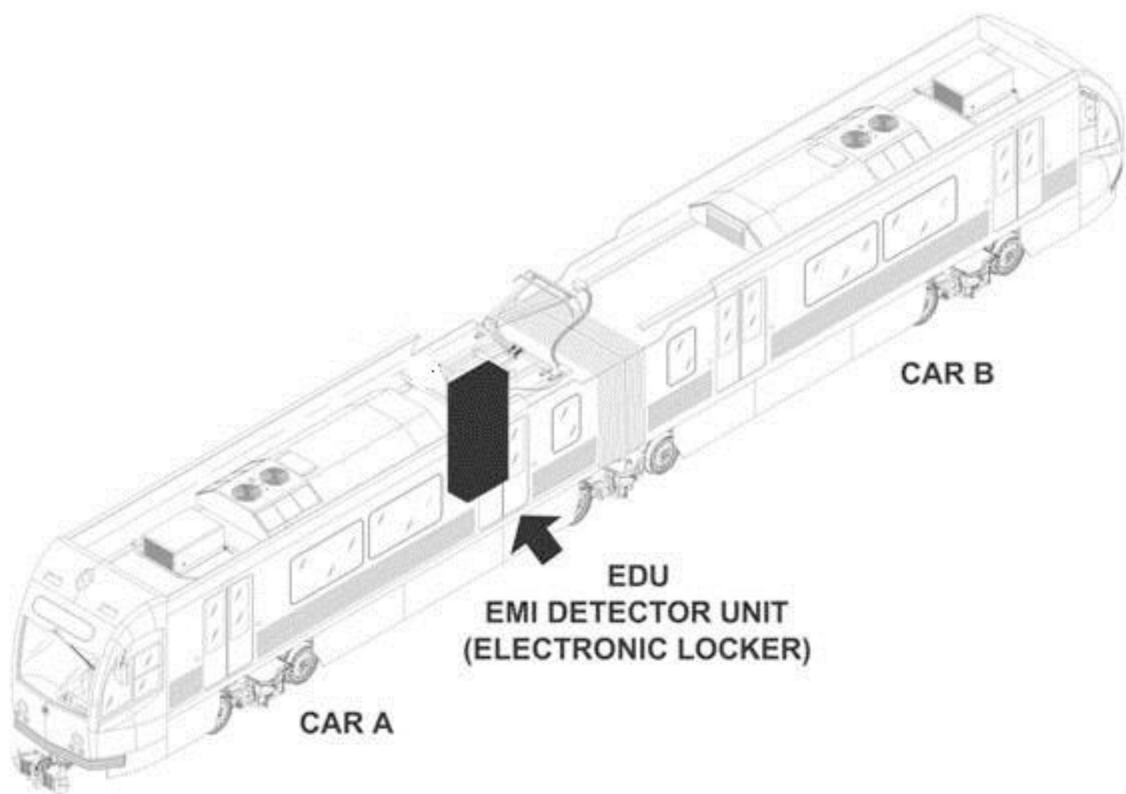
Card Code:
R-C-09-00-00-00/R-03

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**1/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**EMI DETECTOR**

Component:	Man Hours:
BOARD	**1**

Maintenance Task:
REPLACEMENT (TYPICAL)



This Replacement Procedure is applicable to the following Equipment:

LBA-01 E1 Board
EDI-01 Board
PCA-03 Board
POWER SUPPLY Board

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-00-00-00/R-03

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**2/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**EMI DETECTOR**

Component:	Man Hours:
BOARD	**1**

Maintenance Task:
REPLACEMENT (TYPICAL)

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety Rules & Regulations

CAUTION: A TECHNICIAN HANDLING ELECTRONIC ASSEMBLIES AND COMPONENTS SHOULD WEAR A CONDUCTIVE WRIST STRAP WITH A GROUND WIRE CONNECTED EITHER TO GROUND OR CHASSIS (VEHICLE) GROUND.

CAUTION: WHEN TRANSPORTING A PRINTED CIRCUIT BOARD OR COMPONENT, IT MUST BE PROTECTED FROM STATIC WHILE IN TRANSIT.

CAUTION: WHEN REMOVING THE PC BOARD FROM ITS RACK OR CRADLE, WEAR A WRIST STRAP WIRED TO THE VEHICLE OR GROUND.
NEVER TOUCH OR HANDLE THE PC BOARD BY ITS TRACES, CONNECTOR TEETH, OR COMPONENTS.
IMMEDIATELY PLACE THE PC BOARD INTO A CONDUCTIVE STATIC SHIELDING BAG.
CARRY THE PC BOARD TO A STATIC-FREE WORK STATION AND WEAR A GROUNDING STRAP WHEN REMOVING IT FROM THE STATIC BAG.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

CRC Industrial - Precision Cleaner M3 Part#147535

Dry Compressed Air for Electronic Equipment(commercial)

SPARE PARTS:

LBA-01 E1	Board
EDI-01	Board
PCA-03	Boards
POWER SUPPLY	Board

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-09-00-00-00/R-03**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR**
Component: **BOARD**	Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.

3. Set the Master Controller Handle to FSB position.

4. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

5. Remove Electrical Power from Vehicle by lowering the Pantograph.

6. Turn the Transfer Switch to OFF.

7. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

8. Lock out and tag out the Switch in accordance with all LACMTA Safety Rules, Regulations, Policies, and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-00-00-00/R-03**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **4/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR**
Component: **BOARD**	Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

To perform the Task proceed as follows (Refer to Figures 1 & 2):):

REMOVAL

1) Remove Electrical Power from EDU by switching off the 3F25 Circuit Breaker (LV Locker A Section).
2) Gain access to EDU by opening the relevant ELE Locker Door using the Maintenance Key.

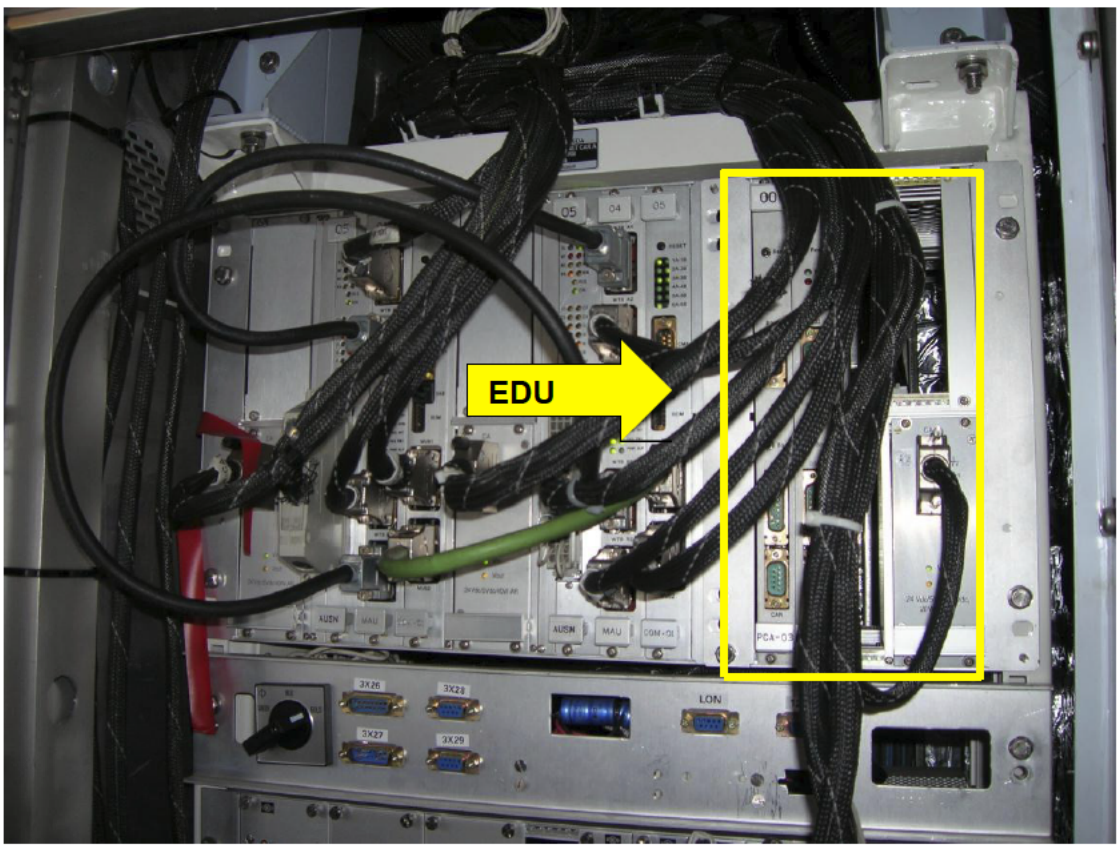


FIGURE 1 EDU LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET	
	Card Code: **R-C-09-00-00-00/R-03**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **5/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR**
Component: **BOARD**	Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

3) Locate the Board to be replaced.

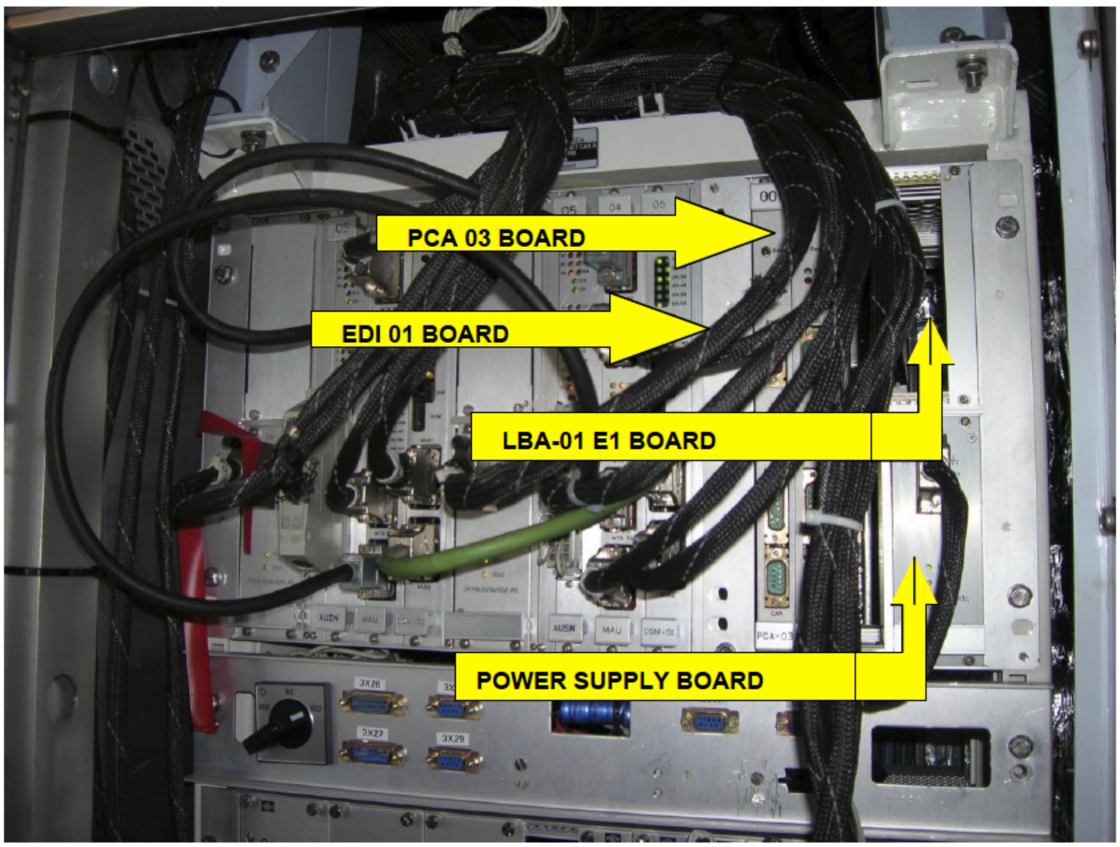


FIGURE 2 EDU - BOARDS LOCATION

4) Disconnect the Board Connectors using suitable screwdriver.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-00-00-00/R-03**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR**
Component: **BOARD**	Man Hours: **1**
Maintenance Task: **REPLACEMENT (TYPICAL)**	

PROCEDURE:

5) Loose the Board Fixing Screws. Retain them for later use.
6) Carefully pull the Board out from the EDU Rack and slide it out from the relevant guide.

CAUTION: A TECHNICIAN HANDLING ELECTRONIC ASSEMBLIES AND COMPONENTS SHOULD WEAR A CONDUCTIVE WRIST STRAP WITH A GROUND WIRE CONNECTED EITHER TO GROUND OR CHASSIS (VEHICLE) GROUND.

CAUTION: NEVER TOUCH OR HANDLE THE PC BOARD BY ITS TRACES, CONNECTOR TEETH, OR COMPONENTS.

INSTALLATION

To perform the Task proceed as follows (Refer to Figures 1 & 2):

NOTE: It is assumed that the Vehicle is in Safety Conditions in accordance with LACMTA Overhaul Regulations.

1) Check the Board receptacle for signs of overheating.
2) Slide the Board into its guide, assure proper alignment to the receptacle and push firmly to seat the Board into the receptacle.
3) Secure the Board by tightening the relevant fixing Screws.
4) Reconnect the Board Connectors.
5) Leave the ELE Locker.
6) Reinstate Electrical Power to EDU by switching ON the 3F25 Circuit Breaker (LV Locker A Section).
7) Ensure that all air circulating Fans are operating.
8) Close and lock LV Locker Door.
9) Close and lock ELE Locker Door.
10) Record Task results on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-01-00/R-00

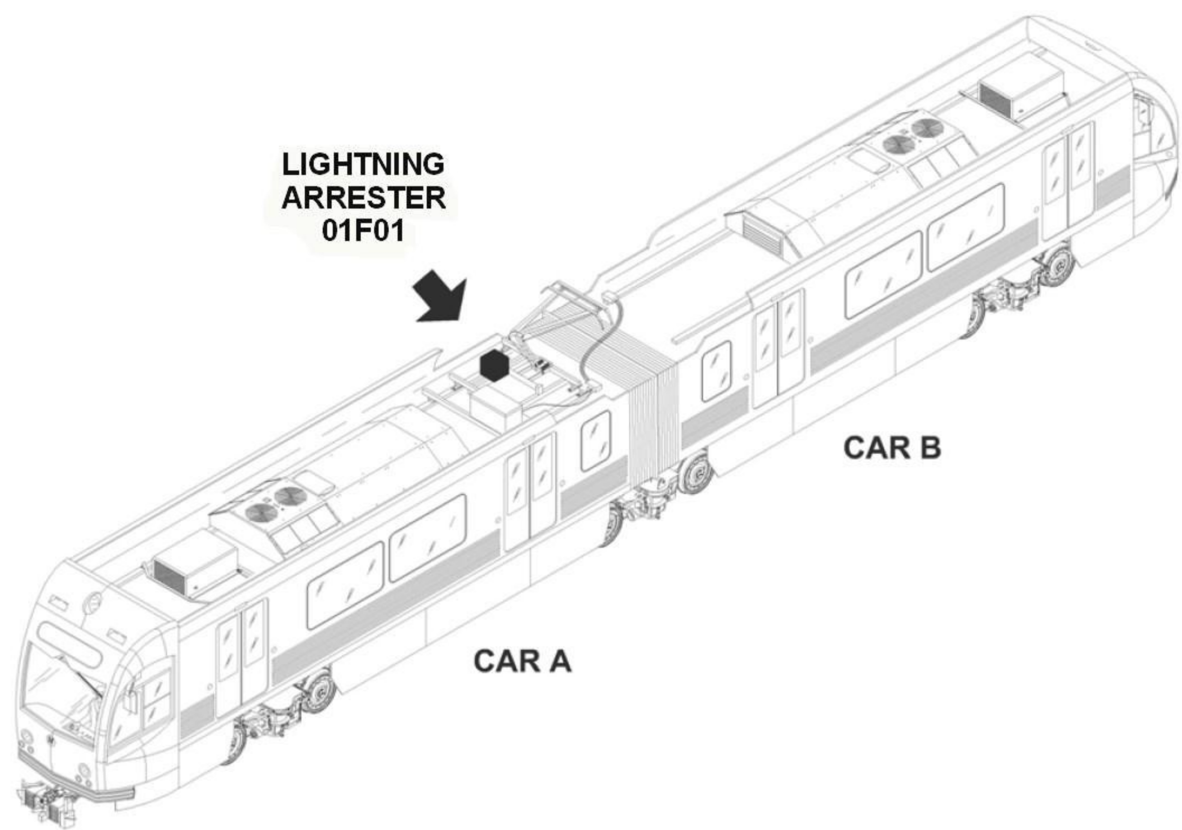
System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**1/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**LIGHTNING ARRESTER (01F01)**

Component:	Man Hours:
	1.25

Maintenance Task:
REPLACEMENT

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-01-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**2/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**LIGHTNING ARRESTER (01F01)**

Component:	Man Hours:
	1.25

Maintenance Task:
REPLACEMENT

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER.(750 V). ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES. DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.
External Scaffold

CONSUMABLES:

Denatured Alcohol,	as needed
Detergent / Water Solution	as needed
Neutral Liquid Soap diluted in Water	as needed

SPARE PARTS:

Lightning Arrester	P/N	AA02PUN

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-01-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**3/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**LIGHTNING ARRESTER (01F01)**

Component:	Man Hours:
	1.25

Maintenance Task:
REPLACEMENT

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

REMOVAL

To perform the Removal Procedure proceed as follows (Refer to Figure 1):

1. Access to Vehicle Roof "A" Car according to MTA procedures.

2. Disconnect the High Voltage Copper Wire from the Terminal of the Lightning Arrester.

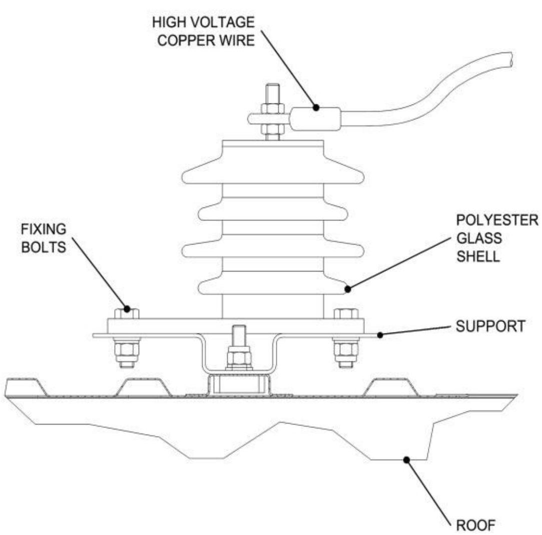
3. Disconnect the Grounding Strap from the Lightning Arrester.

4. Remove the fixing Screws **(19mm)**, Washers and Nuts.

5. Lift and Remove the Lightning Arrester from Support using suitable Lifting Device.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-01-01-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **LIGHTNING ARRESTER (01F01)**	
Component:		Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**		

PROCEDURE (CONT'D):



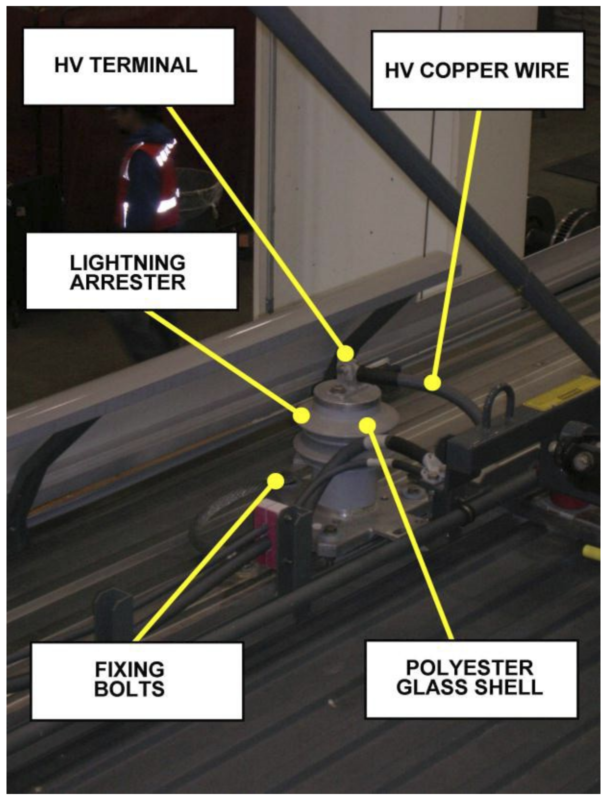


Figure 1 - LIGHTNING ARRESTER REPLACEMENT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-01-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**LIGHTNING ARRESTER (01F01)**

Component:	Man Hours:
	1.25

Maintenance Task:
REPLACEMENT

PROCEDURE:
INSTALLATION

To perform the Installation Procedure proceed as follows (Refer to Figure 1):

1. Access to Vehicle Roof "A" Car according to MTA procedures.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF. ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

2. Position the Lightning Arrester on Support using suitable Lifting Device.
3. Install the fixing Screws, Washers and Nuts.
4. Connect the Lightning Arrester Ground Strap.
5. Connect the High Voltage Copper Wire to Lightning Arrester.Terminal.
6. Clean accurately the Lightning Arrester Polyester Glass Shell with Denatured Alcohol or Neutral Liquid Soap diluted in Water. Dry accurately using a clean cloth.
7. Remove all Tools /Rags, that were used, from the Vehicle Roof.
8. Leave the Vehicle Roof according to MTA procedures.
9. Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.
10. Restore Electrical Power to the Vehicle.
11. Record Task results on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-01-01-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **6/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **LIGHTNING ARRESTER (01F01)**	
Component:		Man Hours: **1.25**
Maintenance Task: **REPLACEMENT**		

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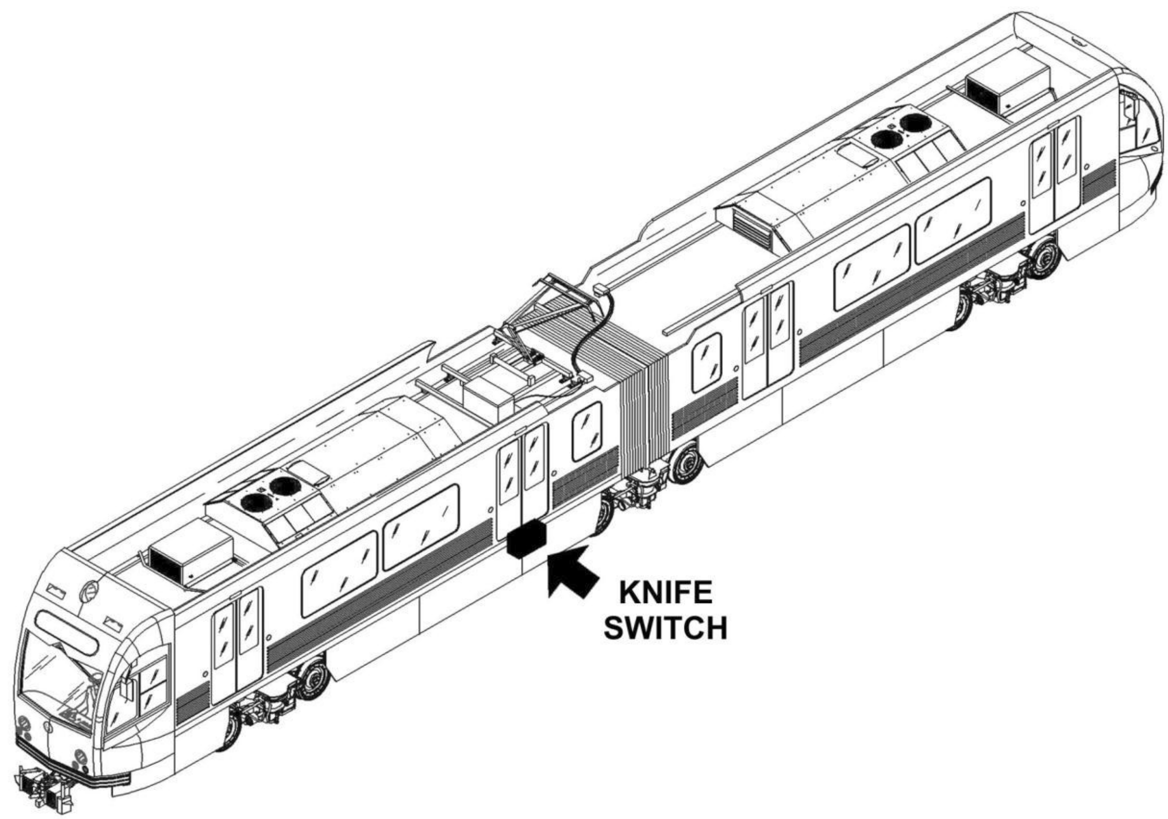
P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-09-01-02-00/R-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/8**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**
Component:	Man Hours: **2.00**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-01-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/8**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**
Component:	Man Hours: **2.00**
Maintenance Task: **REPLACEMENT**	

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT. REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: HIGH VOLTAGE IS PRESENT ON THE INVERTER GROUP. AFTER REMOVING ALL POWER FROM THE VEHICLE, WAIT A MINIMUM OF 1 MINUTE PRIOR TO REMOVING OR OPENING MAIN INVERTER GROUP,SINCE THE CAPACITORS DISCHARGE TIME IS 10 SECONDS.
FAILURE TO COMPLY WITH SAFETY REGULATIONS COULD RESULT IN SERIOUS INJURY OR EVEN DEATH IF NOT FOLLOWED.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

CAUTION: THE INTERNAL PART OF THE KNIFE SWITCH COVER IS SHAPED IN SUCH A WAY THAT IT IS NOT POSSIBLE TO CLOSE IT IF THE SWITCH IS NOT IN "NORMAL" POSITION.
FORCING IT CLOSED COULD RESULT SWITCH / COVER DAMAGE.

CAUTION: PAY ATTENTION TO NOT DAMAGE THE BOX WATERTIGH GLANDS.
FAILURE TO COMPLY CAN CAUSE HEAVY DAMAGE TO THE EQUIPMENT / VEHICLE.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.
Support Hydraulic Device

CONSUMABLES:

CRC 2000 Contact Cleaner
CRC Industrial - Precision Cleaner M3 PN 147535

SPARE PARTS:

Knife Switch P/N AA03F8N (301612)

P2550 CORRECTIVE MAINTENANCE SHEET

	Card Code: **R-C-09-01-02-00/R-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/8**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**
Component:	Man Hours: **2.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle over the Pit (or Stand Up Rail).
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).
4. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.
7. Lock out and tag out the Switch in accordance with all LACMTA Safety Rules, Regulations, Policies, and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-02-00/R-00

System: HIGH VOLTAGE POWER DISTRIBUTION	Sheet: 4/8
Subsystem/Assy: LINE VOLTAGE AND CURRENT PROTECTION	Unit: KNIFE SWITCH
Component:	Man Hours: 2.00

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

REMOVAL

To perform the Removal Procedure proceed as follows (Refer to Figures 1 through 6):

1. Remove Skirts according to Sheet R-C-02-05-00-00 / R-00 to gain access to Knife Switch Box.

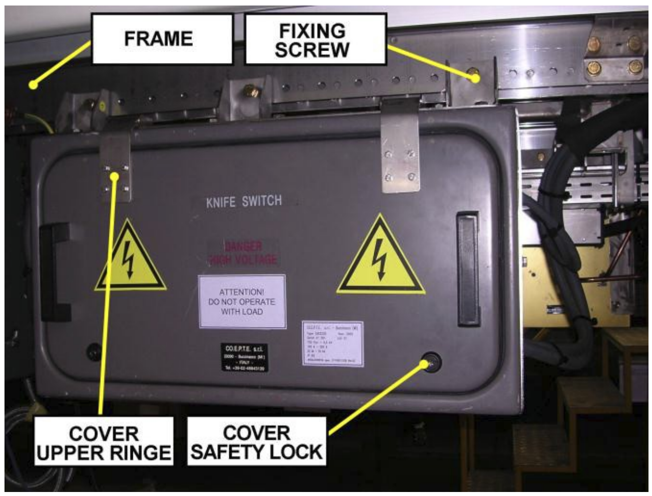


FIG 1 KNIFE SWITCH BOX

2. Open the Knife Switch by unlocking the relevant Safety Locks using the Maintenance Key, then lift the Cover from its Upper Hinges and remove it.

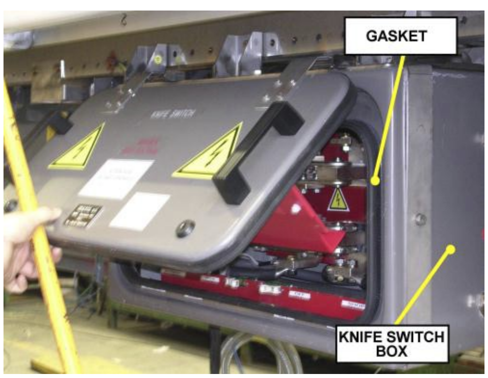


FIG 2 KNIFE SWITCH BOX COVER OPENING

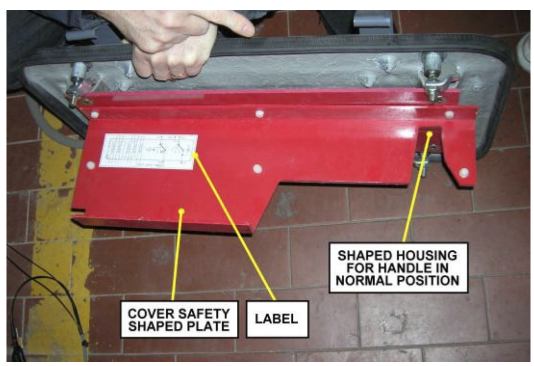


FIG 3 KNIFE SWITCH BOX COVER REMOVED

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-02-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/8**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**KNIFE SWITCH**

Component:	Man Hours:
	2.00

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

3. Disconnect the HV Cables from Knife Switch Terminals.

4. Slip the Cables through the Box watertight Glands.

CAUTION:
PAY ATTENTION TO NOT DAMAGE THE GLANDS.

5. Retain Cables, Terminals and relevant Hardware for later use.

6. Protect the HV Cables Terminals and Connector using suitable Protection Caps.

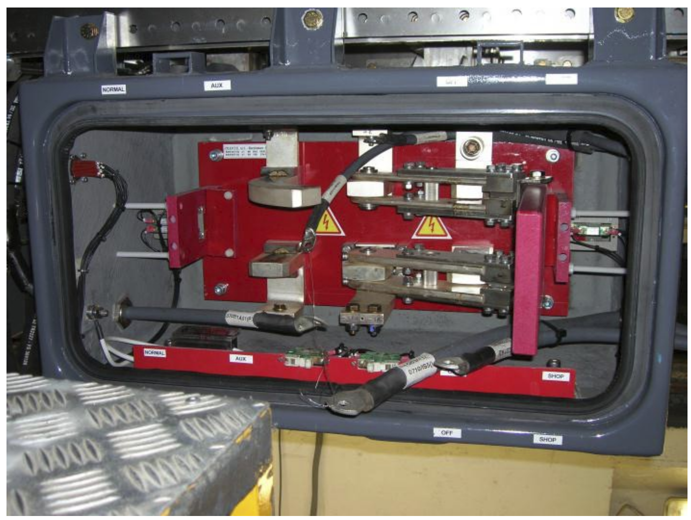


FIG 4 HV CABLES DISCONNECTION

7. Place the Support Hydraulic Device under the Knife Switch.Box.

FIG 5 SUPPORT HYDRAULIC DEVICE

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-01-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/8**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**
Component:	Man Hours: **2.00**
Maintenance Task: **REPLACEMENT**	

INSTALLATION

8. Remove the fixing Screws (2, 5), Washers (3, 6) and Nuts (4, 7).

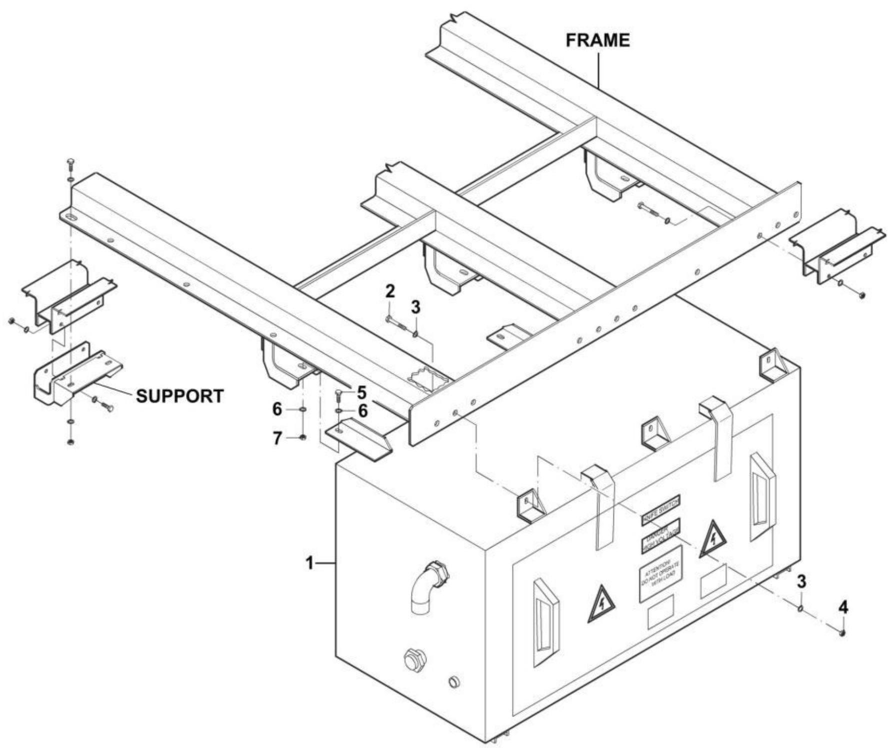


FIG 6 KNIFE SWITCH REPLACEMENT

NOTE: Now the Knife Switch is free. It remains in position because it is partially supported by the Frame. To lower it, a first movement (shift) in the lateral direction is needed to allow the disengagement from its Frame.

9. Lower and remove the Knife Switch using the Support Hydraulic Device.
10. Make available the removed Knife Switch for Maintenance.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-02-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**7/8**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**KNIFE SWITCH**

Component:	Man Hours:
	2.00

Maintenance Task:
REPLACEMENT

PROCEDURE (CONT'D):

INSTALLATION

To perform the Installation proceed as follows (Refer to Figures 1through 6):

**WARNING: HEAVY OBJECT - KNIFE SWITCH WEIGHS 176 LB.
SUPPORT KNIFE SWITCH WITH SUITABLE LIFTING DEVICE.
FAILURE TO COMPLY CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH.**

1. Position the Knife Switch to be installed on the Support Hydraulic Device, ready for on vehicle installation.
2. Carefully raise the Knife Switch using Support Hydraulic Device.
3. Place the Knife Switch (1) on the Frame in order to match Frame installation holes with the Knife Switch fixing holes.
4. Install the fixing Screws (2, 5), Washers (3, 6) and Nuts (4, 7).Torque to **52 ft lb.**
5. Install the HV Cables with relevant Terminals.

CAUTION: PAY ATTENTION TO NOT DAMAGE THE BOX WATERTIGH GLANDS.
FAILURE TO COMPLY SO CAN CAUSE HEAVY DAMAGE TO THE EQUIPMENT / VEHICLE.

6. Connect the HV Cables to Knife Switch Terminals Torque according to the following values:

SCREW TYPE	TORQUE
M8	15.2 ft lb
M10	30 ft lb
M12	52 ft lb

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-01-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **8/8**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **KNIFE SWITCH**
Component:	Man Hours: **2.00**
Maintenance Task: **REPLACEMENT**	

PROCEDURE (CONT'D):

7. Lubricate the mechanical connections using recommended agent.

8. Move the Knife Switch (by the Insulated Handle) to verify that it can be moved freely from NORMAL position to any other positions (AUXILIARY, OFF and SHOP) and vice versa.

9. Clean the Knife Switch Blades and Power Clips with the recommended cleaner using the lint-free rag.

10. Re position the Knife Switch Handle in "NORMAL" position.

11. Position the Knife Switch Cover onto its Upper Hinges and close it using the Maintenance Key.

CAUTION: THE INTERNAL PART OF THE KNIFE SWITCH COVER IS SHAPED IN SUCH A WAY THAT IT IS NOT POSSIBLE TO CLOSE IT IF THE SWITCH IS NOT IN "NORMAL" POSITION.

FORCING IT CLOSED COULD RESULT SWITCH / COVER DAMAGE.

12. Install Skirts according to Sheet R-C-02-05-00-00 / R-00.

13. Close the relevant Skirt using the Maintenance Key.

14. Restore Electrical Power.

15. Record Task result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-01-03-01/R-00

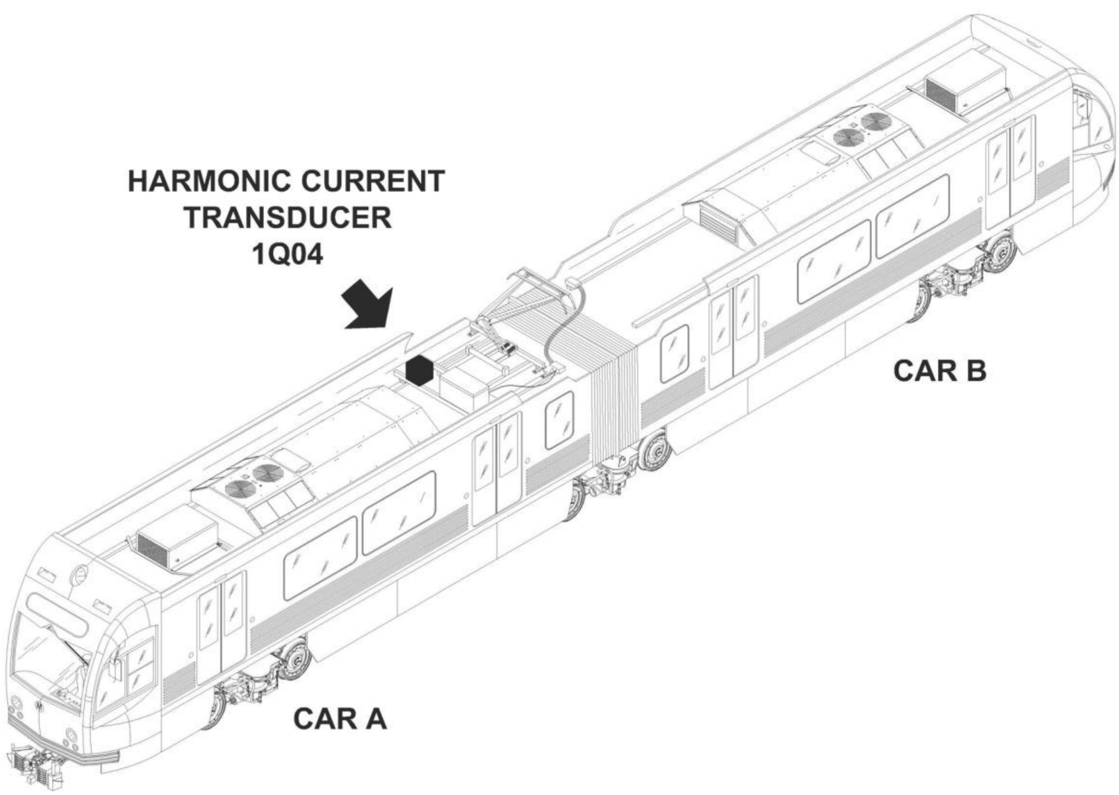
System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**1/6**

Subsystem/Assy:	Unit:
LINE VOLTAGE AND CURRENT PROTECTION	**EMI DETECTOR SYSTEM**

Component:	Man Hours:
HARMONIC CURRENT TRANSDUCER (HCT)	**1.5**

Maintenance Task:
REPLACEMENT

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-01-03-01/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**
Component: **HARMONIC CURRENT TRANSDUCER (HCT)**	Man Hours: **1.5**
Maintenance Task: **REPLACEMENT**	

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER.(750V)ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES. IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT. REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.
External Scaffold

CONSUMABLES:
NA

SPARE PARTS:

Harmonic Current Transducer (HCT) P/N AA04JW3

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-01-03-01/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **3/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**	
Component: **HARMONIC CURRENT TRANSDUCER (HCT)**		Man Hours: **1.5**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).
4. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.
7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power. That person knows why the Power was removed and when it safe to restore it.
Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

REMOVAL

To perform the Removal Procedure proceed as follows (Refer to Figure 1):

1. Gain access to Vehicle Roof according to LACMTA regulations.
2. Disconnect the Low Voltage Connector (12) from the Harmonic Current Transducer.
3. Remove the Screws (3), Washers (4, 5) and Nuts (6), then remove the Cover (2).
4. Remove the Screws (7), Washers (8, 9) and Nuts (10), then remove, using suitable Lifting Device, the Harmonic Current Transducer (1) from Support (11).

NOTE: Disconnect the wires going through the HCT from one end and free them from clamps in order to remove the HCT. The HCT is a single unit you have to pulled the HV wires from one end.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-01-03-01/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**	
Component: **HARMONIC CURRENT TRANSDUCER (HCT)**		Man Hours: **1.5**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

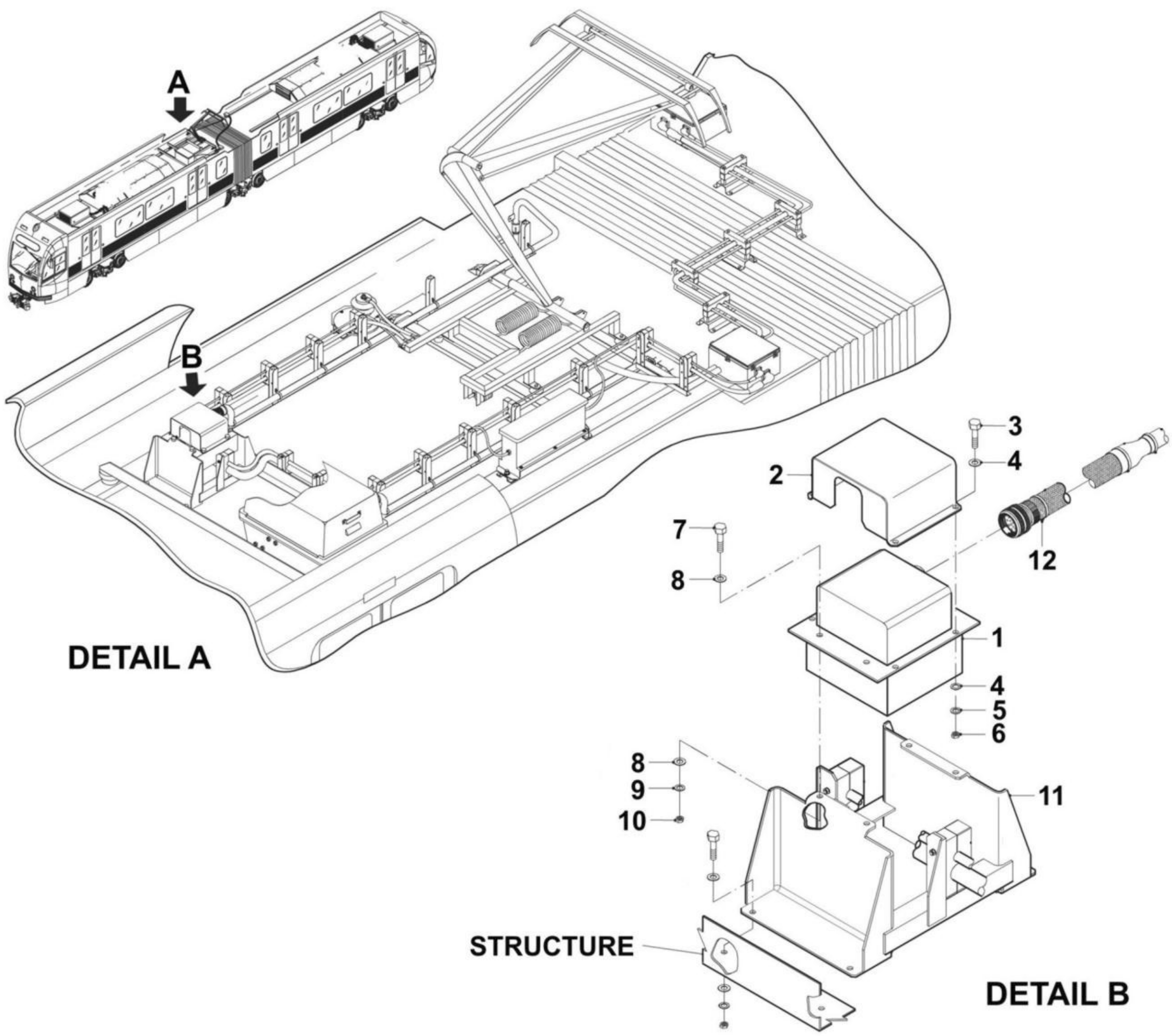


Figure 1 - HARMONIC CURRENT TRANSDUCER (HCT)REPLACEMENT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-01-03-01/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **5/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**
Component: **HARMONIC CURRENT TRANSDUCER (HCT)**	Man Hours: **1.5**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

INSTALLATION

To perform the Installation Procedure proceed as follows (Refer to Figure 1):

1. Position the Harmonic Current Transducer (1) on Support (11), using suitable Lifting Device.

2. Install the Screws (7), Washers (8, 9) and Nuts (10).Torque to **30 ft lb.**

3. Install the Cover (2).

4. Install the Screws (3), Washers (4, 5) and Nuts (6). Torque to **15.2 ft lb.**

5. Connect the Low Voltage Connector (12) to the Harmonic Current Transducer.

6. Remove all Tools /Rags, that were used, from the Vehicle Roof.

7. Leave the Vehicle Roof according to MTA procedures.

8. Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.

9. Restore Power to Vehicle.

10. Record Task result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains..

Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-01-03-01/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **6/6**
Subsystem/Assy: **LINE VOLTAGE AND CURRENT PROTECTION**	Unit: **EMI DETECTOR SYSTEM**	
Component: **HARMONIC CURRENT TRANSDUCER (HCT)**		Man Hours: **1.5**
Maintenance Task: **REPLACEMENT**		

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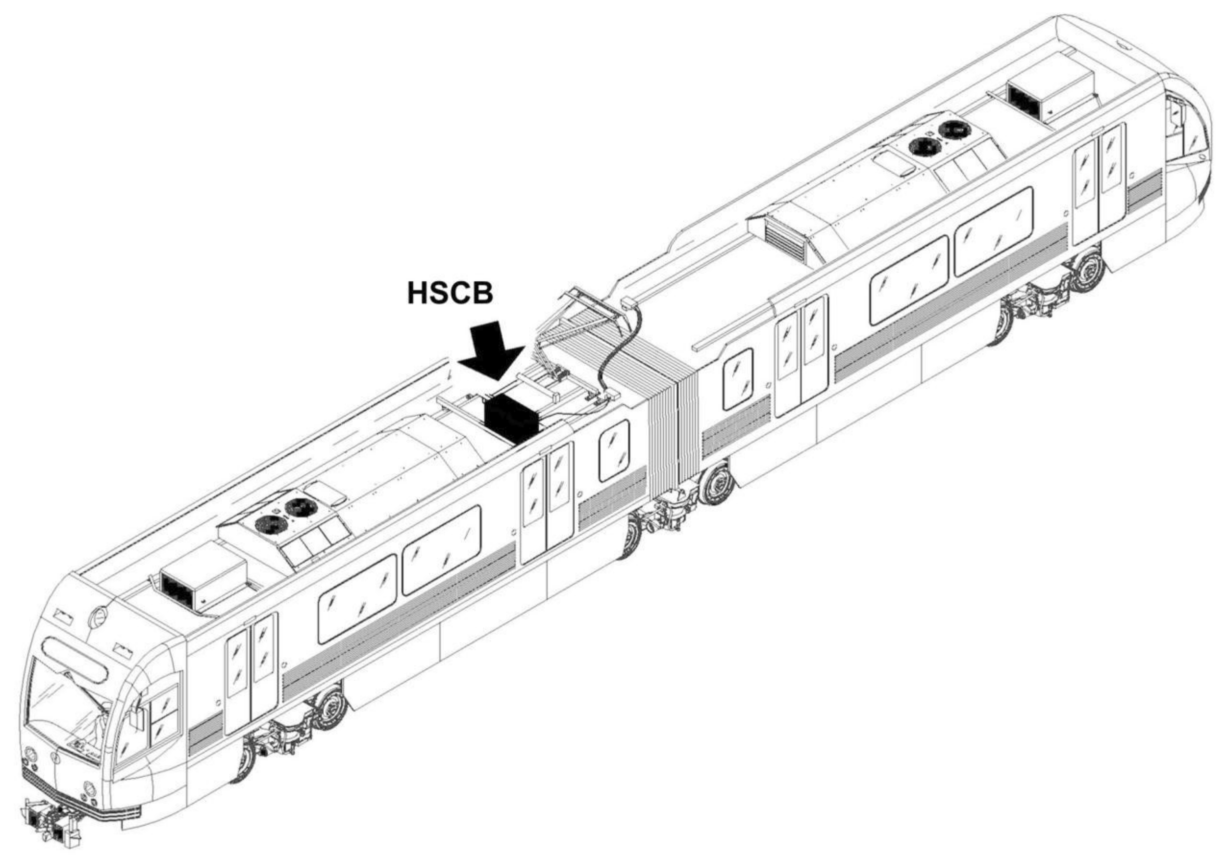
P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-01-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component:	Man Hours: **2**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-01-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component:	Man Hours: **2**
Maintenance Task: **REPLACEMENT**	

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

**WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.
IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.**

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

**WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.**

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

**WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.**

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit.
External Scaffold

CONSUMABLES:NA

SPARE PARTS:

Fire Box &HSCB (Whole Assembly) P/N AA03LMZ (211VQ00801B)

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-01-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component:	Man Hours: **2**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).
4. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.
7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-01-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component:		Man Hours: **2**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

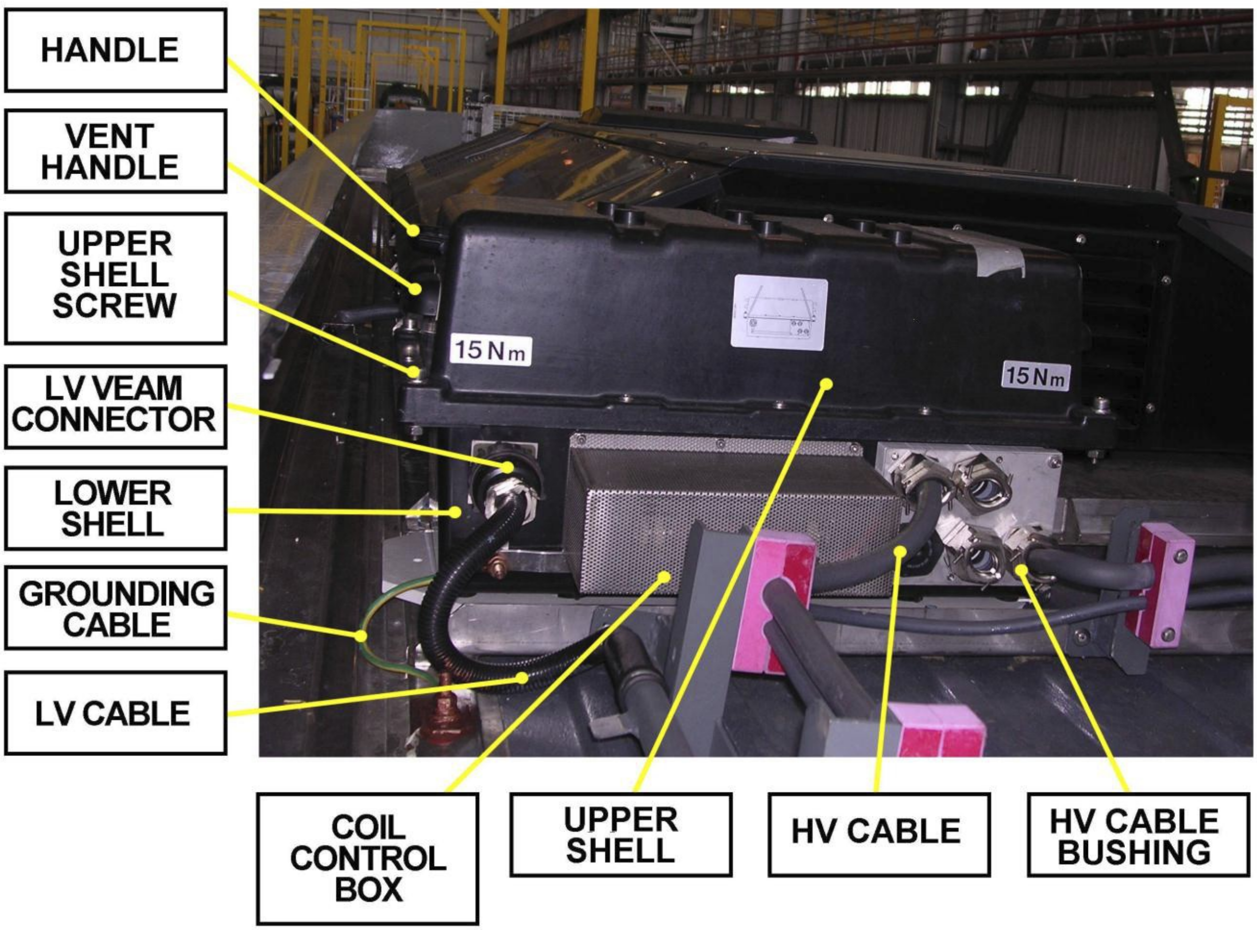


Figure 1 - HSCB - FIRE BOX - EXTERIOR

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-01-00/R-00

System: HIGH VOLTAGE POWER DISTRIBUTION	Sheet: 5/12
Subsystem/Assy: HIGH SPEED CIRCUIT BREAKER & CIRCUITS	Unit: HSCB & FIRE BOX
Component:	Man Hours: 2

Maintenance Task:
REPLACEMENT

PROCEDURE:

A. **ARC CHUTE**
B. **CLOSING DEVICE**
C. AUXILIARY **CONTACTS**
D. **TRIPPING DEVICE**
E. **MAIN CIRCUIT**

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. PRESSURE SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. PIVOT SOCKET SPRING
10. FORK
11. LOWER CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. UPPER CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT

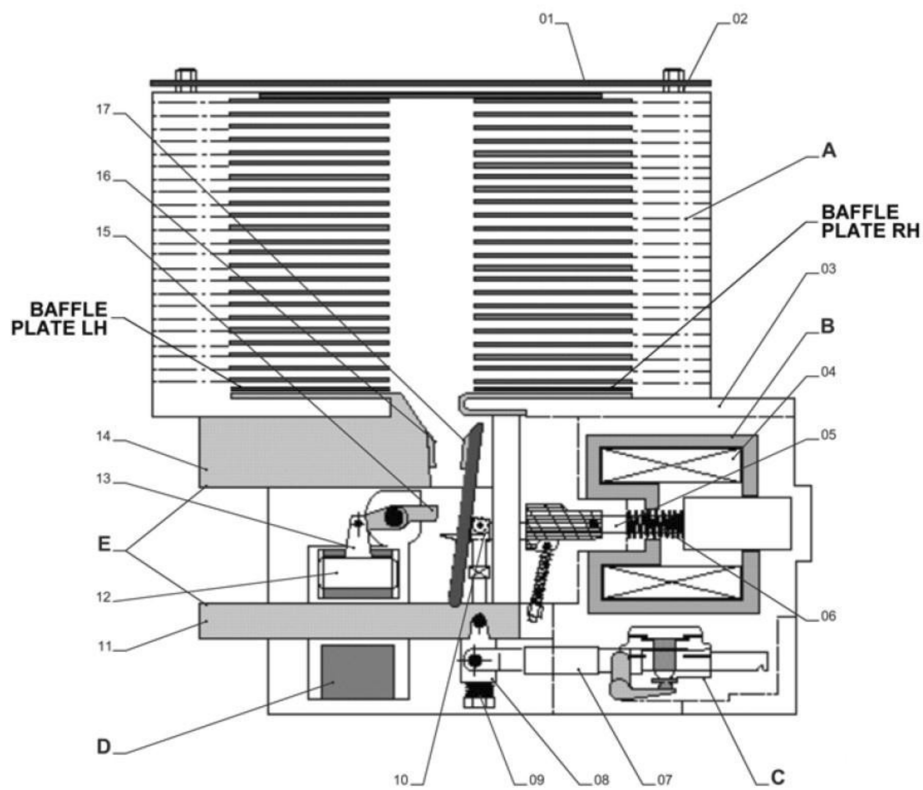


FIGURE 2 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-01-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB & FIRE BOX**
Component:	Man Hours: **2**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

REMOVAL

A HSCB ASSY DISCONNECTION & REMOVAL FROM FIRE BOX(Refer to Figures 1 through 3)

To remove the HSCB from the Fire Box proceed as follows:

1 Access to Vehicle Roof "A" Car according to MTA procedures.

NOTE: It is advisable to retain the removed Hardware for later use.

A1 On Fire Box Exterior

1 Disconnect the HSCB Fire Box Grounding Cable.
2 Unplug the external LV VEAM Movable Connector (18).
3 Loose and remove the attaching Hardware connecting the Fire Box Upper Shell to the the Fire Box Lower Shell.
4 Remove the complete Upper Shell (1) from the Lower Shell (2).

A2 On Fire Box Interior

1. Unclamp and remove the Inner Movable Connector (23) from Fixed Connector (19).
2. Disconnect the Grounding Cable. (24) from the side of the Closing Device (33).
3. Disconnect the Main Circuit Feed Cables fixed to Connection Plates (11, 14) by removing the relevant M12 attaching Hardware.
4. Remove the two M6 Screws securing Copper Plate (13) to Lower Shell.
5. Remove the four Screws, then remove the Flanges (15).

A3 HSCB Removal
1. Remove the HSCB Assy from the Lower Shell (2).
2 Position the HSCB Assy on suitable Support.

NOTE: Be careful during HSCB mounting screws removal, because there is a lack of space under the HSCB Mounting.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-01-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **7/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component:	Man Hours: **2**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

B ***FIRE BOX LOWER SHELL REMOVAL(***Refer to Figures 1 through 4).

NOTE: The Fire Box Upper Shell have been removed as per previous step A1.

To remove the Fire Box Lower Shell proceed as follows:

NOTE: It is advisable to retain the removed Hardware for later use.

B1 ***On Fire Box Interior***

1 Remove the six Protection Caps (26) from the Insulating Plate (4).
2 Remove the six fixing Screws from the Insulating Plate (29, 30) and from the Cable Plate (17). Retain the Screws for later use.
3 Remove the Cable Plate (17) and unscrew the Glands (32).
4 Open the Lugs of the Cables.
5 Slip the Cables from the Cable Plate (17) and the Glands (32).

NOTE: Now all the Connections and Parts installed into the Lower Shell of the Fire Box are fully disengaged / removed from the Lower Shell.

B2 ***On Fire Box Exterior***

1. Loose and remove the M12 Screws (2), Washers (3, 4) and Nuts (5).
2. Remove the Fire Box Lower Shell from Supports(6).

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-01-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **8/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component:		Man Hours: **2**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

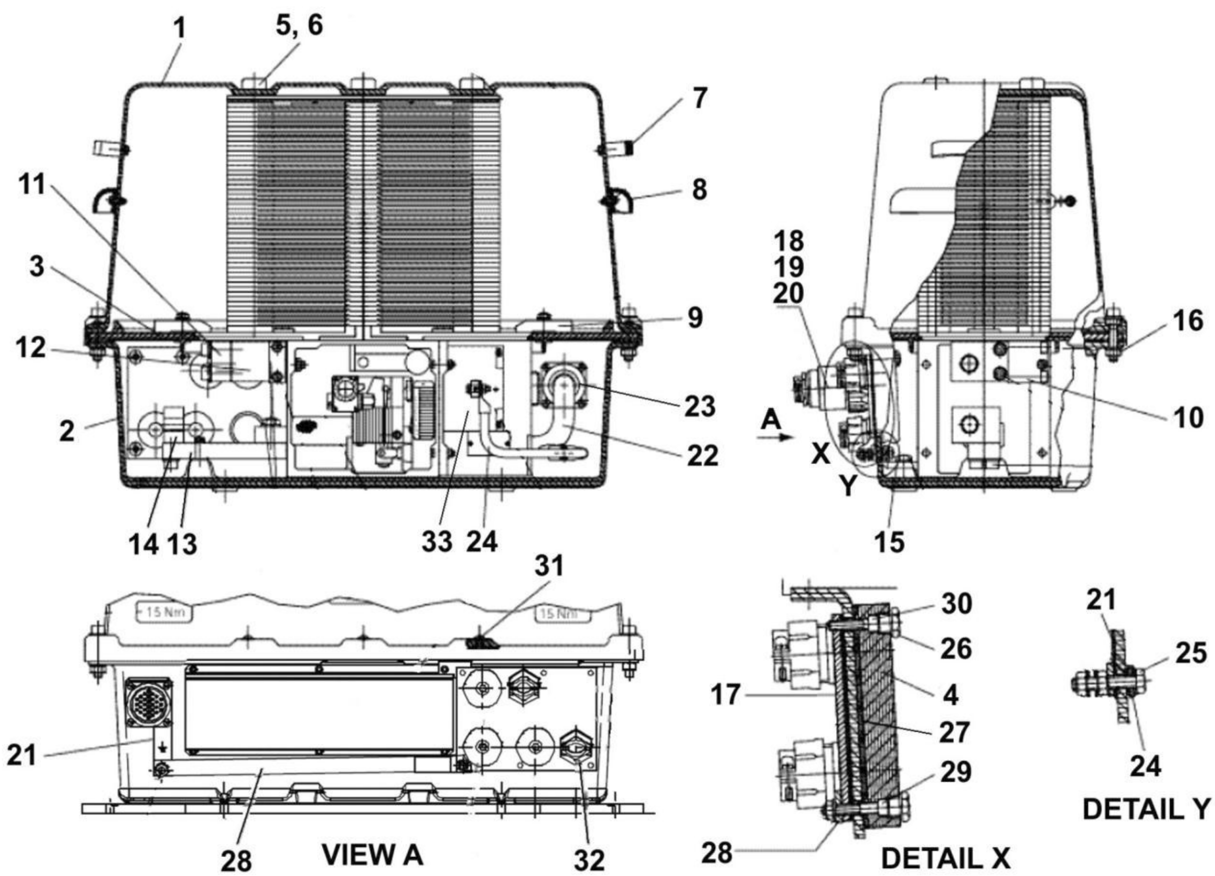


FIGURE 3 - HSCB ELECTRICAL CONNECTIONS & HARDWARE REMOVAL /INSTALLATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-01-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**9/12**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
	2

Maintenance Task:
REPLACEMENT

PROCEDURE:

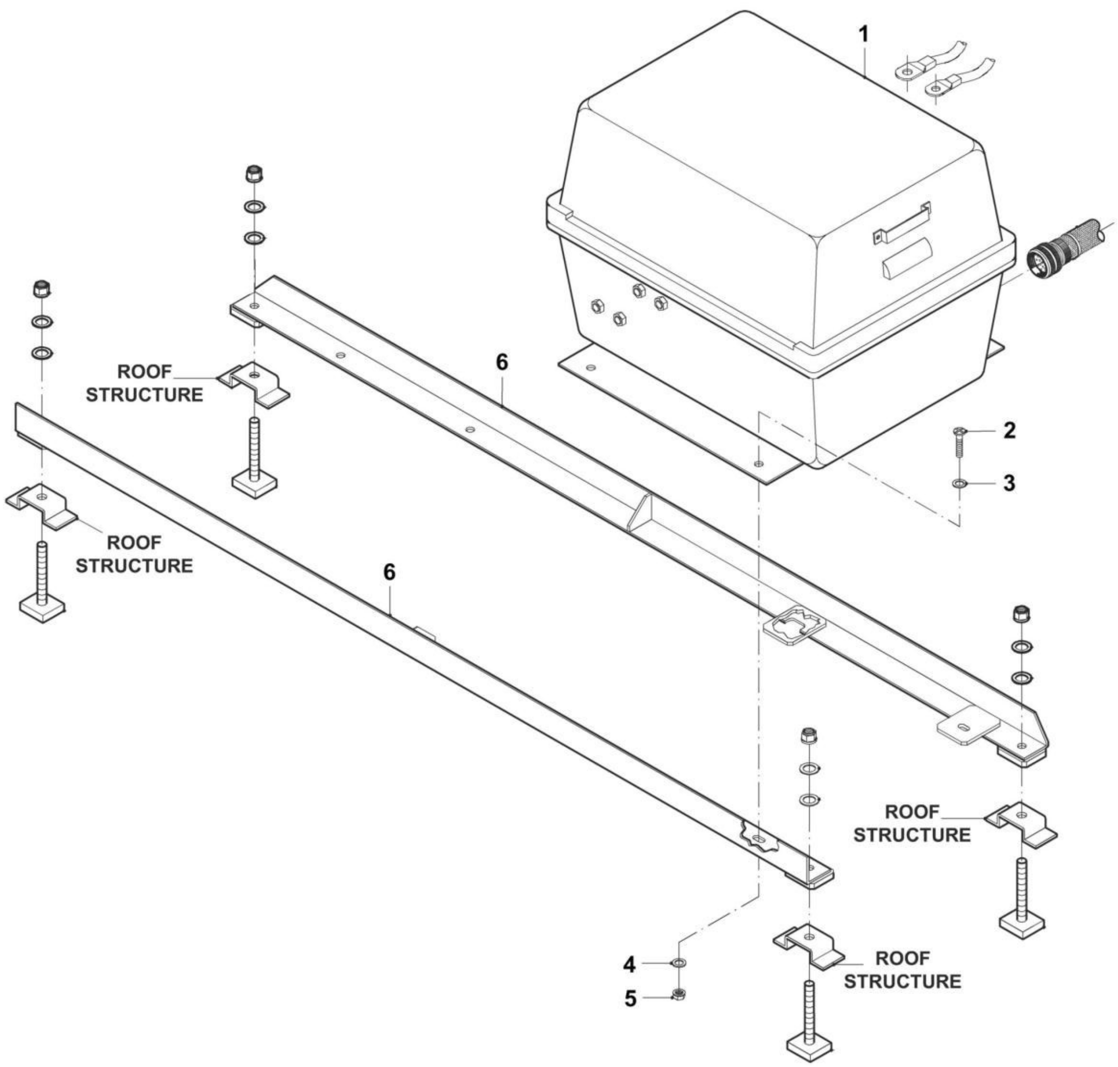


FIGURE 4 - HSCB FIRE BOX REMOVAL / INSTALLATION

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-01-00/R-00

System:
HIGH VOLTAGE POWER DISTRIBUTION

Sheet: **10/12**

Subsystem/Assy:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS

Unit: **HSCB**

Component:

Man Hours: **2**

Maintenance Task:
REPLACEMENT

PROCEDURE:

INSTALLATION

NOTE: It is assumed that the spare Fire Box & the HSCB are stored as a Whole Assembly.
NOTE: It is assumed that the Fire Box & HSCB Assy is positioned on the Roof on suitable Support in order to safely accomplish the following Operations.

A PRELIMINARY OPERATIONS(Refer to Figure 3)

1 Loose and remove the attaching Hardware connecting the Fire Box Upper Shell to the Fire Box Lower Shell.
2. Remove the complete Upper Shell (1) from the Lower Shell (2).
3. Remove the HSCB from the Lower Shell (2) as follows:
   - Unclamp and remove the Inner Movable Connector (23) from Fixed Connector (19)
   - Disconnect the Grounding Cable. (24) from the side of the Closing Device (33)
   - Disconnect the Main Circuit Feed Cables fixed to Connection Plates (11, 14) by removing the relevant M12 attaching Hardware
   - Remove the two M6 Screws securing Copper Plate (13) to Lower Shell
   - Remove the four Screws, then remove the Flanges (15)
4. Remove the HSCB Assy from the Lower Shell (2)
5. Position the HSCB Assy on suitable Support

B FIRE BOX LOWER SHELL INSTALLATION(Refer to Figures 3 & 4)

To install Fire Box Lower Shell proceed as follows:

B1 On Fire Box Interior

1. Remove the six protection Caps (26) from the Insulating Plate (4).
2. Remove the six fixing Screws from the Insulating Plate (29, 30) and from the Cable Plate (17).
3. Remove the Cable Plate (17) and unscrew the Glands (32).

B2 Fire Box Lower Shell Positioning

1 Position the Fire Box on Supports (6).
2 Install the fixing Screws (2), Washers (3, 4) and Nuts (5). Torque to **12.5 ft lb.**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-01-00/R-00

System: HIGH VOLTAGE POWER DISTRIBUTION	Sheet: 11/12
Subsystem/Assy: HIGH SPEED CIRCUIT BREAKER & CIRCUITS	Unit: HSCB
Component:	Man Hours: 2

Maintenance Task:
REPLACEMENT

PROCEDURE:

B3 Fire Box Connections and Parts Installation in the Lower Shell

1. Slip the Glands (32) and then the Cable Plate (17) onto the Cables before crimping the Lugs. Make sure that Lugs and Cables Plate are on the threaded side of the Gland.
2. Crimp the Lugs.
3. Place the whole (Glands and Cable Plate) at their place into the Lower Shell.
4. Place the Internal Seal (27) and the Insulating Plate (4) against the Inner Wall of the Lower Shell onto the four Cables.
5. Insert the 5 fixing Screws (30) and the Grounding Bar Screws (29) in the Insulating Plate.Torque to **4.5 ft lb**.
6. Place the six protection Caps (26) on the Insulating Plate and Torque to **2.2 ft lb.**
7. Screw the Glands on the Cables Plate.

NOTE: Now all the Connections and Parts installed into the Lower Shell of the Fire Box are fully engaged / fixed.

C HSCB INSTALLATION & CONNECTION(Refer to Fig 3)

1. Position the HSCB into the Lower Shell.
2. Fit the Flanges (15) and the four M8 Screws; Torque to **11.04 ft lb**.(**15 Nm)**
3. Install the two M6 Screws to secure the Copper Plate (13) to Lower Shell. Torque to **6.2 ft lb.**
4 Connect the Main Circuit Feed Cables fixed to the Connection Plates (11, 14), Torque the relevant M12 Bolts to **25.7 ft lb**.(**35 Nm).**
5 Connect the Grounding Cable (24) to the side of the Closing Device (33) using the relevant M6 Nuts and Screws.Torque to **6.2 ft lb**.
6 Engage the Inner Movable Connector (23) with the Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.
7 Check for HSCB Mechanical & Electrical Components clean. As need use recommended cleaner and clean lint - free rags.
8 Check for HSCB Arc Chute clean. As need use Vacuum cleaner and clean lint - free rags.
9 Position the complete Upper Shell (1) onto the Lower Shell. Torque to **11.04 ft lb**.(**15 Nm).**
10 Engage the LV VEAM Outer Movable Connector (18) into Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.
11 Reconnect the HSCB Fire Box Grounding Cable. Torque to **5.8 ft lb**.(**8 Nm).**

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-01-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **12/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component:		Man Hours: **2**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

D FINAL OPERATIONS

1 Remove all Tools /Rags that were used, from the Vehicle Roof.

2 Leave the Vehicle Roof according to MTA procedures.

3 Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.

4 Restore Electrical Power to the Vehicle.

5 Record Task result on the Defect Report Card for administrative and maintenance planning.

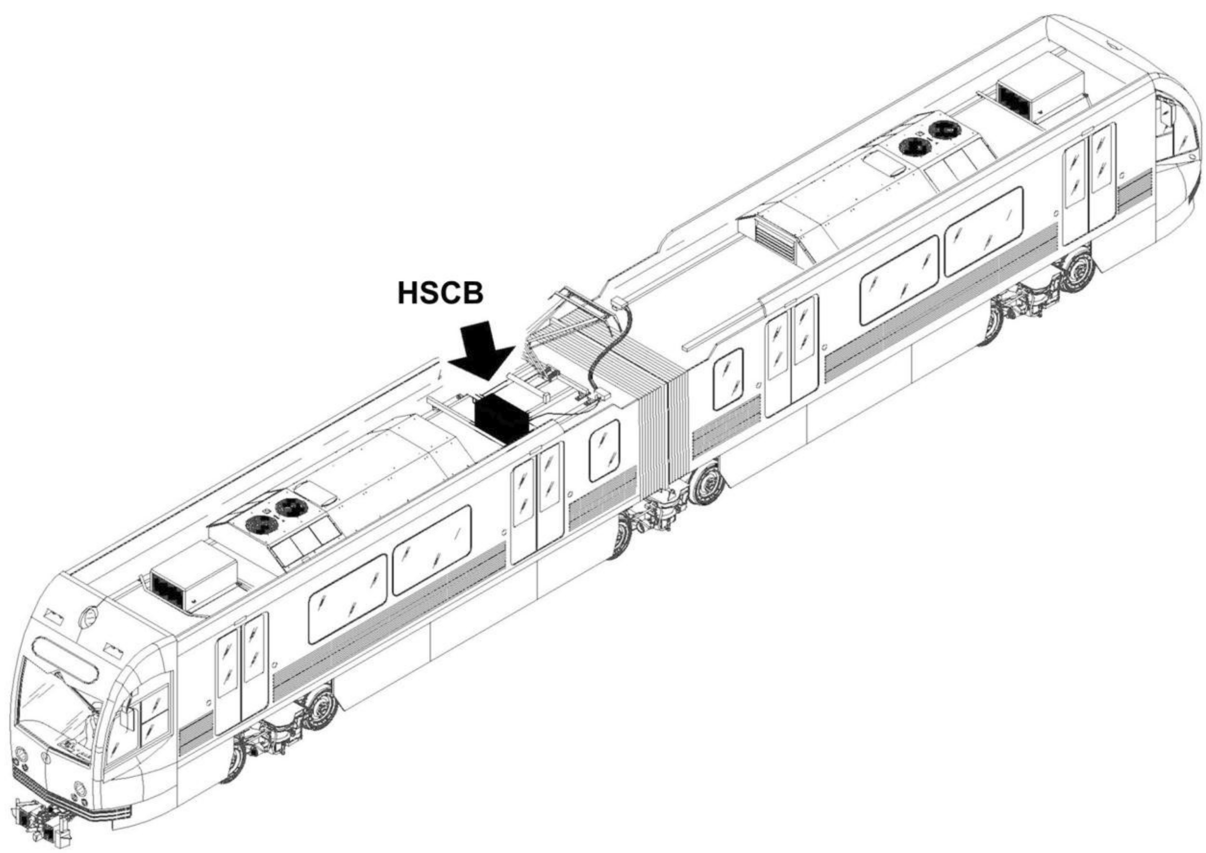
NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.

Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MAIN CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MAIN CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES. IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT. REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER. NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

CAUTION DO NOT TOUCH THE PRESSURE NUT OF THE SHOCK-ABSORBER.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit External Scaffold Nylon Rod

CONSUMABLES:

Litea 806-12 Grease ASEOL /Bern

SPARE PARTS:

HSCB Main Contact Kit: PN HSBT 231017 R0500

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MAIN CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).
4. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.
7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power. That person knows why the Power was removed and when it safe to restore it.
Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

REMOVAL

To remove the Main Contact proceed as follows::

A HSCB ASSY DISCONNECTION & REMOVAL FROM FIRE BOX:

1. Remove the HSCB according to Sheet R-C-09-02-01-00/R-00 Step A.

B FRAME ASSEMBLY AND MAIN CIRCUIT REMOVAL(Refer to Figures 3 & 4):

1. Remove the Arc Chute (6.600) by removing the four M8 screws.
2. Disconnect the Main Circuit Copper Plates fixed to Connection Plates (6.103, 6.104).
3. Remove the Screws (4 x M6) locking the Closing Device (6.300) to the Frame (6.101).
4. Withdraw the Closing Device by at least 90 mm.
5. Remove the Screws (4 x M8) locking the Frame (6.101) to the Floor.
6. Remove the Frame Assembly (6.101) and the Main Circuit and position them on a Work Bench.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-02-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **MAIN CONTACT**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

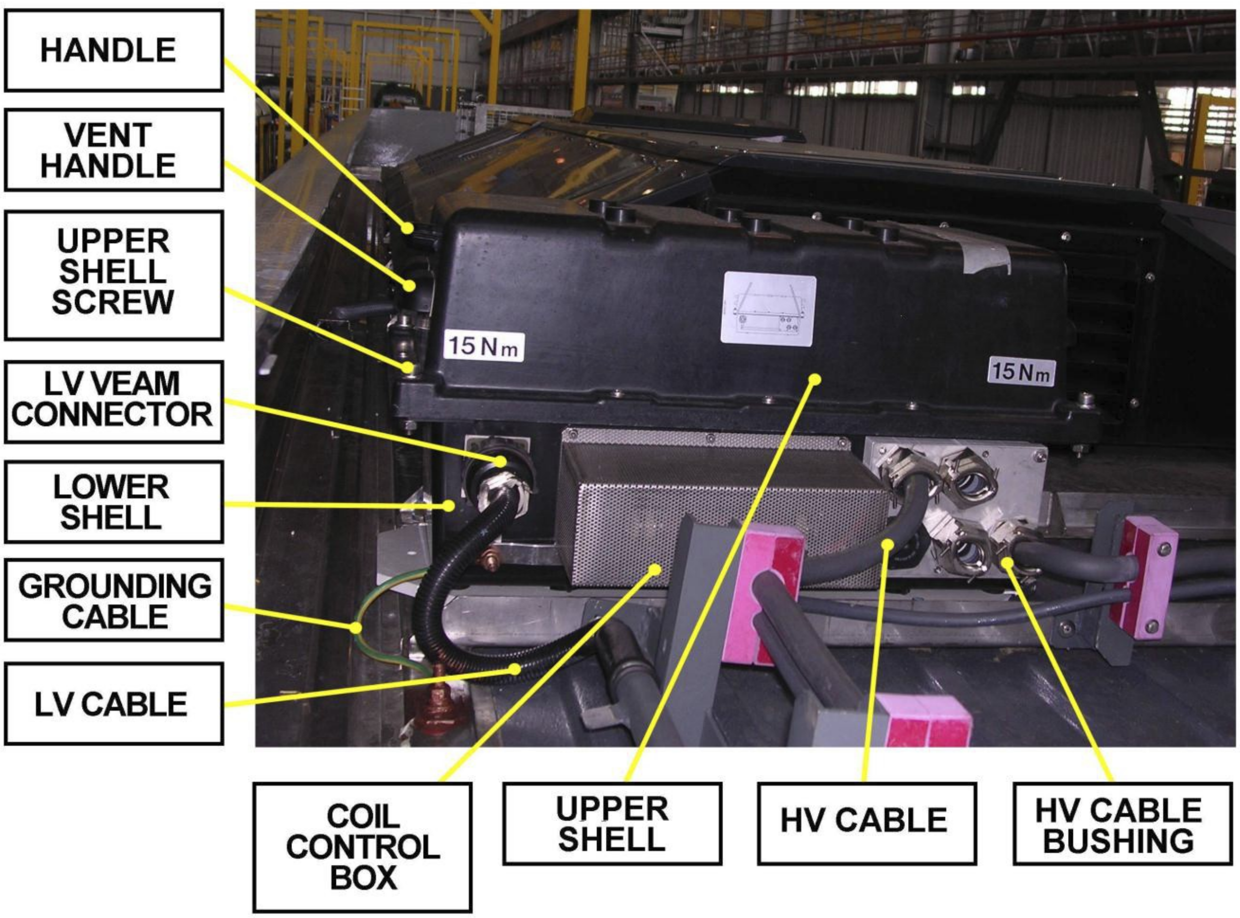


Figure 1 - HSCB - FIRE BOX - EXTERIOR

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-02-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **5/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MAIN CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

A. **ARC CHUTE**
B. **CLOSING DEVICE**
C. **AUXILIARY CONTACTS**
D. **TRIPPING DEVICE**
E. **MAIN CIRCUIT**

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. PRESSURE SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. **PIVOT** SOCKET SPRING
10. FORK
11. **LOWER** CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. **UPPER** CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT

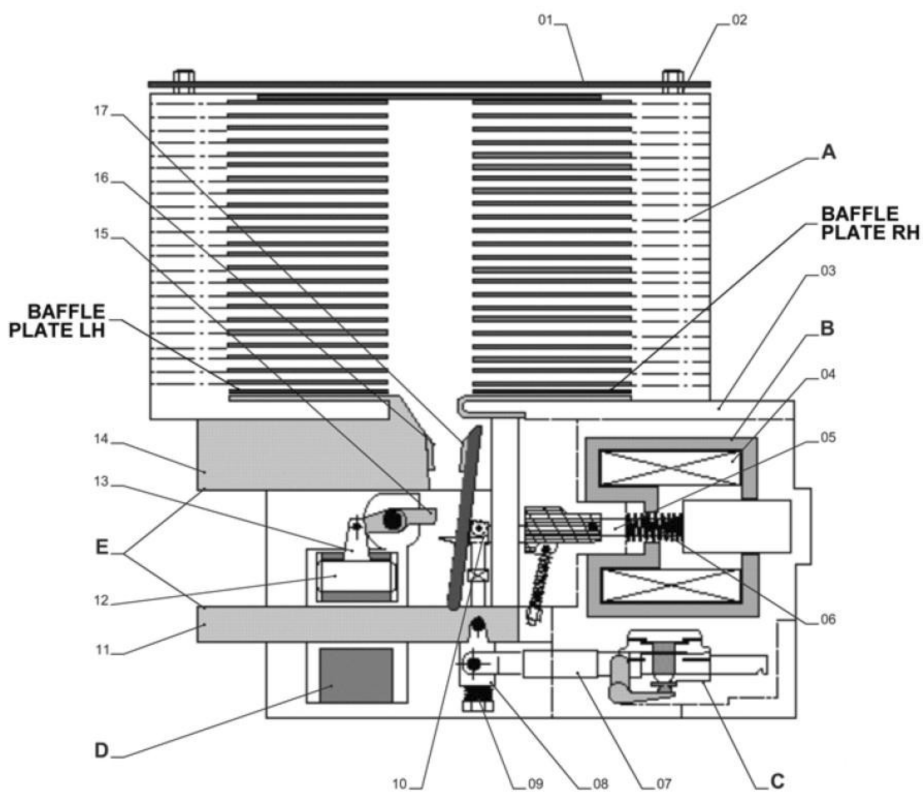


FIGURE 2 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: R-C-09-02-02-00/R-00	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MAIN CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

C DISMANTLING OF THE MOVING CONTACTS (6.102) (Refer to Figures 3 & 4)

1. Unscrew the Screw (M8) of the Guide Assembly (6.141), maintaining the Guide (6.110) in place by a Wrench (10 mm).
2. Unscrew until a distance of 2 mm remains between the Screw head and the Frame Bottom (6.101).
3. Separate the Guide Assembly (6.141) from the Moving Contact (6.102), lifting it by the Guide (6.110), in order to unhook the Rod (6.112).
4 Lower the Guide Assembly (6.141) until below the Lower Connection, then rotate it to remove
5. Lift the Moving Contact (6.102), and extract it through the Connection (6.109).

D DISMANTLING OF THE UPPER CONNECTION (6.103)(Refer to Figures 3 & 4)

1. Remove the Nuts (S.121) of the Stud-Bolt (6.120).
2. Remove the Stud (6.120) through the Frame (6.101).
3. Remove, starting with the Screw on the Power Cable side, the two Locking Screws (S-113) of the Connection (6.107) on the Upper Connection (6.103).

NOTE: Do not get rid of the Nut (S.115) situated between Frame (6.101) and Connection (6.103)
When the wear of the 2nd Screw (S.113- on the contact side) is too much, rotate the Connection (6.107) by 90°.

E REMOVING OF THE LEFT CONNECTION (6.107).(Refer to Figures 3 & 4)

1 Advance and remove the Upper Connection (6.103) or the Connection Assembly (6.107 and 6.103).

F DISMANTLING OF THE RIGHT CONNECTION (6.108)(Refer to Figures 3 & 4)

1. Remove the 2 Locking Screws (S-112) of the Shock-Absorber Assembly (6.140) on the Connection (6.109).

CAUTION DO NOT TOUCH THE PRESSURE NUT OF THE SHOCK-ABSORBER.

2. Loosen the 2 Locking Screws (S-124) of the Connection (6.109) on the Lower Connection (6.104).
3. Push the Shock-Absorber Assembly (6.140) by means of a Nylon Rod in the direction of the lower Connection (6.104) and remove the Shock-Absorber Assembly (6.140).
4. Remove the connecting Screw (S.111) between the connections (6.108 and 6.109):

NOTE: The Screw is exposed by removal of the Shock-Absorber Assembly (6.140).

5. Remove the Screw (S.113) of the Connection (6.108) as well as the Nut (S.115).
6. Withdraw the Connection (6.108) and remove it.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-02-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**7/12**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
MAIN CONTACT	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

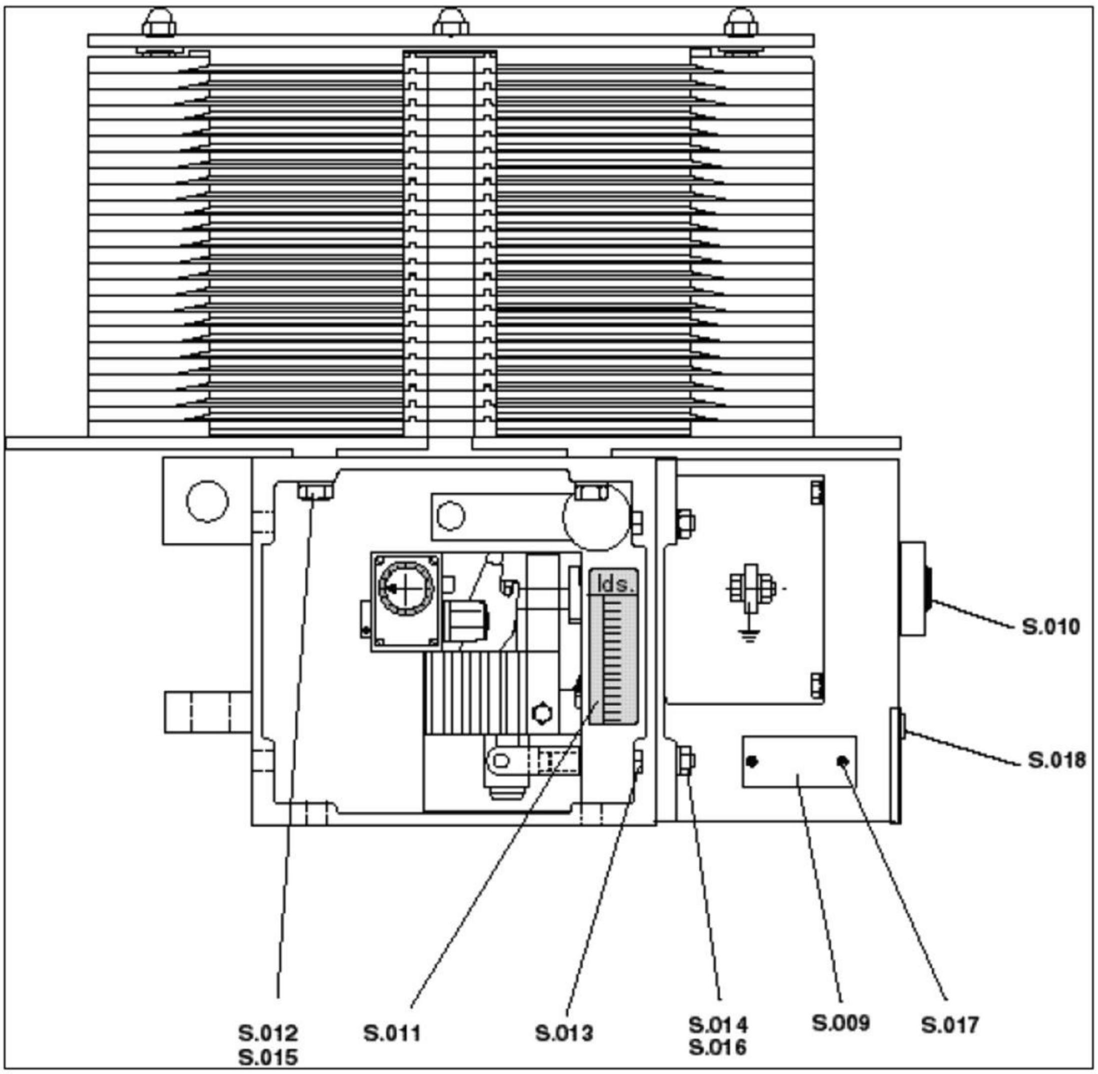


FIGURE 3 - HIGH SPEED CIRCUIT BREAKER - HARDWARE

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-02-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **8/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **MAIN CONTACT**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

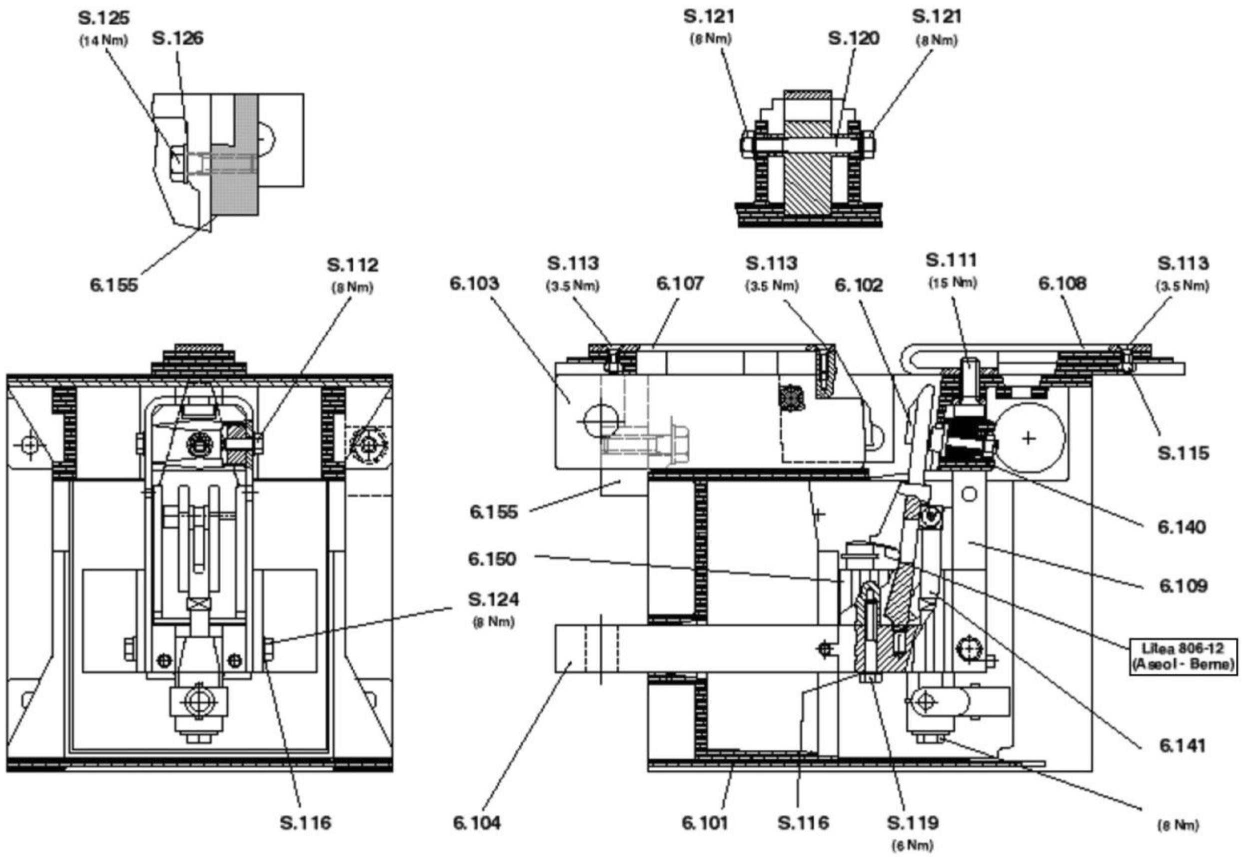


FIGURE 4- HSCB MAIN CIRCUIT ASSEMBLY

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-02-00/R-00**

System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **9/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MAIN CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

INSTALLATION

NOTE: It is assumed that the HSCB is safely positioned on the Work Bench

To install the Main Contact proceed as follows

A. MOUNTING OF THE RIGHT CONNECTION (6.108)(Refer to Figures 3 & 4):

1. Introduce the Right Connection (6.108) on the Frame (6.101).

2. Place the Locking Screw (S.113) through the Right Connection (6.108) and the Frame (6.101); screw on the Nut but do not tighten it.

3. Introduce the Screw (S.111) through the Connection (6.109) and the Frame (6.101) (6.101) and place it on the Right Connection (6.108).
Torque the Screw (S.111) to **11.04 ft lb** (**15 Nm**)and then the Nut (S.115) to **2.6 ft lb** (**3.5 Nm**.)

4. Introduce the Shock-Absorber Assembly (6.140) below the connection (6.109) and fully push it forward and to the top.

5. Place the 2 Locking Screws (S.112) of the Shock-Absorber Assembly (6.140) on the Connection (6.109) and torque to **5.8 ft lb (8 Nm)**.

6. Push the Lower Connection (6.104) against the Tripping Device (6.200) and torque the locking Screws (S.124) of the Connection (6.109) to **5.8 ft lb (8 Nm).**

B MOUNTING OF THE UPPER CONNECTION (6.103)(Refer to Figures 3 & 4):

1. Introduce the Upper Connection (6.103) into the Frame (6.101) and push it back.

2. Place the Left Connection (6.107) on the Upper Connection (6.103) and screw it in, tightening thereafter the Locking Screw (S.113) to **2.9 ft lb** (**4 Nm**).

3. Introduce the Stud-Bolt (S.120) through the Frame (6.101) and then through the Upper Connection (6.103).

4. Place the second fixing Screw (S.113) on the Left Connection (6.107),then the Nut (S.115), and torque them to **2.6 ft lb**(**3.5 Nm**).

5. Mount both the Nut (S.121) on the Stud-Bolt (S.120) and torque to **5.8 ft lb (8 Nm)**.

P2550 CORRECTIVE MAINTENANCE SHEET			
Card Code: **R-C-09-02-02-00/R-00**			
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **10/12**	
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**		
Component: **MAIN CONTACT**		Man Hours: **1**	
Maintenance Task: **REPLACEMENT**			

PROCEDURE:

C. MOUNTING OF THE MOVING CONTACTS (6.102)(Refer to Figures 3 & 4)::

1. Clean the groove in the lower Connection (6.104) with a cloth, greasing it thereafter with Litea 806-12 grease (ASEOL Bern)
2. Introduce the Moving Contact (6.102) into the Frame (6.101) and place it in the groove of the Lower Connection (6.1 04).
3. Prepare the Guide Assembly Kit as follow:
   - Carefully grease the Slot of the Guide (6.110): (Litea 806-12 grease of ASEOL/Bern)
   - Remove the useless Ring on the Rod (6.112)
   - Do not loose the Rod (6.112) or the Contact Roller (6.111)
   - Keep manually the Rod (6.112) properly centered onto the Guide (6.110)
4. Introduce the Guide Assembly (6.141)below the Lower Connection (6.104), fit the Pivot Socket (6.105) into the Lower Connection (6.104) and hook the Rod (6.112) onto the Moving Contact (6.102).
5. Torque the Screw (M8) underneath the Guide Assembly (6.141) to **5.8 ft lb**.(**8 Nm)**, maintaining the guide (6.110) in place (by means 10 mm wrench).

D. FRAME ASSEMBLY AND MAIN CIRCUIT INSTALLATION(Refer to Figures 3 & 4):

1. Fix the Circuit Breaker on the Floor (4 x M8) and torque to **11.04 ft lb**. (**15 Nm)**.
2. Carefully grease the Fork (6.307) using Litea 806-12 Grease of ASEOL /Bern.
3. Check the Closing Device for the following:
   a) The Fork (6.307) is engaged through the Guide (6.110) and the Moving Contact (6. 102).
   b) The Fork (6.106) of the Guide Assembly (6.141) is engaged through the Closing Device Housing (6.301).
   c) The Pins of the Lower Connection (6.104) are engaged through the Closing Device Housing (6.301).
4. Fix the Closing Device (6.300) against the Frame (6.101); Torque the Nuts (S.014) to **5.8 ft lb**.(**8 Nm)**.
5. Fix the Power Copper Plates on the Upper Connection (6.104)and Lower Connection(6.104;torque to **25.7 ft lb** (**35 Nm**.)
6. Mount the Arc-Chute (6.600) on the Circuit Breaker; torque the 4 Screws (S.012) to **11.04 ft lb**. (**15 Nm)**.
7. Install the two M6 Screws to secure the Copper Plate (6.104) to Lower Shell; torque to **6.2 ft lb.**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-02-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**11/12**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
MAIN CONTACT	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

E. HSCB INSTALLATION & CONNECTIONS.

1. Connect the Grounding Cable (24) to the side of the Closing Device (33) using the M6 Nuts and Screws Torque to **6.2 ft lb**.

2. Engage the Inner Movable Connector (23) with the Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.

3 Connect the Grounding Cable (24) to the side of the Closing Device (33) using the relevant M6 Nuts and Screws Torque to **6.2 ft lb**.

4 Engage the Inner Movable Connector (23) with the Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.

5 Check for HSCB Mechanical & Electrical Components clean. As need use recommended cleaner and clean lint - free rags.

6 Check for HSCB Arc Chute clean. As need use Vacuum cleaner and clean lint - free rags.

7 Position the Upper Shell (1) onto the Lower Shell. Torque to **11.04 ft lb**.(**15 Nm)**

8 Engage the LV VEAM Outer Movable Connector (18) into Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.

9 Reconnect the HSCB Fire Box Grounding Cable. Torque to **5.8 ft lb**. (**8 Nm)**

F FINAL OPERATIONS

1 Remove all Tools /Rags that were used, from the Vehicle Roof.

2 Leave the Vehicle Roof according to MTA procedures.

3 Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.

4 Restore Electrical Power to the Vehicle.

5 Record Task result on the Defect Report Card for administrative and maintenance planning

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS (**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **“At every Task Completion.”**

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-02-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **12/12**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **MAIN CONTACT**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

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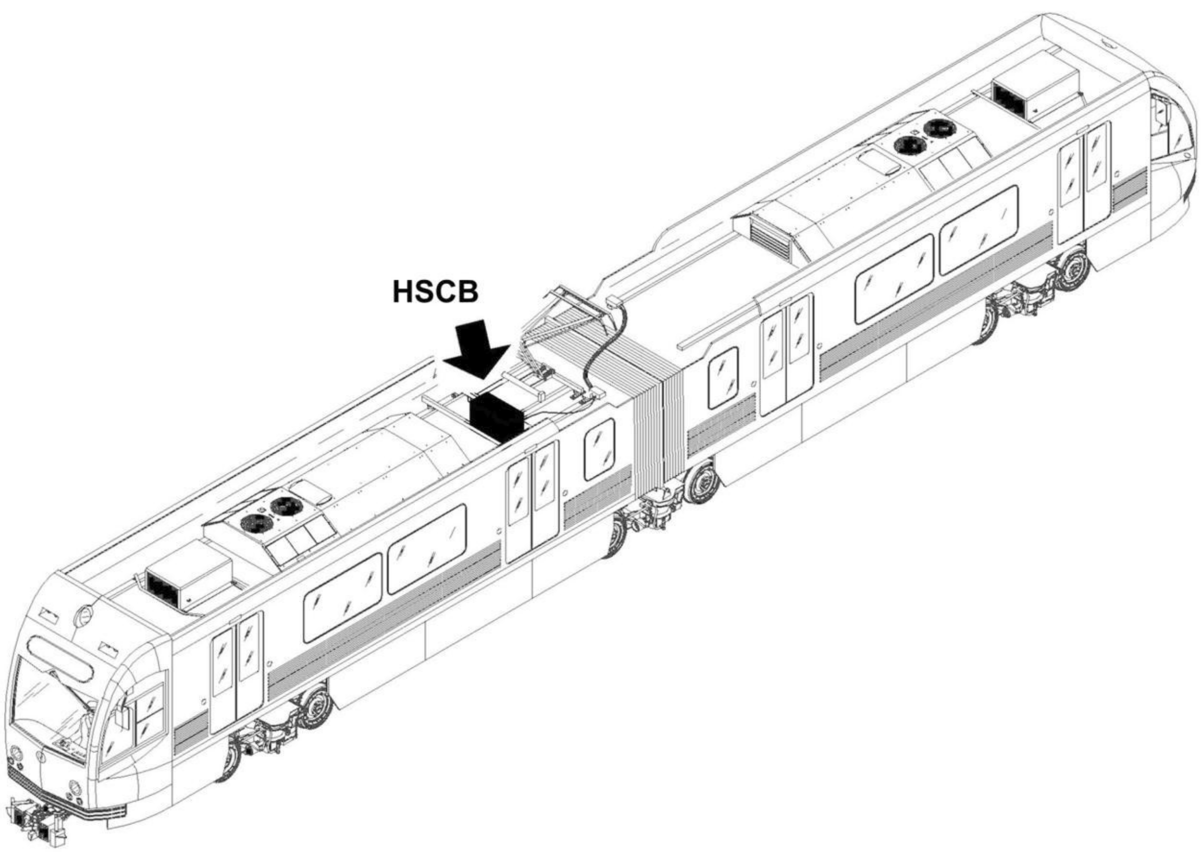
P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-03-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **1/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **CLOSING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-03-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **2/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **CLOSING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

SAFETY PRECAUTIONS:

WARNING **BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.**

WARNING: **DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.**
IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: **DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.**

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: **ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.**
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: **BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.**

WARNING: **NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.**

WARNING: **KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.**
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

CAUTION NEVER TIGHTEN OR UNTIGHTEN THE MOVING CORE SCREW (6.329).

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit. External Scaffold Special Tool W-6

CONSUMABLES:

Litea 806-12 Grease of ASEOL /Bern

SPARE PARTS:

HSCB Closing Device PN: HSBT 131014

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-03-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**3/14**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
CLOSING DEVICE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-03-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **4/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **CLOSING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

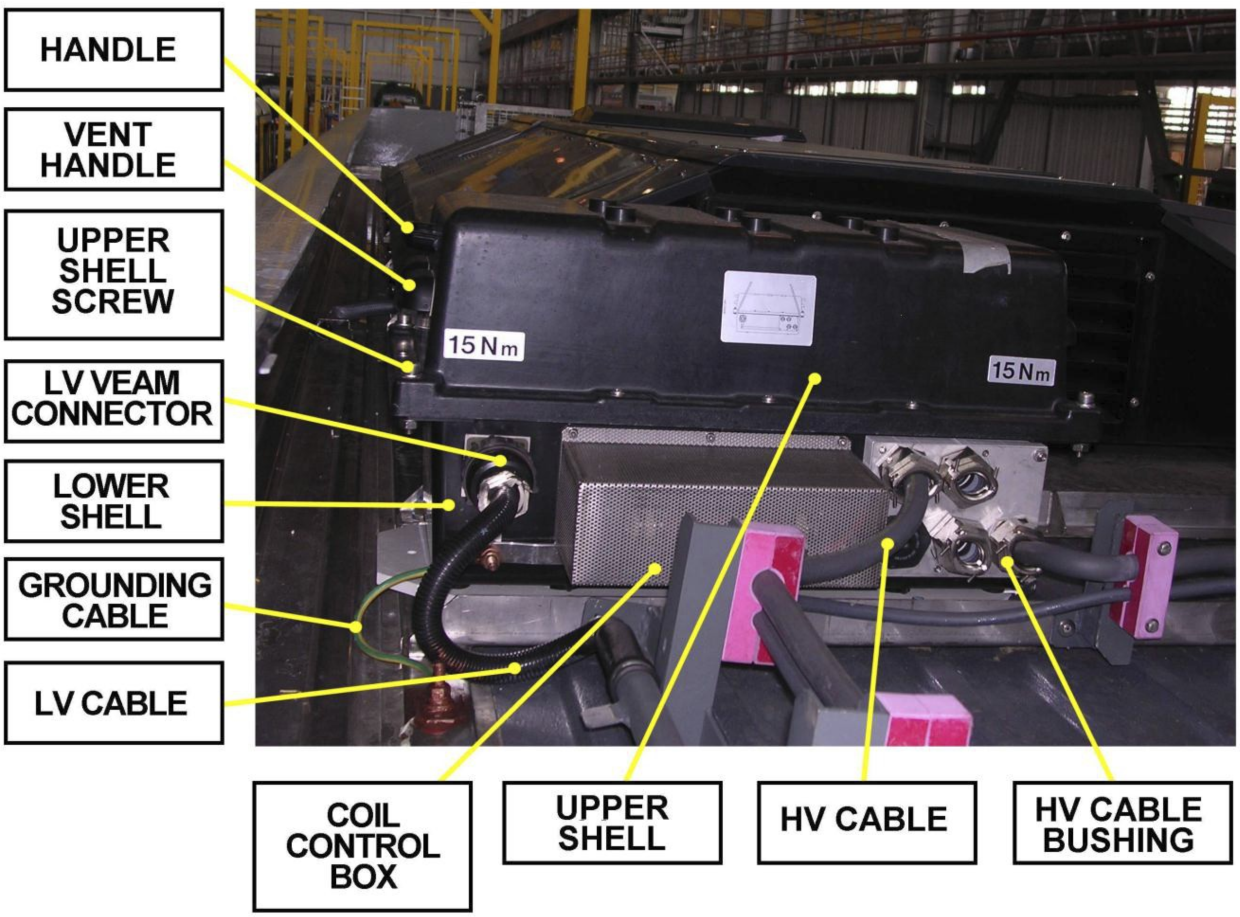


Figure 1 - HSCB - FIRE BOX - EXTERIOR

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-03-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **5/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **CLOSING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

A. **ARC CHUTE**
B. **CLOSING DEVICE**
C. **AUXILIARY CONTACTS**
D. **TRIPPING DEVICE**
E. **MAIN CIRCUIT**

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. PRESSURE SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. **PIVOT** SOCKET SPRING
10. FORK
11. LOWER CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. UPPER CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT

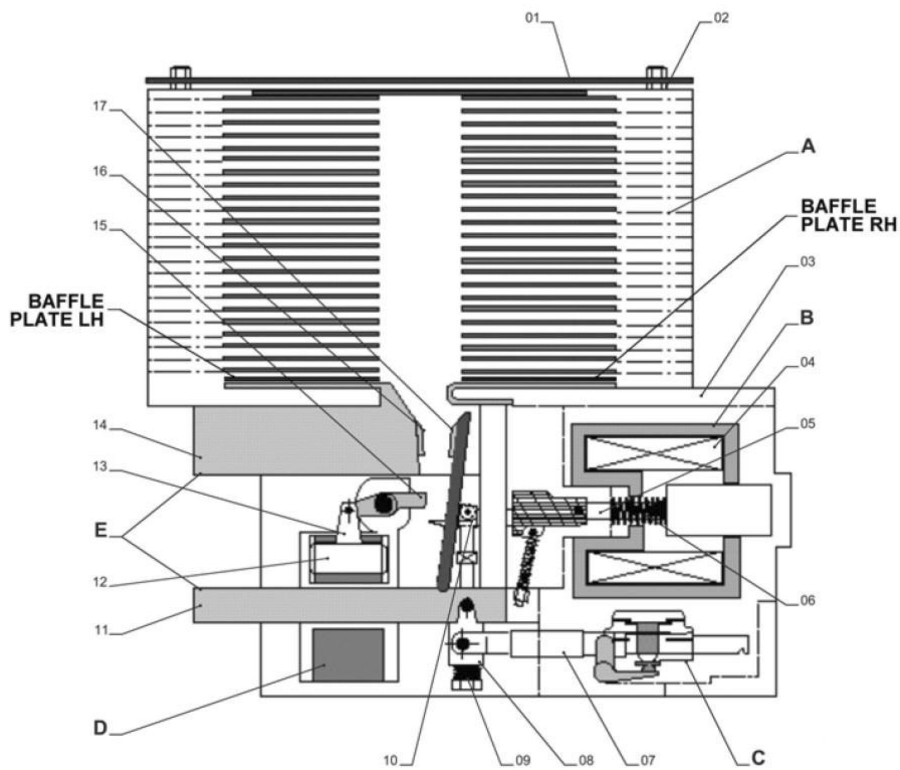


FIGURE 2 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-03-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **CLOSING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:
REMOVAL

To remove the Closing Device proceed as follows

A HSCB ASSY DISCONNECTION & REMOVAL FROM FIRE BOX:

1. Remove the HSCB according to Sheet R-C-09-02-01-00/R-00 Step A.

B FRAME ASSEMBLY AND MAIN CIRCUIT REMOVAL

1. Remove the Frame Assembly and Main Circuit according to Sheet R-C-09-02-02-00/R-00 Step B.

C CLOSING DEVICE REMOVAL(Refer to Figures 3 through 5):

1. Remove the Auxiliary Housing (6.401) Locking Screws (S.018) on the Closing Housing (6.301).
2. Disconnect the Grounding on the Stud (6.357).
3. Separate the Closing Housings (6.301) from the Auxiliary Housing (6.401) and disconnect the 2 Coil (6.303) Feed Wires (S.340).
4. Place the Closing Device on a work bench, supported by the rover (6.302) side, placing the Special Tool (W-6) beneath the Screw (6.329), in order to advance the Fork (6.307).
5. Remove the Spring Ring (6.336) by means of Small Pliers.
6. Dismount the Rod (6.315).
7. Remove the Fork (6.307) with the Pin (6.305), the Rod (6.304) and the Spring (6.322).
8. Remount the Closing Device on the Shims on the Work Bench.
9. Remove the Locking Screws and Nuts (4 x M5) from the Cover (6.302) and take away the latter.
10. Remove the Moving Core (6.330).

CAUTION NEVER TIGHTEN OR UNTIGHTEN THE MOVING CORE SCREW (6.329).

11. Remove Socket Bz (6.314).
12. Remove Rear Plate (6.309) and MVQ ring (6.319).

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-03-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**7/14**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
CLOSING DEVICE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

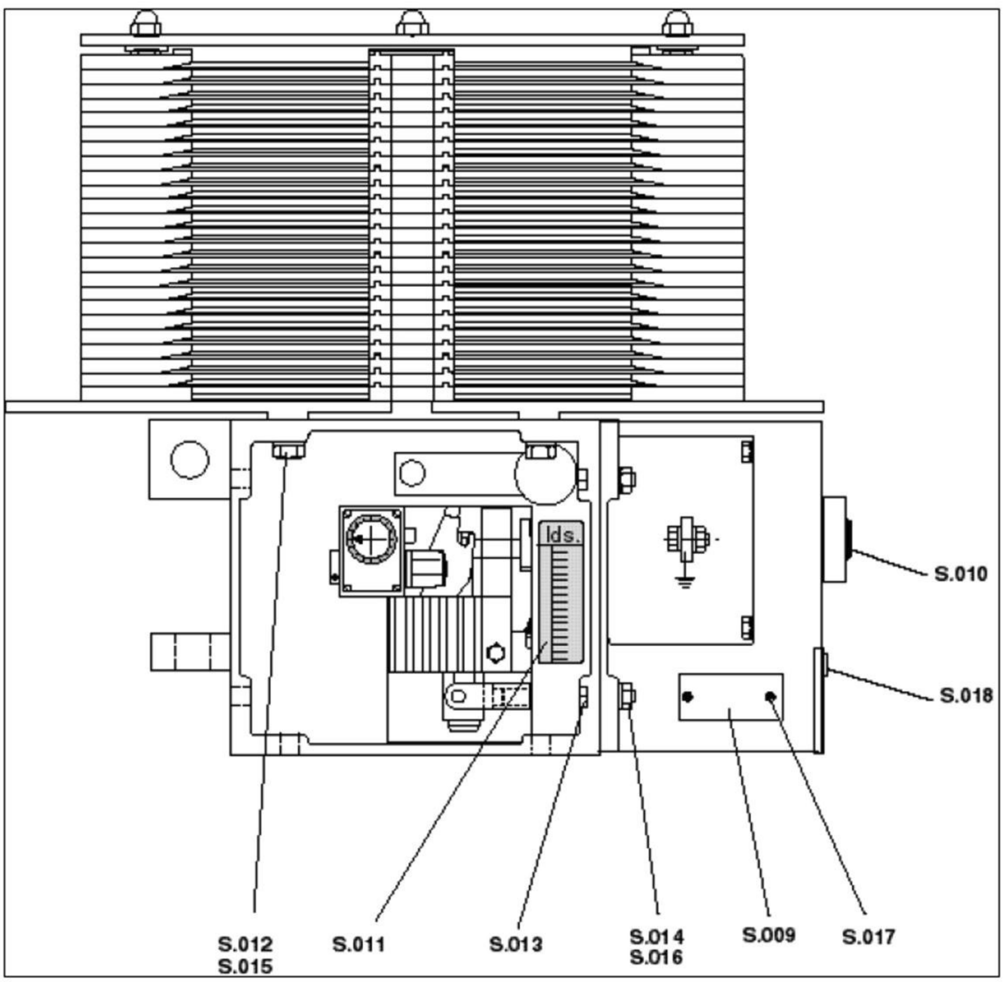
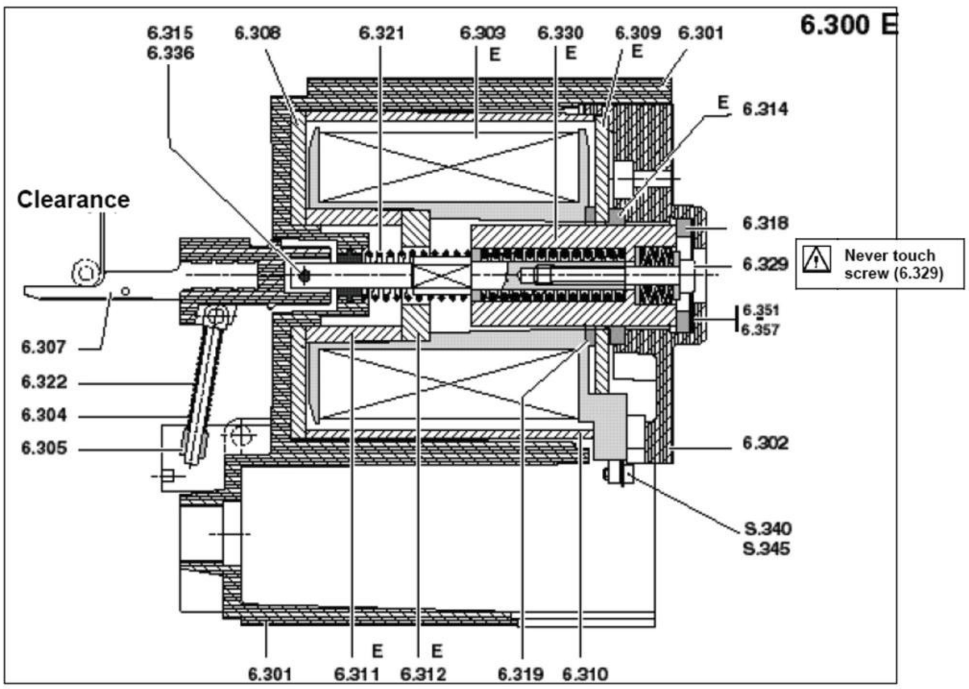


FIGURE 3 - HIGH SPEED CIRCUIT BREAKER - HARDWARE

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-03-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **8/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **CLOSING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:



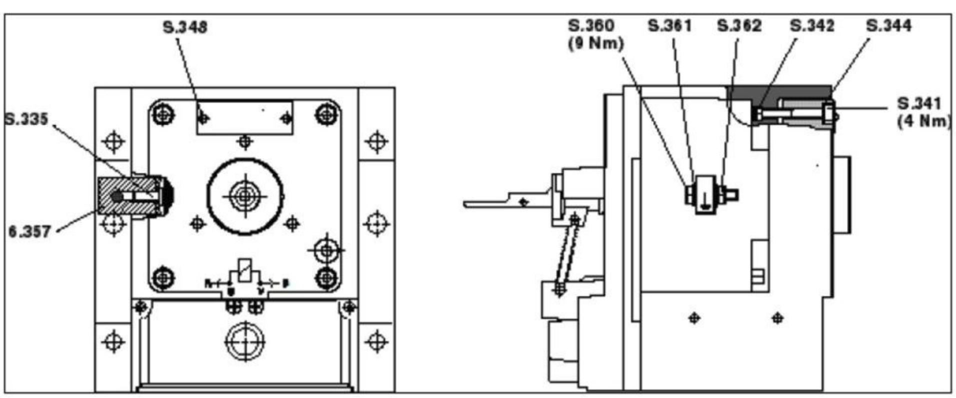


FIGURE 4 - HSCB CLOSING DEVICE ASSEMBLY

P2550 CORRECTIVE MAINTENANCE SHEET	
	Card Code: **R-C-09-02-03-00/R-00**
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **9/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **CLOSING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

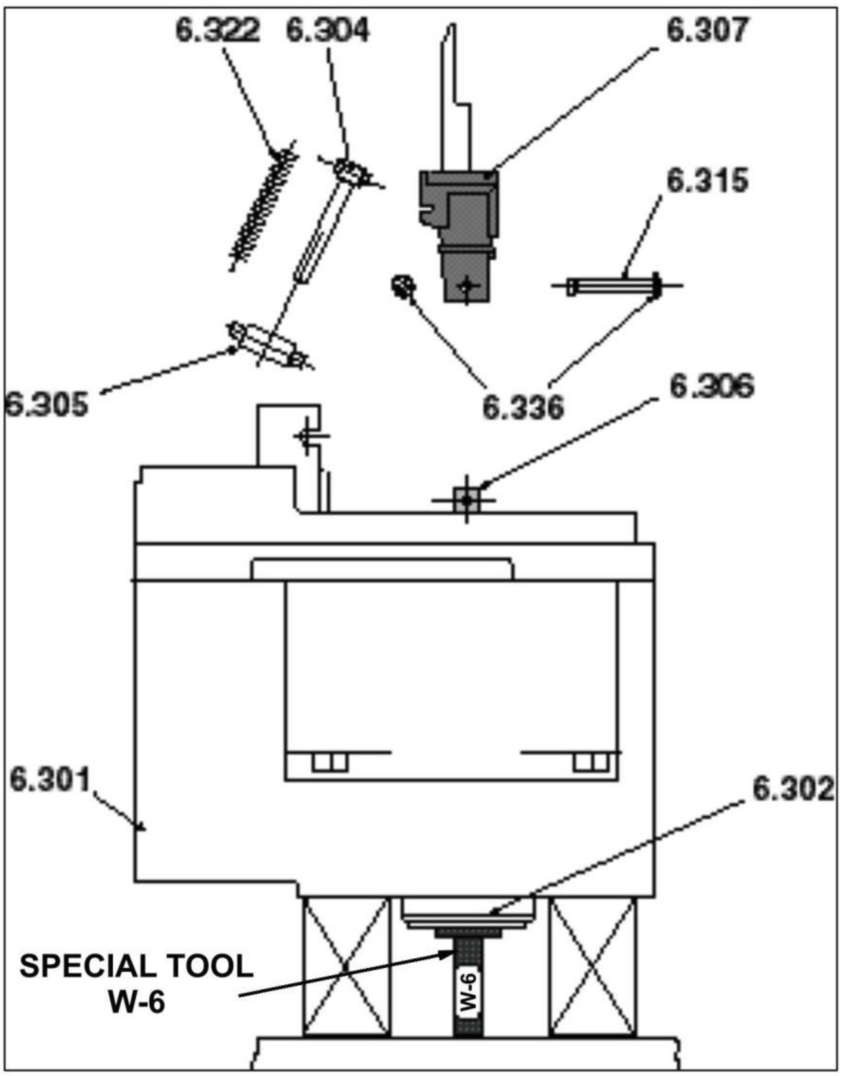


FIGURE 5 - HSCB CLOSING DEVICE DISMANTLING

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-03-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **10/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **CLOSING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

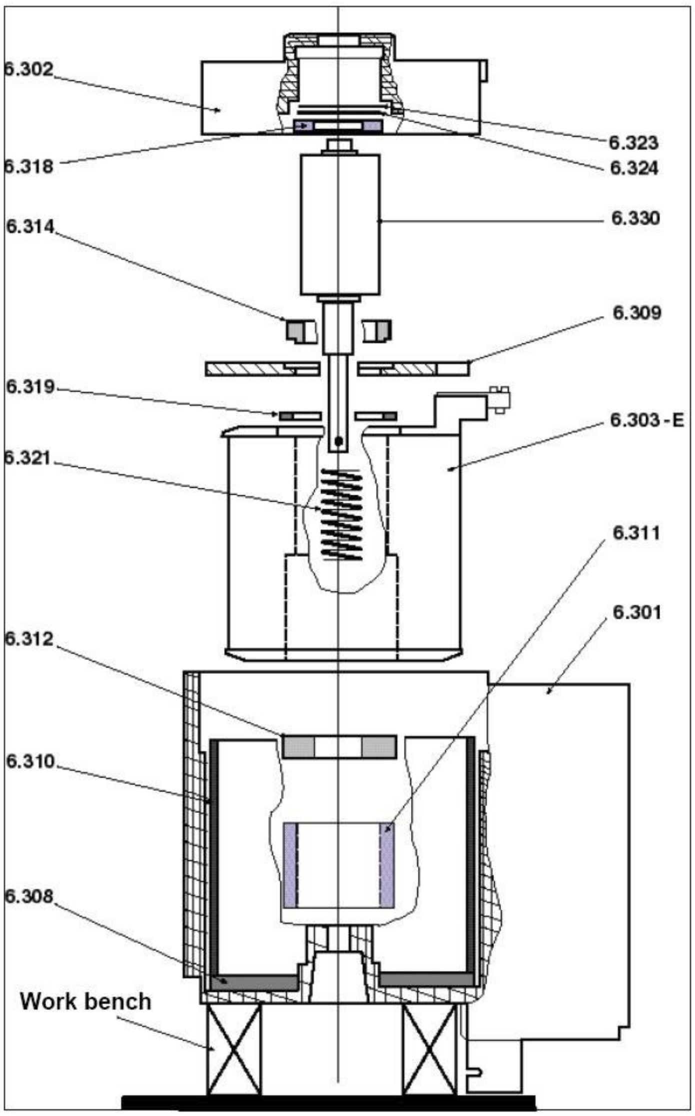


FIGURE 6 -HSCB CLOSING DEVICE MOUNTING

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-03-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**11/14**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
CLOSING DEVICE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

INSTALLATION

NOTE: It is assumed that the HSCB is safely positioned on the Work Bench.

To install the Closing Device proceed as follows

A CLOSING DEVICE INSTALLATION(Refer to Figures 3, 5, 6)

1. Introduce the Spring (6.321).
2. Place the new MVQ Ring (6.319).
3. Place the Rear Plate (6.309) and new Socket Bz (6.314).
4. Grease lightly the new Core Assembly (6.330) and then clean it with a soft paper.
5. Introduce the Core Assembly (6.330) into the Coil Housing (6.303).
6. Drive out the PUR washer (6.318) from the Cover (6.302) by means of a 3 mm Punch and replace it by a new PUR Washer (6.318), without forgetting the setting Washers (6.351 - 6.357).
7. Place the Cover (6.302) and lock it by the 4 Screws/Nuts (S.341 - S.342), torque them to **2.9 ft lb (4 Nm).**
8. Remount the Closing Device, placing the Special Tool (W-6) between the Screw (6.329) and the Work Bench.
9. Introduce the Fork (6.307) onto the Rod (6.306) and introduce thereafter the Rod (6.315) through the Fork (6.307) and the Rod (6.306).
10. Place the Spring Ring (6.336) on the Rod (6.315).
11. Remove the Special Tool (W-6) by pushing the Screw (6.329).
12. Place the Pin (6.305) on the Closing Housing (6.301) and introduce then the Spring (6.322) onto the Rod (6.304).
13. Introduce the two last mentioned items (Rod and Spring) into the Pin (6.305) and then the Fork (6.307).
14. Put the Closing Device (6.300) in place.
15. Introduce the Auxiliary Housing (6.401) by about **15 mm**.
16. Connect the Wires of the Closing Coil (S.340).
17. Advance the Auxiliary Housing (6.401) and mount the Locking Screws (S.018) on the Closing Housing (6.301).
18. Fix the Closing Device (6.300) against the Frame (6.101) and torque the Nuts (S.014) to **5.8 ft lb** (**8 Nm**).
19. Once the HSCB have been reassemble perform the Inspection provided in the next step B

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-03-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **12/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **CLOSING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

A CLOSING DEVICE INSTALLATION(cont'd)(Refer to Figures 3, 5, 6)

20. Fix the Power Copper Plates on the Upper Connection(6.104)and Lower Connection(6.104. Torque to **35 Nm**.

21. Mount the Arc-Chute (6.600) on the Circuit Breaker. Torque the 4 Screws (S.012) to **11.04 ft lb**. (**15 Nm**).

22. Install the two M6 Screws to secure the Copper Plate (6.104) to Lower Shell. Torque to **6.2 ft lb**

B CLOSING DEVICE INSPECTION & FUNCTIONAL CHECKS

Perform the following checks when the Circuit Breaker has been assembled:

1 Check that:

a) The Fork (6.307) is engaged through the Guide (6.110) and the Moving Contact (6. 102).

b) The Fork (6.106) of the Guide Assembly (6.141) is engaged through the Closing Device Housing (6.301).

c) The Pins of the Lower Connection (6.104) are engaged through the Closing Device Housing (6.301).

2. Measurement of the Clearance **X** between Fork (6.307) and Roller (6.111):(HSCB tripped).

a) Measure the distance between the Cover (6.302) and the Screw (6.329) of the Core Assembly (6.330) as follows:

1) By means of a Depth Gauge:

2) Without moving the Core Assembly.

3) By advancing the Core Assembly in order to readjust the Clearance.

b) Determination of the measuring difference, the result shall be: **X = 0,7 ± 0,3**

c) Adjust the Clearance **X** by adding or removing Setting Washers (6.351 - 6.357).

CAUTION NEVER TIGHTEN OR UNTIGHTEN THE MOVING CORE SCREW (6.329)

3. Set the HSCB to close and check the holding current for type E

NOTE: The value of Type E Holding Current is the 5% of the Closing Current

4. Trip the HSCB:

- By Interruption of Holding
- By Simulation of Imax (unhooking the fork), then Interruption of Holding

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-03-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **13/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **CLOSING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

C. FRAME ASSEMBLY AND MAIN CIRCUIT INSTALLATION(Refer to Figures 3 & 4):

1. Install the Frame Assembly And Main Circuit according to Sheet R-C-09-02-02-00/R-00.Step D

D. HSCB INSTALLATION & CONNECTIONS.

1. Connect the Grounding Cable (24) to the side of the Closing Device (33) using the M6 Nuts and Screws.Torque to **6.2 ft lb**.

2. Engage the Inner Movable Connector (23) with the Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.

3 Connect the Grounding Cable (24) to the side of the Closing Device (33) using the relevant M6 Nuts and Screws.Torque to **6.2 ft lb**.

4 Engage the Inner Movable Connector (23) with the Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.

5 Check for HSCB Mechanical & Electrical Components clean. As need use recommended cleaner and clean lint - free rags.

6 Check for HSCB Arc Chute clean. As need use Vacuum cleaner and clean lint - free rags.

7 Position the Upper Shell (1) onto the Lower Shell. Torque to **11.04 ft lb**.(**15 Nm)**

8 Engage the LV VEAM Outer Movable Connector (18) into Fixed Connector (19) and rotate the Bayonet Retainer until a “click” is heard indicating clamping.

9 Reconnect the HSCB Fire Box Grounding Cable. Torque to **5.8 ft lb**.(**8 Nm)**

F FINAL OPERATIONS

1 Remove all Tools /Rags, that were used, from the Vehicle Roof.

2 Leave the Vehicle Roof according to MTA procedures.

3 Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.

4 Restore Electrical Power to the Vehicle.

5 Record Task result on the Defect Report Card for administrative and maintenance planning

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **“At every Task Completion.”**

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-03-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **14/14**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **CLOSING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

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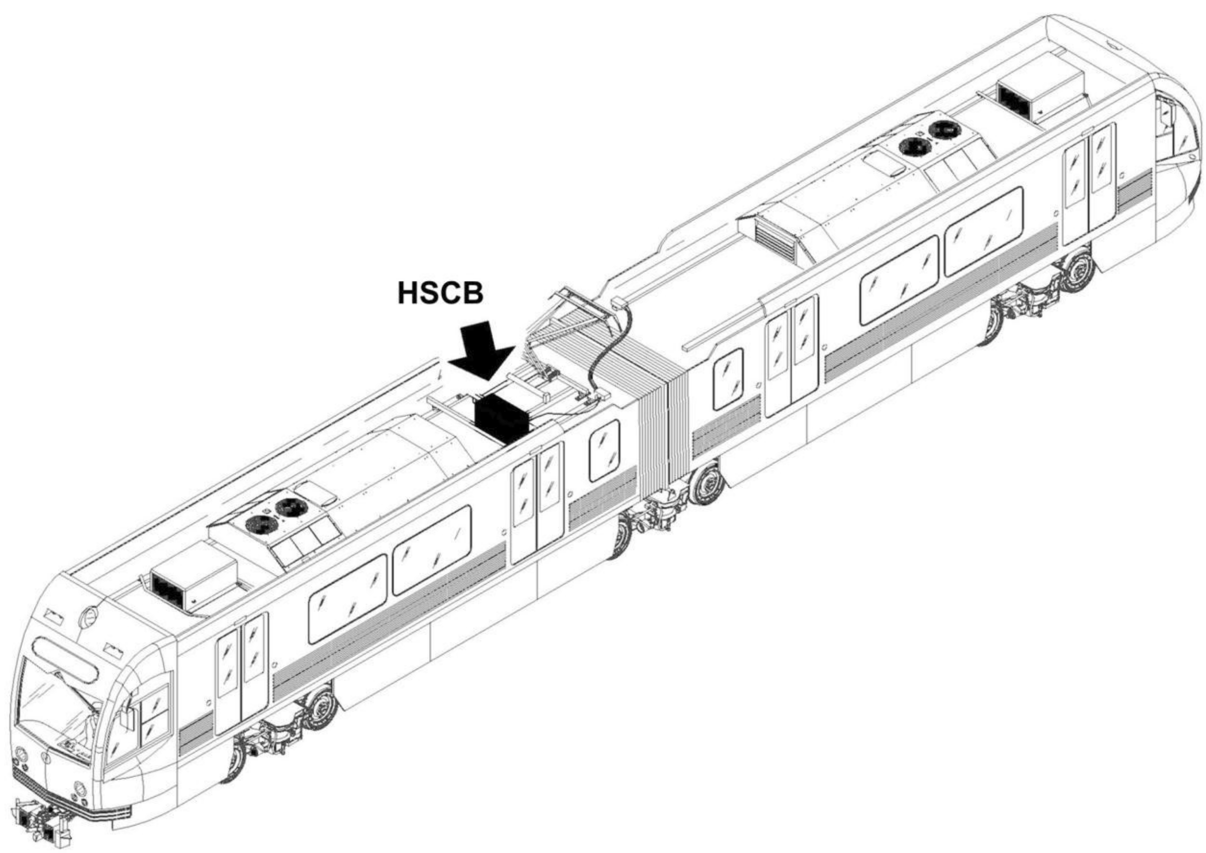
P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-04-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **1/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **TRIPPING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-04-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **2/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **TRIPPING DEVICE**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.
IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

TOOLS:
LACMTA Maintenance Shop Standard Tools Kit. External Scaffold

CONSUMABLES:
Litea 806-12 Grease of ASEOL /Bern

Sealing lacquer (type F-900, manuf. Organic Products Co., Irving - TX

SPARE PARTS:
Tripping Device PN HSBT 231019 R 0300

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-04-00/R-00

System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **TRIPPING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.
2. Set the Master Controller Handle to FSB position.
3. Make sure that all Parking Brakes are applied (by checking on the IDU “Parking Brake A and B Not Released” and on Indicator Panel “A” “Park / Friction Brake” ON).
4. Remove Electrical Power from Vehicle by lowering the Pantograph.
5. Turn the Transfer Switch to OFF.
6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker “A” Section) to OFF.
7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures

NOTE The tag must indicate the name of the person who removed Power. That person knows why the Power was removed and when it safe to restore it.
Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

REMOVAL

To remove the Tripping Device proceed as follows (Refer to Figures 1, 2 and 3):

A HSCB ASSY DISCONNECTION & REMOVAL FROM FIRE BOX:

1. Remove the HSCB according to Sheet R-C-09-02-01-00/R-00 Step A

B MAIN CONTACT REMOVAL

1. Remove the Main Contact (6.100) according to Sheet R-C-09-02-02-00/R-00.

C TRIPPING DEVICE REMOVAL

1. Remove the Connection (6.109) in order to remove the Lower Connection (6.104) from the Tripping Housing (6.201).
2. Remove the Tripping Device (6.200).

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-04-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**4/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
TRIPPING DEVICE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

A. **ARC CHUTE**
B. **CLOSING DEVICE**
C. **AUXILIARY CONTACTS**
D. **TRIPPING DEVICE**
E. **MAIN CIRCUIT**

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. **PRESSURE** SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. **PIVOT** SOCKET SPRING
10. FORK
11. **LOWER** CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. **UPPER** CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT

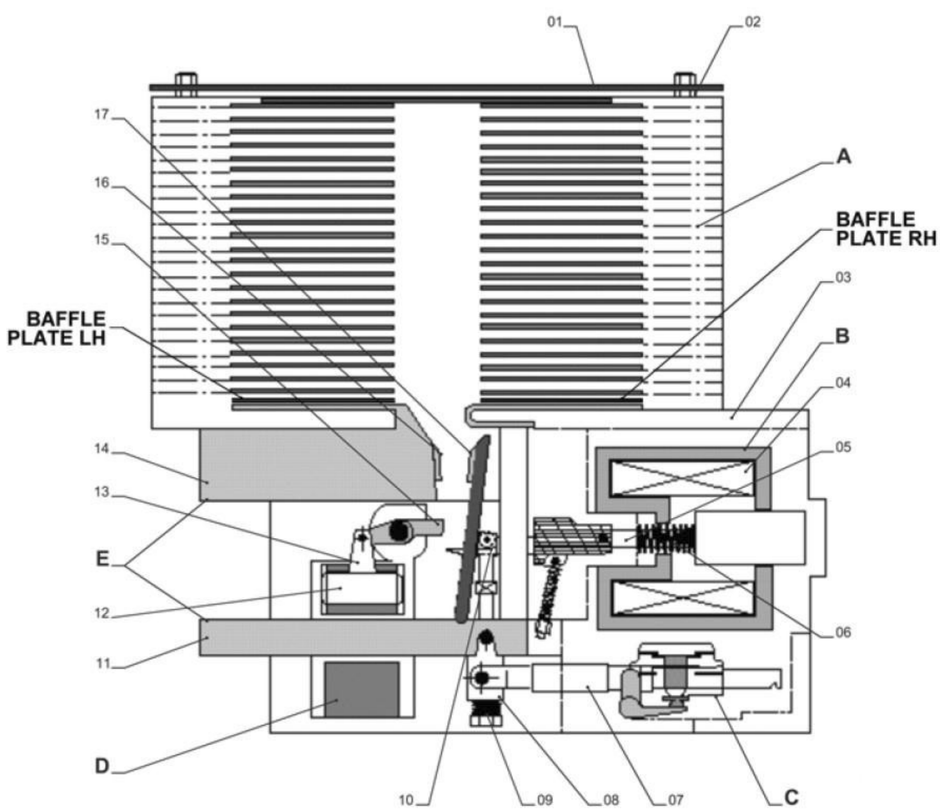


FIGURE 2 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-04-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **5/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **TRIPPING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

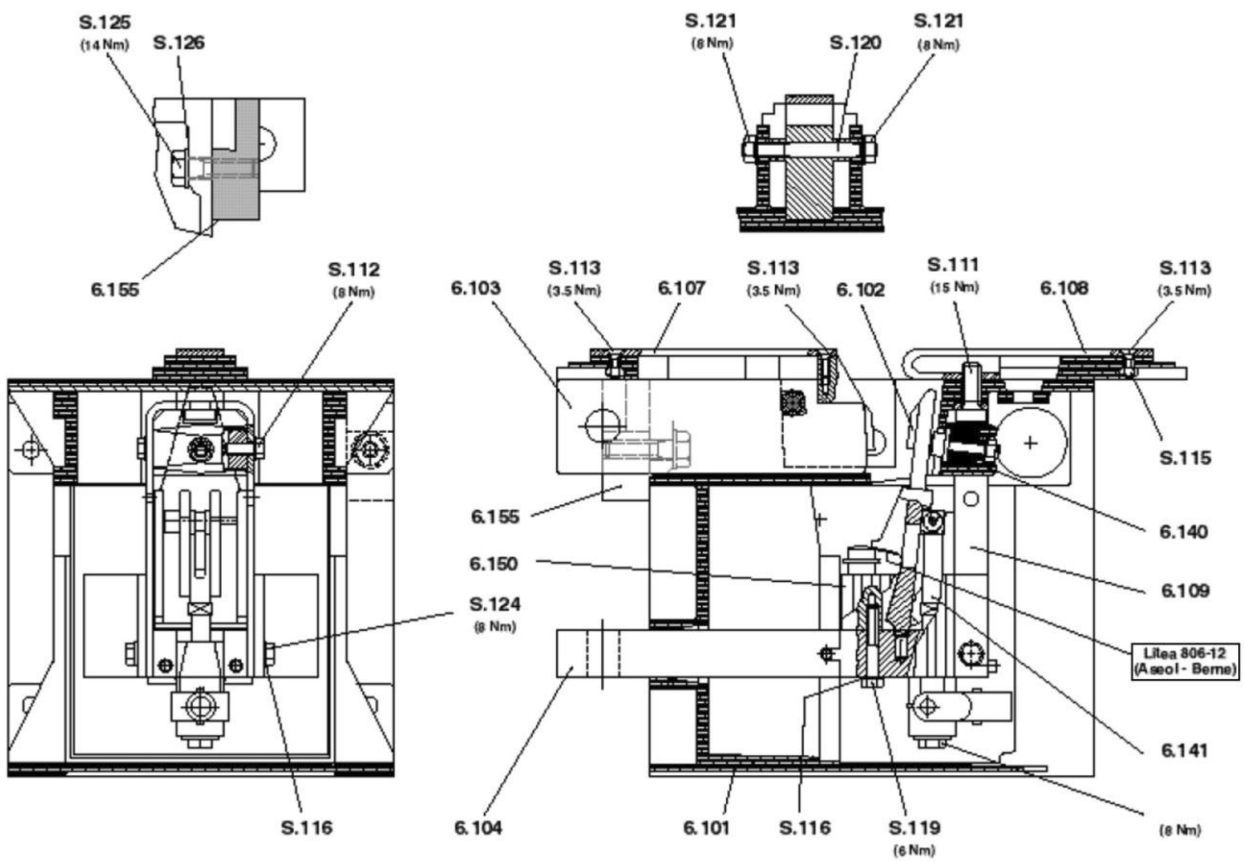


FIGURE 2 - HSCB MAIN CIRCUIT ASSEMBLY

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-04-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **TRIPPING DEVICE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

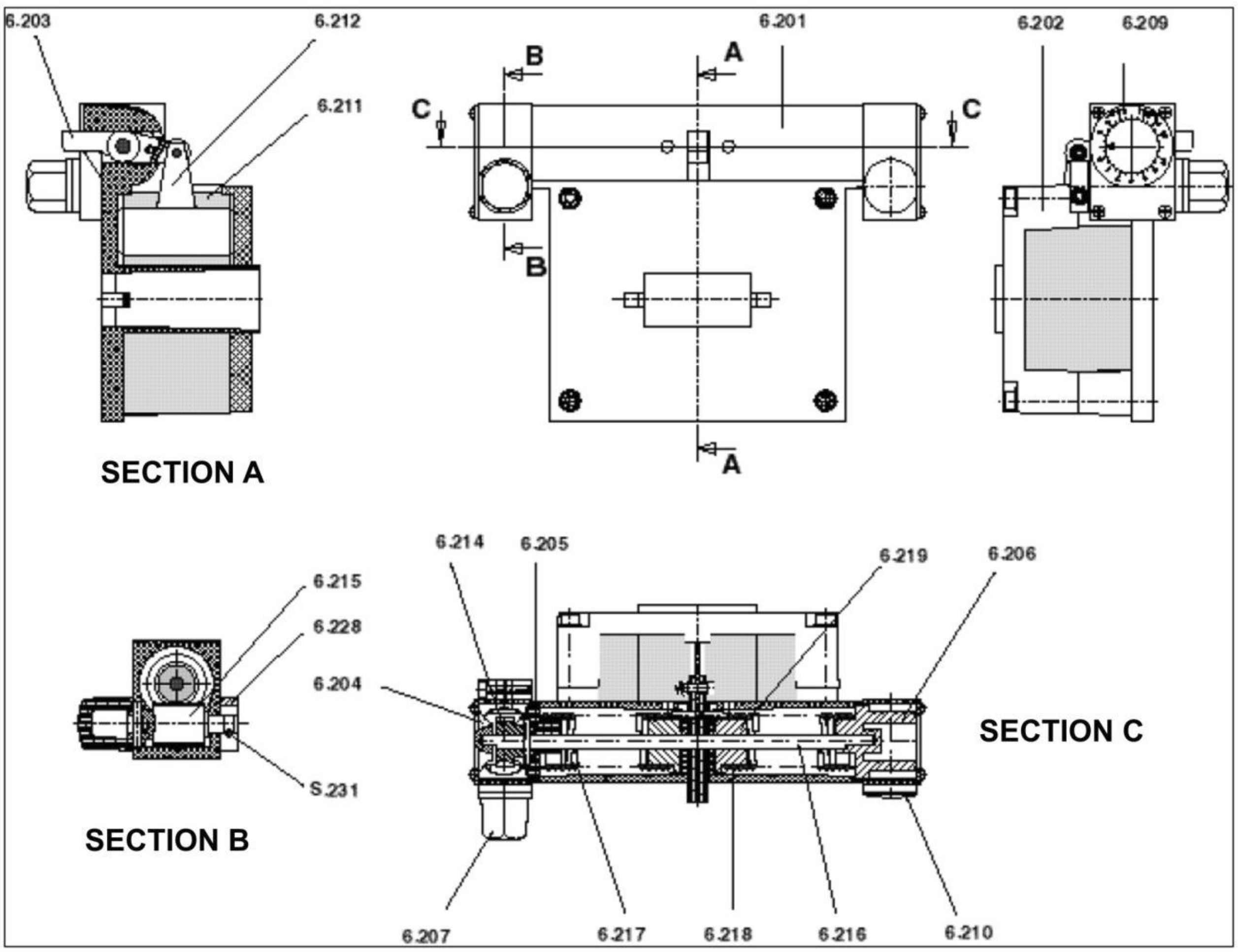


FIGURE 3 - HSCB TRIPPING DEVICE ASSEMBLY

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-04-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**7/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
TRIPPING DEVICE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:
INSTALLATION

NOTE: It is assumed that the HSCB is safely positioned on the Work Bench

To install the Tripping Device proceed as follows (Refer to Figures 1, 2 and 3):

A TRIPPING DEVICE INSTALLATION

1. Position the new Tripping Device (6.200).
2. Introduce the Lower Connection (6.104) into the Tripping Housing (6.201) paying attention to the proper mounting direction.

B MAIN CONTACT INSTALLATION

1. Install the Main Contact (6.100) according to Sheet R-C-09-02-02-00/R-00.

C. FRAME ASSEMBLY AND MAIN CIRCUIT INSTALLATION

1. Install the Frame Assembly And Main Circuit according to Sheet R-C-09-02-02-00/R-00.Step D
2 Calibrate the IDS threshold

D. HSCB INSTALLATION & CONNECTIONS.

1. Install the HSCB according to Sheet R-C-09-02-02-00/R-00.Step F

E TRIPPING CURRENT DEVICE ADJUSTMENT (refer to Fig 4)

1. Verify that the Red Arrow of the Tripping Indicator Knob coincides with the number **7,2** on the Circular Graduated Plate, corresponding to a Tripping Current Value of about **1,700 A**.
2. If not, proceed the as follows:
   a. Locate the Tripping Current Regulation Device
   b. Remove the existing sealing lacquer on the regulation device taking care that any eventual residual will not remain inside the HSCB.
   c. Rotate the Knob until the Movable Reference Mark (red arrow) of the Tripping Indicator coincides with the number **7,2** on the Circular Graduated Plate, corresponding to a Tripping Current Value of about **1,700 A**.
   d. Apply the sealing lacquer (type F-900, manuf. Organic Products Co., Irving - TX) on the Knob.
   e. Install the HSCB cover and tighten the screws to **15 Nm.**

F FINAL OPERATIONS

1 Remove all Tools /Rags, that were used, from the Vehicle Roof.
2 Leave the Vehicle Roof according to MTA procedures.
3 Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-04-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**8/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
TRIPPING DEVICE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

4 Restore Electrical Power to the Vehicle.

5 Record Task result on the Defect Report Card for administrative and maintenance planning

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

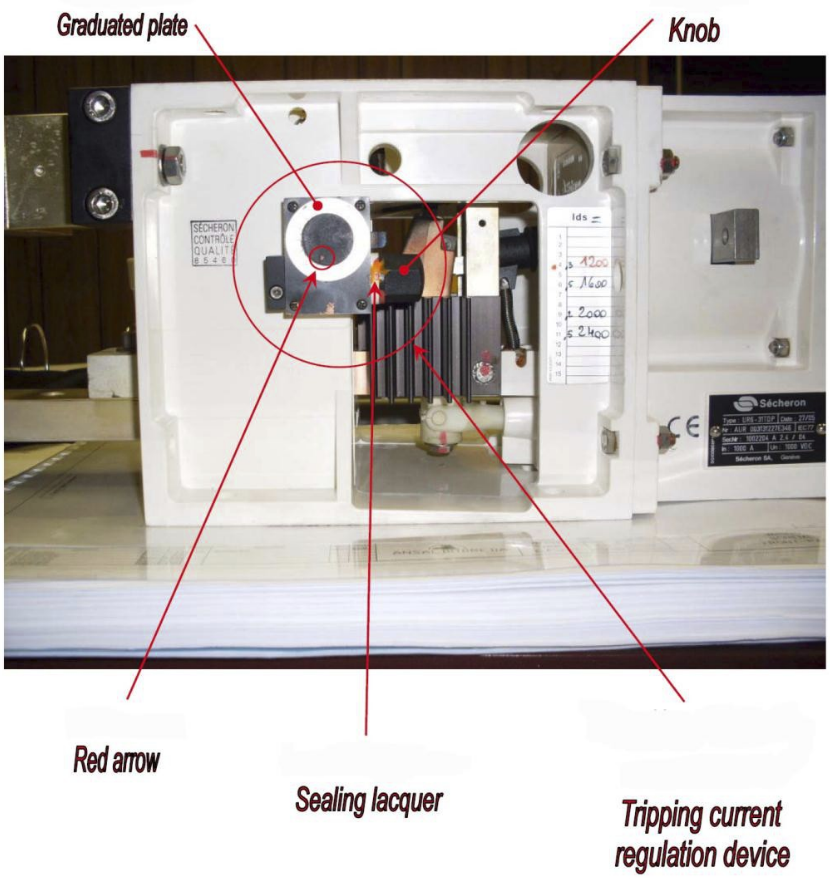
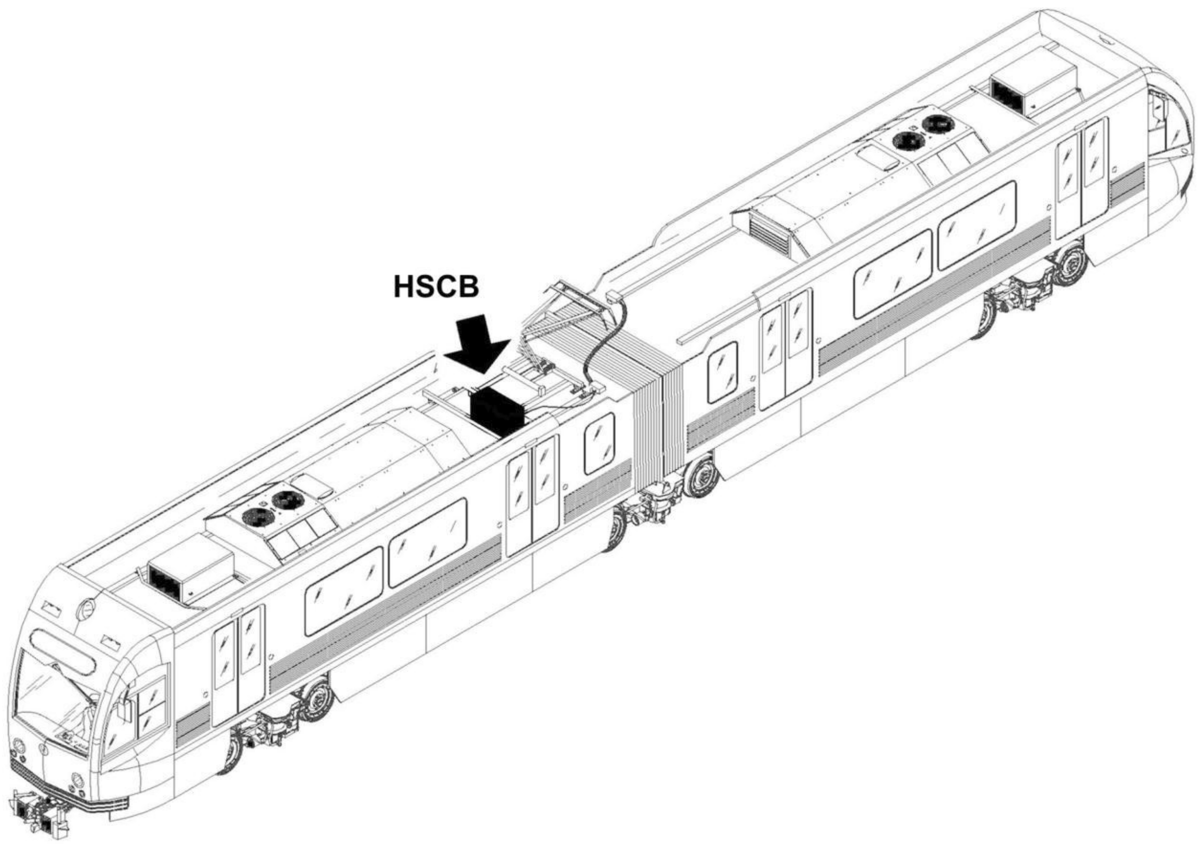


FIGURE 10 -HSCB TRIPPING DEVICE ADJUSTMENT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-05-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **1/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MOVING CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-05-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **2/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MOVING CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.
IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit. External Scaffold

CONSUMABLES:

Litea 806-12 Grease of ASEOL / Bern

SPARE PARTS:

Moving Contact PN HSBA 433111 R 0001

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-05-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**3/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
MOVING CONTACT	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-05-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **4/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MOVING CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

A. **ARC CHUTE**
B. **CLOSING DEVICE**
C. **AUXILIARY CONTACTS**
D. **TRIPPING DEVICE**
E. **MAIN CIRCUIT**

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. **PRESSURE** SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. PIVOT SOCKET SPRING
10. FORK
11. LOWER CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. UPPER CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT

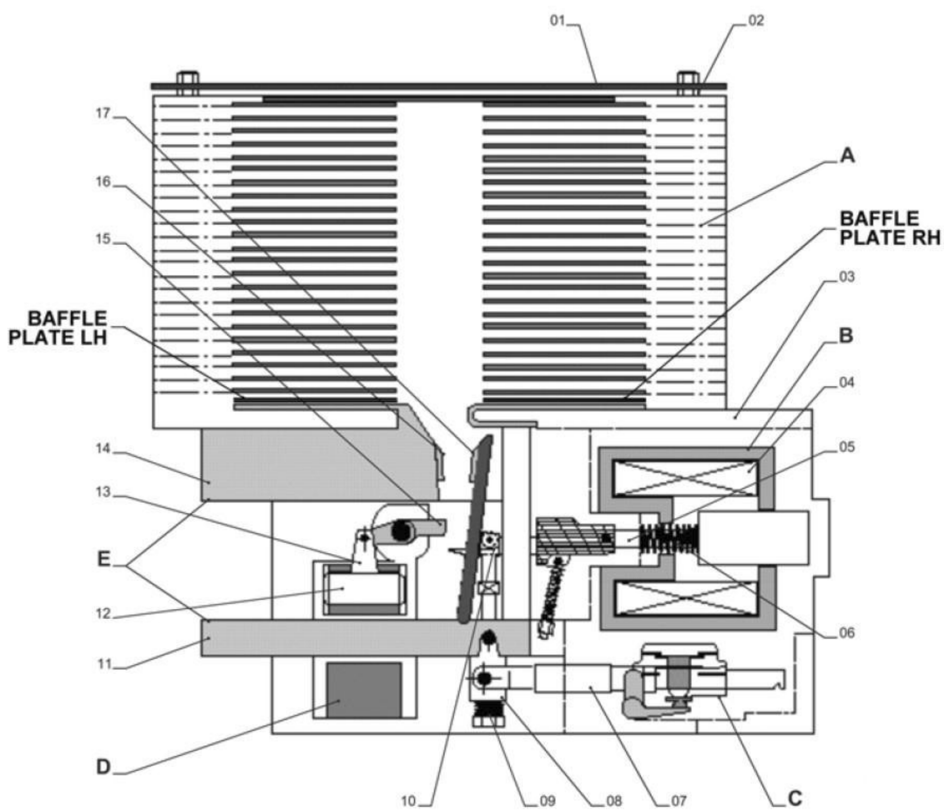


FIGURE 2 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-05-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
MOVING CONTACT	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

REMOVAL

To remove the Moving Contact proceed as follows:

A HSCB ASSY DISCONNECTION & REMOVAL FROM FIRE BOX:

1. Remove the HSCB according to Sheet R-C-09-02-01-00/R-00 Step A.

B FRAME ASSEMBLY AND MAIN CIRCUIT REMOVAL

1. Remove the Frame Assembly and Main Circuit according to Sheet R-C-09-02-02-00/R-00 Step B.

C DISMANTLING OF THE MOVING CONTACTS (6.102) (Refer to Figures 1& 2)

1. Unscrew the Screw (M8) of the Guide Assembly (6.141), maintaining the Guide (6.110) in place by a Wrench (10 mm).

2. Unscrew until a distance of 2 mm remains between the Screw head and the Frame Bottom (6.101).

3. Separate the Guide Assembly (6.141) from the Moving Contact (6.102), lifting it by the Guide (6.110), in order to unhook the Rod (6.112).

4 Lower the Guide Assembly (6.141) until below the Lower Connection, then rotate it to remove

5. Lift the Moving Contact (6.102), and extract it through the Connection (6.109).

- Remove the useless Ring on the Rod (6.112)
- Do not loose the Rod (6.112) or the Contact Roller (6.111)
- Keep manually the Rod (6.112) properly centered onto the Guide (6.110)

6. Introduce the Guide Assembly (6.141)below the Lower Connection (6.104), fit the Pivot Socket (6.105) into the Lower Connection (6.104) and hook the Rod (6.112) onto the Moving Contact (6.102). Tighten the Screw (M8) underneath the Guide Assembly.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-05-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**6/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
MOVING CONTACT	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

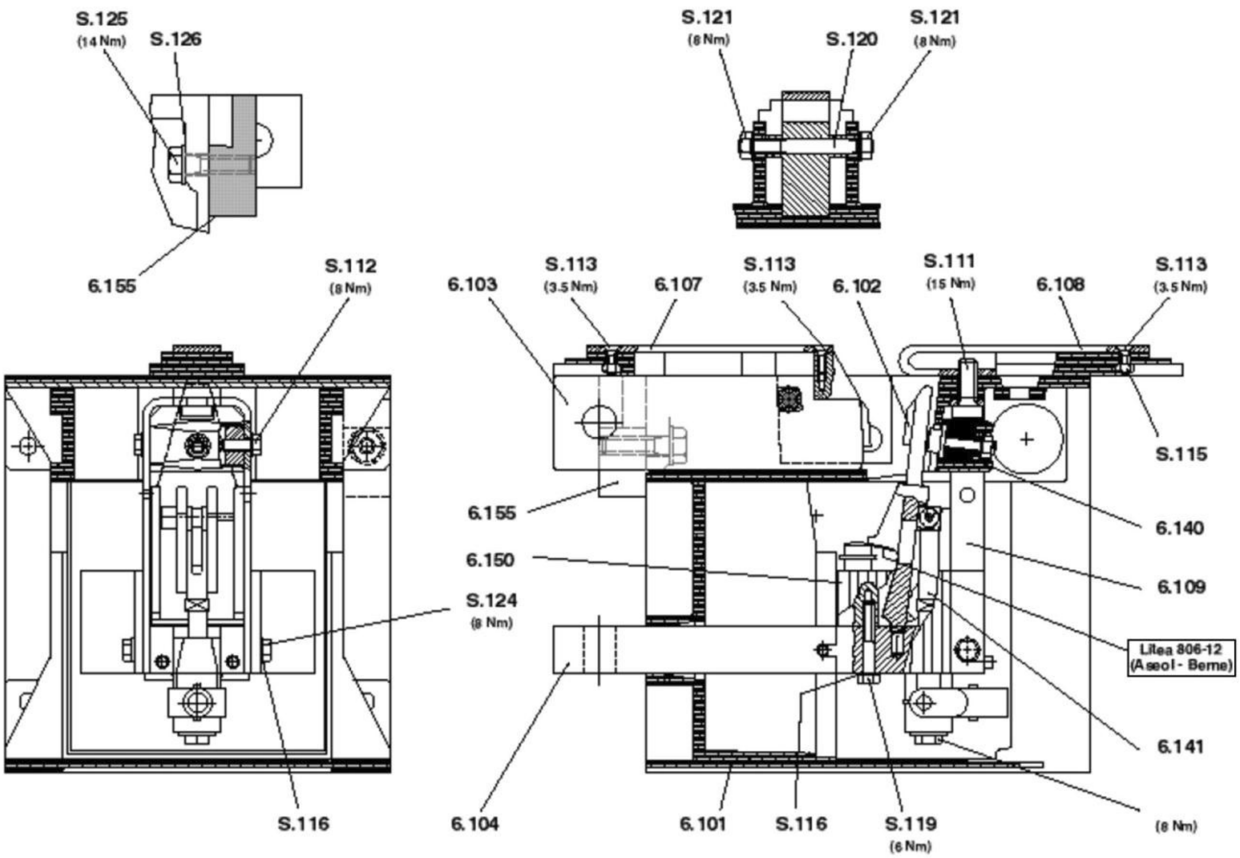


FIGURE 1 - HSCB MAIN CIRCUIT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-05-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**7/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
MOVING CONTACT	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

INSTALLATION

NOTE: It is assumed that the HSCB is safely positioned on the Work Bench

To install the Moving Contact proceed as follows

A. ***MOUNTING OF THE MOVING CONTACTS (6.102)*** (Refer to Figures 1& 2)

1. Clean the groove in the lower Connection (6.104) with a cloth, greasing it thereafter with Litea 806-12 grease (ASEOL Bern).
2. Introduce the Moving Contact (6.102) into the Frame (6.101) and place it in the groove of the Lower Connection (6.1 04).
3. Prepare the Guide Assembly Kit as follows:
- Carefully grease the Slot of the Guide (6.110): (Litea 806-12 grease of ASEOL/Bern)

B. ***FRAME ASSEMBLY AND MAIN CIRCUIT INSTALLATION(***Refer to Figures 3 & 4):
1. Install the Frame Assembly and Main Circuit according to Sheet R-C-09-02-02-00/R-00 Step D.

C. ***HSCB INSTALLATION & CONNECTIONS.***
1. Install the HSCB according to Sheet R-C-09-02-02-00/R-00.Step E.

D **FINAL OPERATIONS**

1 Remove all Tools /Rags, that were used, from the Vehicle Roof.
2 Leave the Vehicle Roof according to MTA procedures.
3 Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.
4 Restore Electrical Power to the Vehicle.
5 Record Task result on the Defect Report Card for administrative and maintenance planning

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-09-02-05-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **8/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **MOVING CONTACT**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

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P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-06-00/R-00

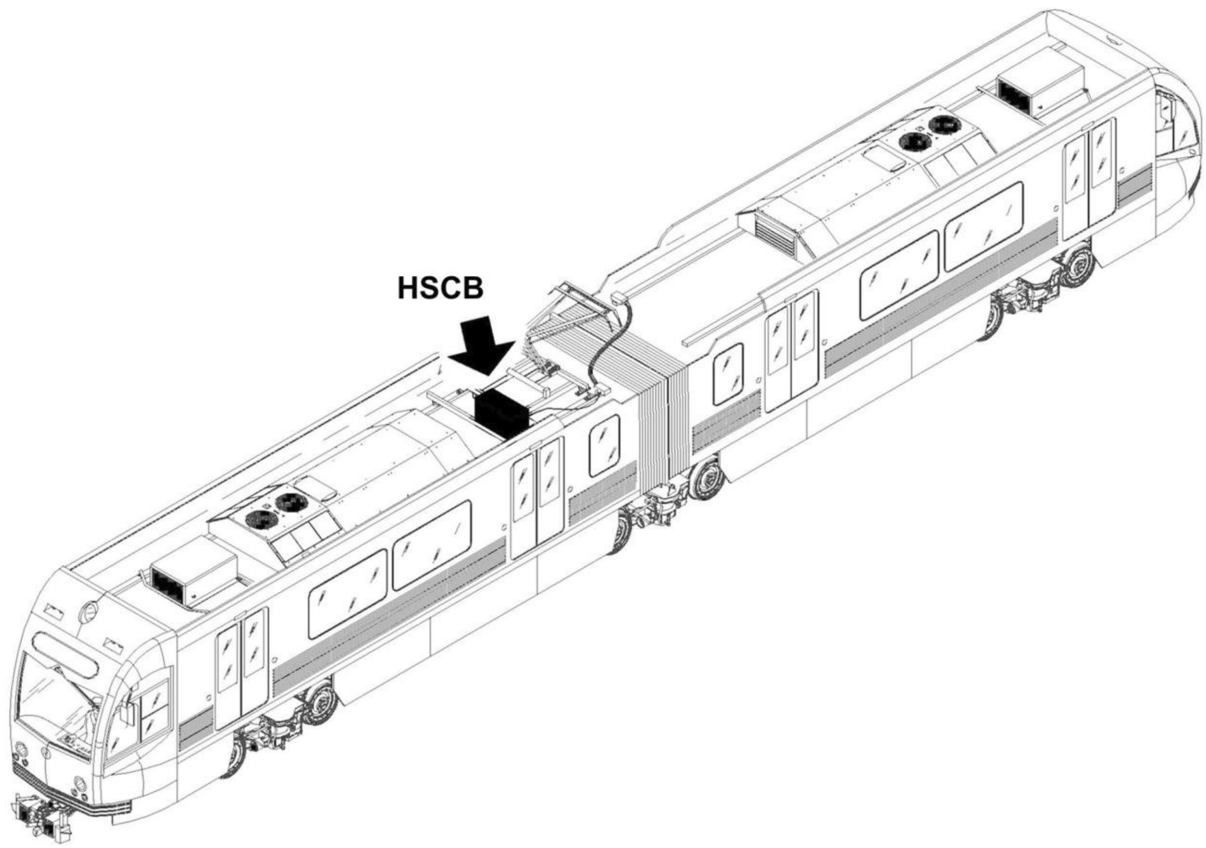
System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**1/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
LIMIT SWITCH	**1**

Maintenance Task:
REPLACEMENT

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-06-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**2/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
LIMIT SWITCH	**1**

Maintenance Task:
REPLACEMENT

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.
IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

TOOLS:
LACMTA Maintenance Shop Standard Tools Kit. External Scaffold Special Tool W-6

CONSUMABLES:
NA

SPARE PARTS:

Limit Switch PN: HSBT 431073 P0001

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-06-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **3/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **LIMIT SWITCH**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-06-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **4/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **LIMIT SWITCH**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

A. **ARC CHUTE**
B. **CLOSING DEVICE**
C. **AUXILIARY CONTACTS**
D. **TRIPPING DEVICE**
E. **MAIN CIRCUIT**

01. TOP PLATE
02. THREADED RODS
03. CHUTE PLATE
04. CLOSING COIL
05. ROD
06. **PRESSURE** SPRING
07. GUIDE ASSEMBLY
08. PIVOT SOCKET
09. PIVOT SOCKET SPRING
10. FORK
11. LOWER CONNECTION
12. SET OF PLATES
13. MOVING MAGNET
14. UPPER CONNECTION
15. LEVER
16. FIXED CONTACT
17. MOVING CONTACT

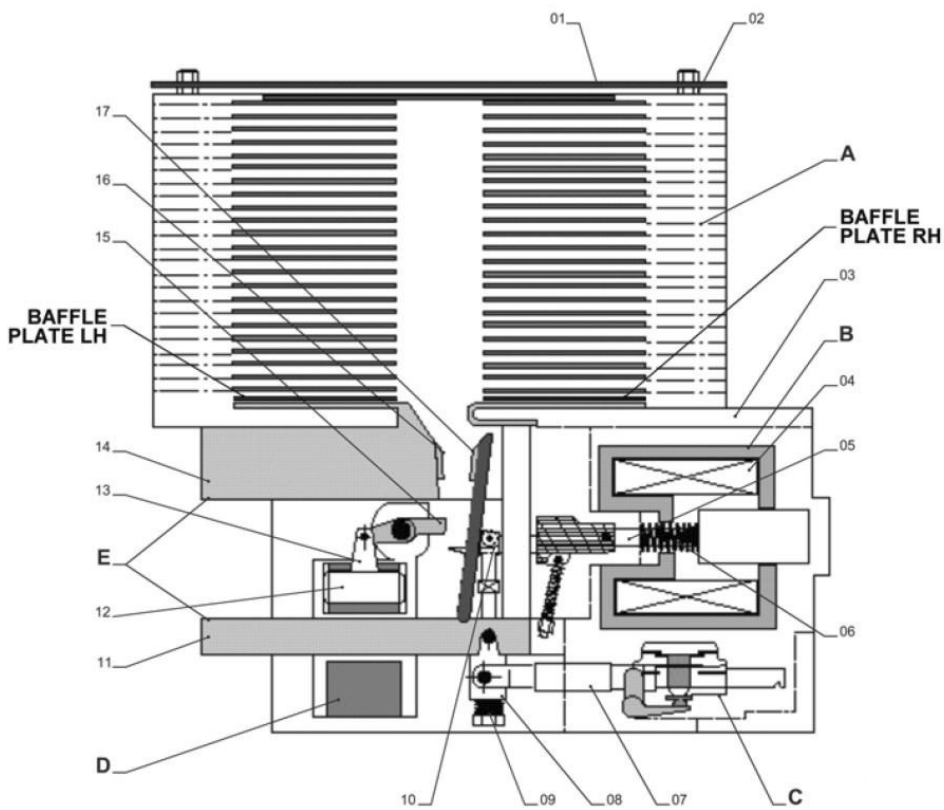


FIGURE 1 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-06-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**5/8**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
LIMIT SWITCH	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

REMOVAL

To remove the Limit Switch proceed as follows

A HSCB ASSY DISCONNECTION & REMOVAL FROM FIRE BOX:

1. Remove the HSCB according to Sheet R-C-09-02-01-00/R-00 Step A.

B FRAME ASSEMBLY AND MAIN CIRCUIT REMOVAL

1. Remove the Frame Assembly and Main Circuit according to Sheet R-C-09-02-02-00/R-00 Step B

C LIMIT SWITCH REMOVAL(Refer to Figures 2 & 3):

2. Remove the Auxiliary Housing (6.401) and the Locking Screws (S.018) on the Closing Housing (6.301).

3. Separate the Auxiliary Housing (6.401) from the Closing Housings (6.301).

4. Compress the Spring (6.207), pressing the Pin (6.402) against the Auxiliary Housing (6.401) placed on a Work Bench; lift the Lever (6.403) until the engaging Dog comes free from the Groove in the Pin
(6.402).

5. Take away the 2 Pins (6.413) on the side of the defective Switch and remove the latter(6.414).

6. Disconnect the Switch.Wires.

P2550 CORRECTIVE MAINTENANCE SHEET		
Card Code: **R-C-09-02-06-00/R-00**		
System: **HIGH VOLTAGE POWER DISTRIBUTION**		Sheet: **6/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**	
Component: **LIMIT SWITCH**		Man Hours: **1**
Maintenance Task: **REPLACEMENT**		

PROCEDURE:

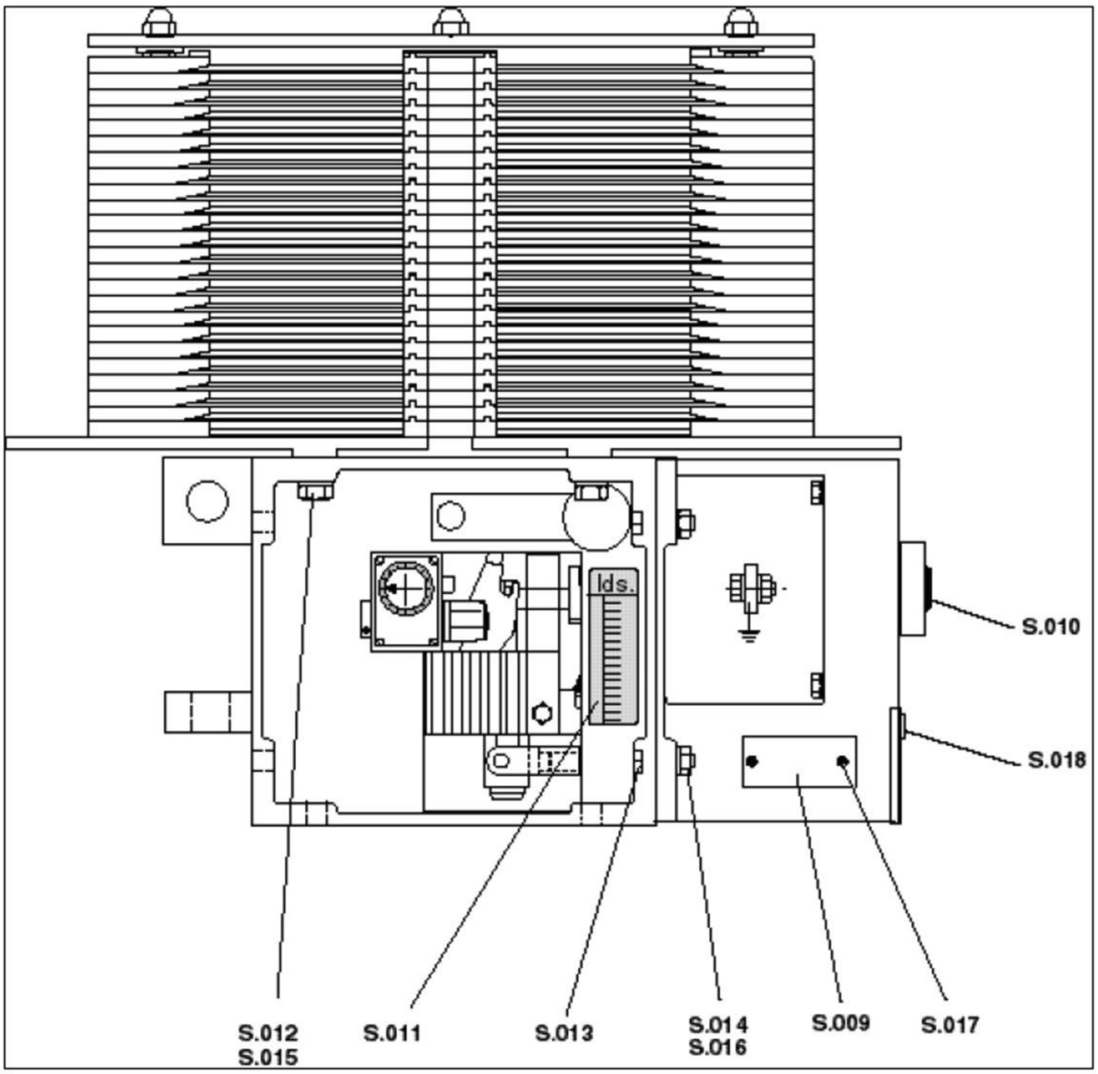


FIGURE 2 - HIGH SPEED CIRCUIT BREAKER - HARDWARE

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-09-02-06-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **7/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **LIMIT SWITCH**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

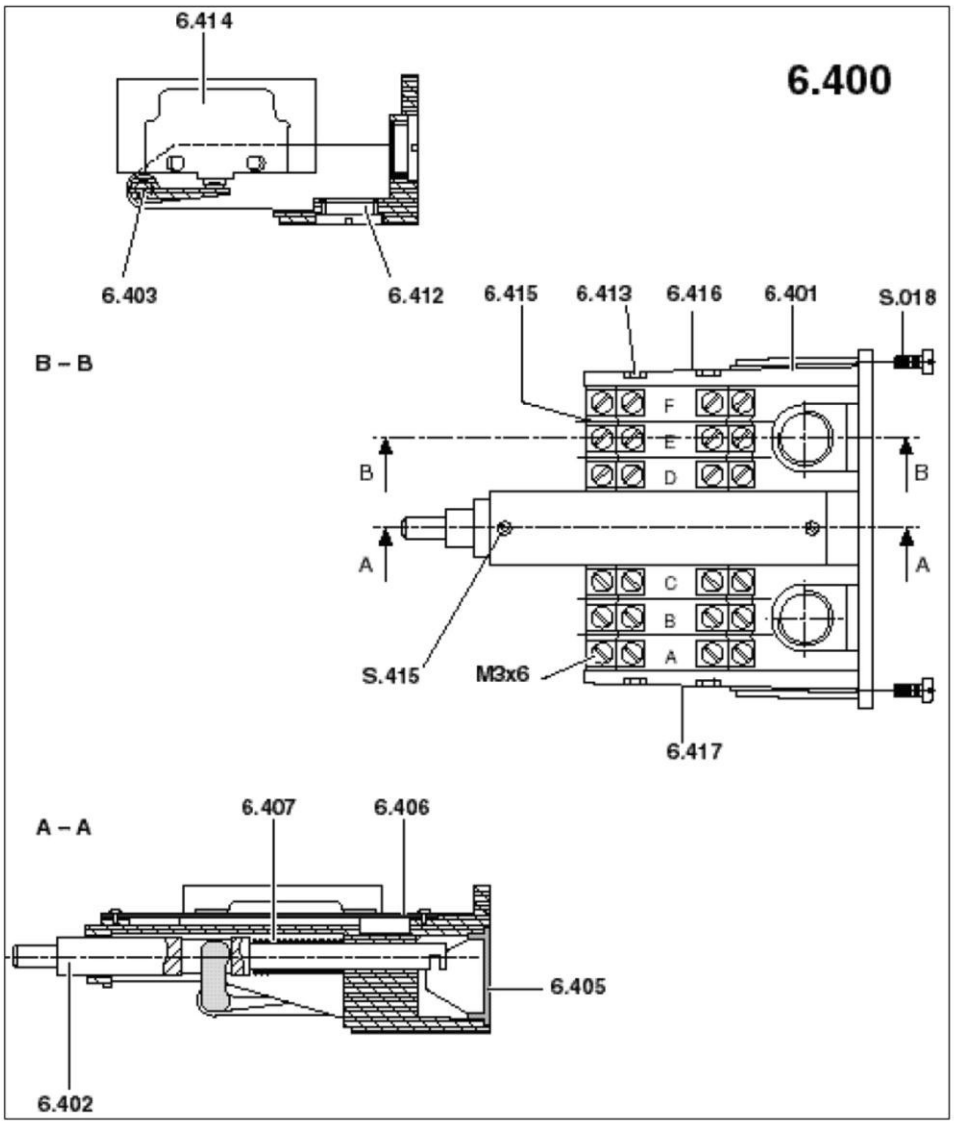


FIGURE 3 - HSCB AUXILIARY CONTACTS ASSEMBLY

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-09-02-06-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **8/8**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **LIMIT SWITCH**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

INSTALLATION

NOTE: It is assumed that the HSCB is safely positioned on the Work Bench

To install the Limit Switch proceed as follows ():

A LIMIT SWITCH INSTALLATION(*R*efer to Figures 2 & 3):

1. **C**onnect the Wires to the new Switch (6.414).
2. Place the Switch (6.414) jointly with the others on the Auxiliary Housing (6.401) and introduce the Pins.
3. Compress the Spring (6.407) between the Pin (6.402) and the Auxiliary Housing (6.401).
4. Press the Lever (6.403) until it fits into the Groove of the Pin (6.402).
5. Mount the Auxiliary Contacts (6.400) on the Closing Device (6.300).
6. Introduce the Auxiliary Housing (6.401) by about **15 mm.**
7. Connect the Wires of the Closing Coil (S.340).
8. Advance the Auxiliary Housing (6.401) and mount the Locking Screws (S.018) on the Closing Housing (6.301).

B. FRAME ASSEMBLY AND MAIN CIRCUIT INSTALLATION

1. Install the Frame Assembly And Main Circuit according to Sheet R-C-09-02-02-00/R-00. Step D.
2. Calibrate the IDS threshold.

C. HSCB INSTALLATION & CONNECTIONS.

1. Install the HSCB according to Sheet R-C-09-02-02-00/R-00. Step E.

D FINAL OPERATIONS

1 Remove all Tools /Rags, that were used, from the Vehicle Roof.
2 Leave the Vehicle Roof according to MTA procedures.
3 Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.
4 Restore Electrical Power to the Vehicle.
5 Record Task result on the Defect Report Card for administrative and maintenance planning.

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-07-00/R-00

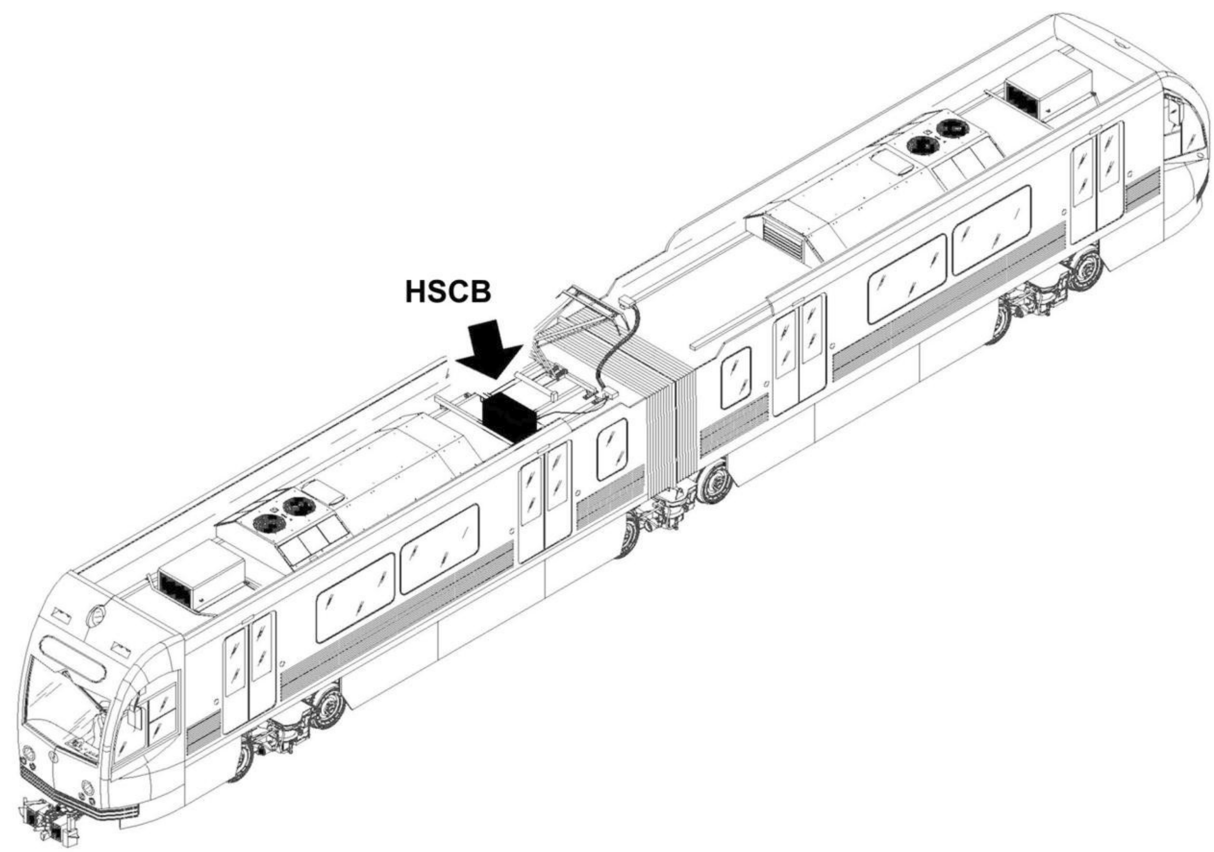
System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**1/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
ARC CHUTE	**1**

Maintenance Task:
REPLACEMENT

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-07-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**2/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
ARC CHUTE	**1**

Maintenance Task:
REPLACEMENT

SAFETY PRECAUTIONS:

WARNING BLUE FLAG THE VEHICLE IN ACCORDANCE WITH ALL LACMTA BLUE FLAG POLICIES, RULES, & PROCEDURES IN ORDER TO WARN THAT MAINTENANCE PERSONNEL ARE WORKING ON, UNDER, OR NEAR ROLLING EQUIPMENT.

WARNING: DANGER OF PERSONAL INJURY EXISTS DUE TO ELECTRICAL POWER (750V) ENSURE PANTOGRAPH IS LOWERED, AND CATENARY POWER IS REMOVED AND ISOLATED PER LACMTA SAFETY RULES AND PROCEDURES.
IF POSSIBLE, WORK SHOULD BE DONE IN AN AREA WITHOUT OVERHEAD CATENARY.

WARNING: DANGER OF PERSONAL INJURY EXISTS WHEN WORKING ON THE ROOF. FOLLOW SAFETY PROCEDURES FOR ACCESSING ROOF.

WARNING: ALWAYS WEAR AN APPROVED SAFETY HARNESS WHEN ACCESSING THE ROOF.

WARNING: ELECTRICAL HAZARD IS PRESENT THROUGHOUT THE HV SYSTEM AND CAUTION MUST BE TAKEN WHILE WORKING ON OR NEAR THE EQUIPMENT.
REMOVE ALL ELECTRICAL POWER BEFORE PERFORMING MAINTENANCE TO THE SYSTEM.

WARNING: BEFORE PERFORMING MAINTENANCE PROCEDURES AND TOUCHING ANY COMPONENT, USE A RELIABLE HIGH VOLTAGE TEST PROBE TO VERIFY THAT NO VOLTAGE IS PRESENT.

WARNING: NEVER APPLY ANY VOLTAGE TO THE CIRCUIT BREAKER WITHOUT AN ARC CHUTE BEING MOUNTED TO IT.

WARNING: KEEP THE HANDS AWAY FROM MOVING PARTS DURING THE OPENING AND CLOSING OPERATION OF THE CIRCUIT-BREAKER.
NON-COMPLIANCE WITH THESE PRECAUTIONS MAY CAUSE SERIOUS INJURY.

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit. External Scaffold

CONSUMABLES:

Litea 806-12 Grease of ASEOL /Bern

SPARE PARTS:

Arc Chute PN HSBT 231018 R0100

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-07-00/R-00

System: HIGH VOLTAGE POWER DISTRIBUTION	Sheet: 3/6
Subsystem/Assy: HIGH SPEED CIRCUIT BREAKER & CIRCUITS	Unit: HSCB
Component: ARC CHUTE	Man Hours: 1
Maintenance Task: REPLACEMENT	

PROCEDURE:

PRELIMINARY OPERATIONS

Set the Vehicle in safety conditions in accordance with LACMTA Maintenance Shop Regulations:

1. Place the Vehicle on a Maintenance Shop Track.

2. Set the Master Controller Handle to FSB position.

3. Make sure that all Parking Brakes are applied (by checking on the IDU "Parking Brake A and B Not Released" and on Indicator Panel "A" "Park / Friction Brake" ON).

4. Remove Electrical Power from Vehicle by lowering the Pantograph.

5. Turn the Transfer Switch to OFF.

6. Set the Pantograph Control Motor Switch (5F02 CB LV Locker "A" Section) to OFF.

7. Lock-out and tag-out the Overhead Catenary, 750Vdc Power, per LACMTA Safety Rules and Procedures.

NOTE The tag must indicate the name of the person who removed Power.

That person knows why the Power was removed and when it safe to restore it.

Only the individual whose name appears on the tag or a person with his approval should remove the tag and restore Power.

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-07-00/R-00

System:	Sheet:
HIGH VOLTAGE POWER DISTRIBUTION	**4/6**

Subsystem/Assy:	Unit:
HIGH SPEED CIRCUIT BREAKER & CIRCUITS	**HSCB**

Component:	Man Hours:
ARC CHUTE	**1**

Maintenance Task:
REPLACEMENT

PROCEDURE:

A.	**ARC CHUTE**
B.	**CLOSING DEVICE**
C.	**AUXILIARY CONTACTS**
D.	**TRIPPING DEVICE**
E.	**MAIN CIRCUIT**

01.	TOP PLATE
02.	THREADED RODS
03.	CHUTE PLATE
04.	CLOSING COIL
05.	ROD
06.	PRESSURE SPRING
07.	GUIDE ASSEMBLY
08.	PIVOT SOCKET
09.	**PIVOT** SOCKET SPRING
10.	FORK
11.	LOWER CONNECTION
12.	SET OF PLATES
13.	MOVING MAGNET
14.	UPPER CONNECTION
15.	LEVER
16.	FIXED CONTACT
17.	MOVING CONTACT

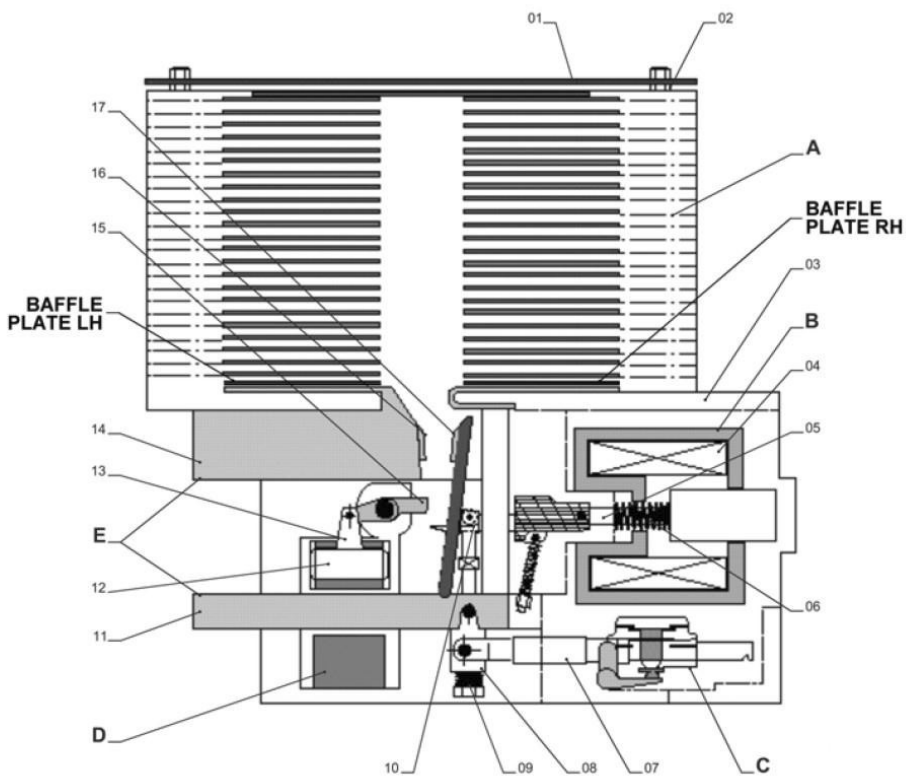


FIGURE 1 - HIGH SPEED CIRCUIT BREAKER - MAIN COMPONENTS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code:
R-C-09-02-07-00/R-00

System: HIGH VOLTAGE POWER DISTRIBUTION	Sheet: 5/6
Subsystem/Assy: HIGH SPEED CIRCUIT BREAKER & CIRCUITS	Unit: HSCB
Component: ARC CHUTE	Man Hours: 1
Maintenance Task: REPLACEMENT	

PROCEDURE:

REMOVAL

To remove the Arch Chute proceed as follows (Refer to Figures 1 and 2):

1 Access to Vehicle Roof "A" Car according to MTA procedures.

NOTE: It is advisable to retain the removed Hardware for later use.

2 Loose and remove the attaching Hardware connecting the Fire Box Upper Shell to the the Fire Box Lower Shell.
3 Place the Arc Chute with Intermediate Plate (305) facing downwards on chocks at least 60 mm thick.
4 Remove the six black PA Buttons with a 3.5 mm Pinspanner.
5 Remove the eight M6 Screws (343) securing the Fire Box Upper Shell to the Intermediate Plate (305).
6 Remove the Upper Shell.
7 Discard the Arc Chute.

INSTALLATION

To install the Arch Chute proceed as follows (Refer to Figures 1 and 2):

1 Lift the Upper Shell with Handles and position it above the Lower Shell.
2 Place the Arc Chute Plate (6.601) in Circuit Breaker Frame (6.101) and lower the Upper Shell Assembly
and the Arc Chute (6.600) until the Intermediate Plate (305) rests on the Lower Shell.
3 Raise and secure the four captive Screws or insert four Screws and torque to **11.04 ft lb** (**15 Nm).**
4. Reinstall the Fire Box Upper Shell onto its position.
Torque the relevant Upper Shell Screws to **12.5 ft-lb**.

FINAL OPERATIONS

1. Remove all Tools /Rags, that were used, from the Vehicle Roof.
2. Leave the Vehicle Roof according to MTA procedures.
3. Restore Power to Overhead Catenary per LACMTA safety rules and procedures or relocate the Vehicle to an area where there is Overhead Catenary.
4. Restore Electrical Power to the Vehicle.
5 Record Task result on the Defect Report Card for administrative and maintenance planning

NOTE: At Task Completion it is recommended to check the correct operation and/or functions of the Subsystem to which the replaced Equipment pertains.
Refer to **HOW TO USE THE R-CM SHEETS(**para 09-III-04-01-02 of this Section) and follow the prescriptions provided at Step 3 **"At every Task Completion."**

P2550 CORRECTIVE MAINTENANCE SHEET	
Card Code: **R-C-09-02-07-00/R-00**	
System: **HIGH VOLTAGE POWER DISTRIBUTION**	Sheet: **6/6**
Subsystem/Assy: **HIGH SPEED CIRCUIT BREAKER & CIRCUITS**	Unit: **HSCB**
Component: **ARC CHUTE**	Man Hours: **1**
Maintenance Task: **REPLACEMENT**	

PROCEDURE:

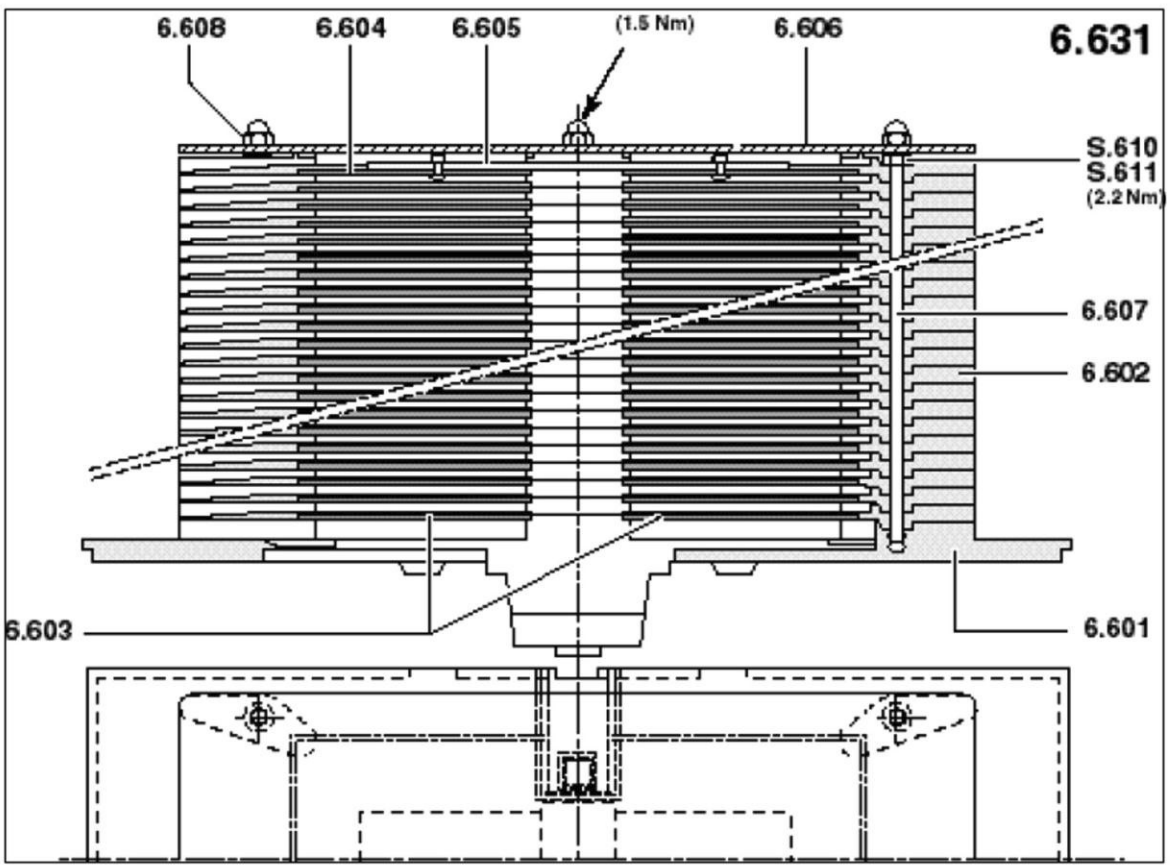


FIGURE 2 - ARC CHUTE ASSEMBLY

09-III-05 CONSUMABLE MATERIALS LIST (R-CML)

The Consumable Materials needed to accomplish the HVDS Running Maintenance are listed, sequenced in alphabetical order by SUBSYSTEM /ASSY -UNIT / COMPONENT, in the following Table 09-III-05.1

Table 09-III-05.1 Running Maintenance Consumable Materials List (R-CML)

SYSTEM 09	HIGH VOLTAGE DISTRIBUTION SYSTEM		
SUBSYSTEM /ASSY - UNIT / COMPONENT	**AGENT**	**PN**	**MTA PN**
EMI DETECTOR SYSTEM - HCT TRANSDUCER	CRC Industrial - Precision Cleaner	M3 PN 147535	
	Dry Compressed Air for Electronic Equipment	(commercial)	
HIGH SPEED CIRCUIT BREAKER	Contact Cleaner		
	Multi-Purpose Abrasive Rubber Fine Grade 0		
	Scoth Brite		
	Sealing lacquer	Type F-900 Organic Products Co., Irving - TX	
HIGH SPEED CIRCUIT BREAKER POLYESTER PARTS	Denatured alcohol or Solution of liquid soap diluted in water		
HIGH SPEED CIRCUIT BREAKER MECHANICAL MOVING PARTS	Litéa 806-12 (Aseol Bern) Grease or Molycote Longterm W2		
HIGH SPEED CIRCUIT BREAKER STAINLESS STEEL PARTS	Litoplex 1043 (Aseol Bern)		
KNIFE SWITCH	CRC 2000 Contact Cleaner		
	CRC Industrial - Precision Cleaner	M3 PN 147535	
LIGHTNING ARRESTER	Denatured Alcohol		
	Detergent / Water Solution		
	Neutral Liquid Soap diluted in Water		

09-III-06 TEST EQUIPMENT & SPECIAL TOOLS LIST (R-TESTL)

The Tools and Test Equipment needed to accomplish the HVDS Running Maintenance are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSY -UNIT/COMPONENT, in the following Table 09-III-06.1.

Refer to “Tools and Test Equipment Manual” for Special Tools / Test Equipment Description and Maintenance.

Table 09-III-06.1 Running -Test Equipment & Special Tools List (R-TESTL)

SYSTEM 09 HIGH VOLTAGE DISTRIBUTION SYSTEM				
SUBSYSTEM /ASSY - UNIT / COMPONENT	**LACMTA STANDARD TOOLS KIT**	**LACMTA WORKSHOP DEVICES**	**SPECIAL TOOL / TEST EQUIPMENT**	**PN**
HARMONIC CURRENT TRANSDUCER (HCT)	X	External Scaffold.		
HIGH SPEED CIRCUIT BREAKER	X	Vacuum Cleaner		
			Arc Chute Gauge (3,14 x 7,86 Inch)	SG 100029
			Special Flexible 0.5 mm Thickness Gauge (20 x 300 mm),	SG 100029 P2
			Contact Depth Gauge W-6	HSBA 431494P0001
KNIFE SWITCH	X	Module Support Hydraulic Device		
LIGHTNING ARRESTER	X	External Scaffold.		
CABLING	X		CABLE CERTIFIER (Type LT 8600)	
HV DISTRIBUTION SYSTEM COMPONENTS	X		Phase Sequence Meter (Fluke 9040)	2NV55
			Multimeter (Fluke 87 V/E)	4EB19
			Hi Pot Ac Power Supply	
			Insulation Tester / Megohmmeter	
			Portable Test Unit(Ptu)(Dell-)	