LOS ANGELES COUNT

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE AND SERVICE MANUAL

SECTION 01 VEHICLE SYSTEM

Metro

AnsaldoBreda

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01
PART I
THEORY OF OPERATION
SECTION 01 - VEHICLE SYSTEM

SECTION 01

VEHICLE SYSTEMS

PART I

THEORY OF OPERATION

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VEHICLE SYSTEMS

01-I-01 INTRODUCTION

This Section of 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

01-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
AADS	Automatic Announcement and Display System
AB	AnsaldoBreda
ADA	American with Disabilities Act
ADU	Automatic Display Unit
APS	Auxiliary Power Supply
ASU	Air Supply Unit
ATP	Automatic Train Protection
BCU	Brake Control Unit
C	Coast
CB	Circuit Breaker
CCH	Communication Control Head
CCI	Cab to Cab Intercom
CCU	Communication Control Unit
DCAC	Direct Current Alternate Current
DC/DC	Direct Current Direct Current
DCU	Door Control Unit
DSP	Digital Signal Processor
EB	Emergency Brake
ECU	Electronic Control Unit
EDU	EMI Detector Unit
EED	Exterior Emergency Device
EMI	ElectroMagnetic Interference
ER	Event Recorder
FSB	Full Service Brake
GTW	Gateway
HCT	Harmonic Current Transducer
HP	High Pressure
HRSB	High Rate Service Brake
HSCB	High Speed Circuit Breaker
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HVDS	High Voltage Distribution System

Abbreviation	Meaning
IDU	Integrated Diagnostic Unit
IED	Interior Emergency Device
IGBT	Isolated Gate Bipolar Transistor
L ED	Light Emitted Diode
L ON	Local O perating Ne work
L P	Low Pressure
L RV	Light Rail Vehicle
L V	Low Voltage
L VDS	Low Voltage Distrib ution System
L VPS	Low Voltage Power Supply
M	Motorin g (Power)
M BL	Metro Blue Line
M C	Master Controller
M GL	Metro Green Line
M oT	Master of Train
M oV	Master of Vehicle
M R	Main Reservoir
M TA	Metropolitan Transportation Autority
M TBF	Mean Time Betwee n Failure
M V	Medium Voltage
M VB	Multifun ction Vehicl e Bus
N C	Normall y Closed
N O	Normall y Open
P A	Public Announcement
P CB	Printed Circuit Boar d
P GL	Pasadena Gold Lin e
PIC	Passen ger Interco m
P TU	Portable Test Unit
R MS	Root Mean Square
S B	Service Brake
S CEB	Slide C ontrolled Emergency Brake
S R	Supply Reservoir
S JC	Start Up Circuit
TCMS	Train C ontrol and Monitoring System
TCN	Train C ommunicati on Network
TCU	Traction Control Unit

Abbreviation	Meaning
TOD	Train Operator Display
TWC	Train to Way-side Communication
VHF	Very High Frequency
VNC	Vehicle Network Controller
VVVF	Variable Voltage Variable Frequency
WTB	Wired Train Bus

01-I-01.b LIST OF DEFINITIONS

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

Definition	Meaning
//	Parallel
'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
LC filter	Filter made up of Inductance and capacity
Rear door	The door close to the Articulation Section
RLC filter	Filter made up of Resistance, Inductance and Capacity
Sine-wave	Sinusoidal wave

01-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	
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)
Ω	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)

01-I-02 THEORY OF OPERATION

01-I-02.01 The P2550 LRV - General Description

This Section provides an overview of the vehicle in its entirety and of the systems mounted on it, their interrelations and operating principles, with a brief description of each system and its operations.

The P2550 Light Rail Vehicle has been designed for operations on the LACMTA MBL, MGL and MGDL.

In particular:

- The P2550 LRV is mechanically and pneumatically but not electrically compatible with the MTA Vehicles Fleet Series P2000, P2020 and P865.
- The P2550 LRV is electrically compatible only with another P2550 LRV The electrical pins need to be electrically insulated from one electrical head to the corresponding electrical head while the P2550 is coupled to either a Blue Line or Green Line LRV. For this reasons when the P2550 LRV is coupled with a Vehicle pertaining to MTA Fleet, the Drum Switch of both coupled Vehicles must be set to “ISOLATE” position.
- The Automatic Train Protection (ATP) and the Train-to-Wayside Communication (TWC) systems are compatible with operations on the Pasadena Gold Line, Metro Blue Line and Metro Green Line, East Side extension.

The vehicle is made up of two sections, the “A” and “B” car body sections, joined by an articulation section in correspondence with the Center Truck.

The two sections are connected together through the articulation section to form a single operating unit.

Each Car section is equipped with an end cab, which is fully bi-directional, from where the driver can operate the vehicle.

The vehicle can be operated alone or connected to other (up to four, in total) vehicles, thus forming a Train Consist.

Each vehicle end is provided with an electro-mechanical coupler that provides mechanical and pneumatic coupling, and trainlined electrical control signals.

The vehicle is designed to have a 30-year service-life under normal service conditions and preventive maintenance operations with an estimated annual mileage of 90,000 miles (145,000 km).

Vehicle exterior and underside components are designed to minimize damage due to collisions with vehicles, wayside debris, and the like.

The vehicle is a high-floor car with high-level passenger boarding. Accommodation for four wheelchairs is provided, two per car section.

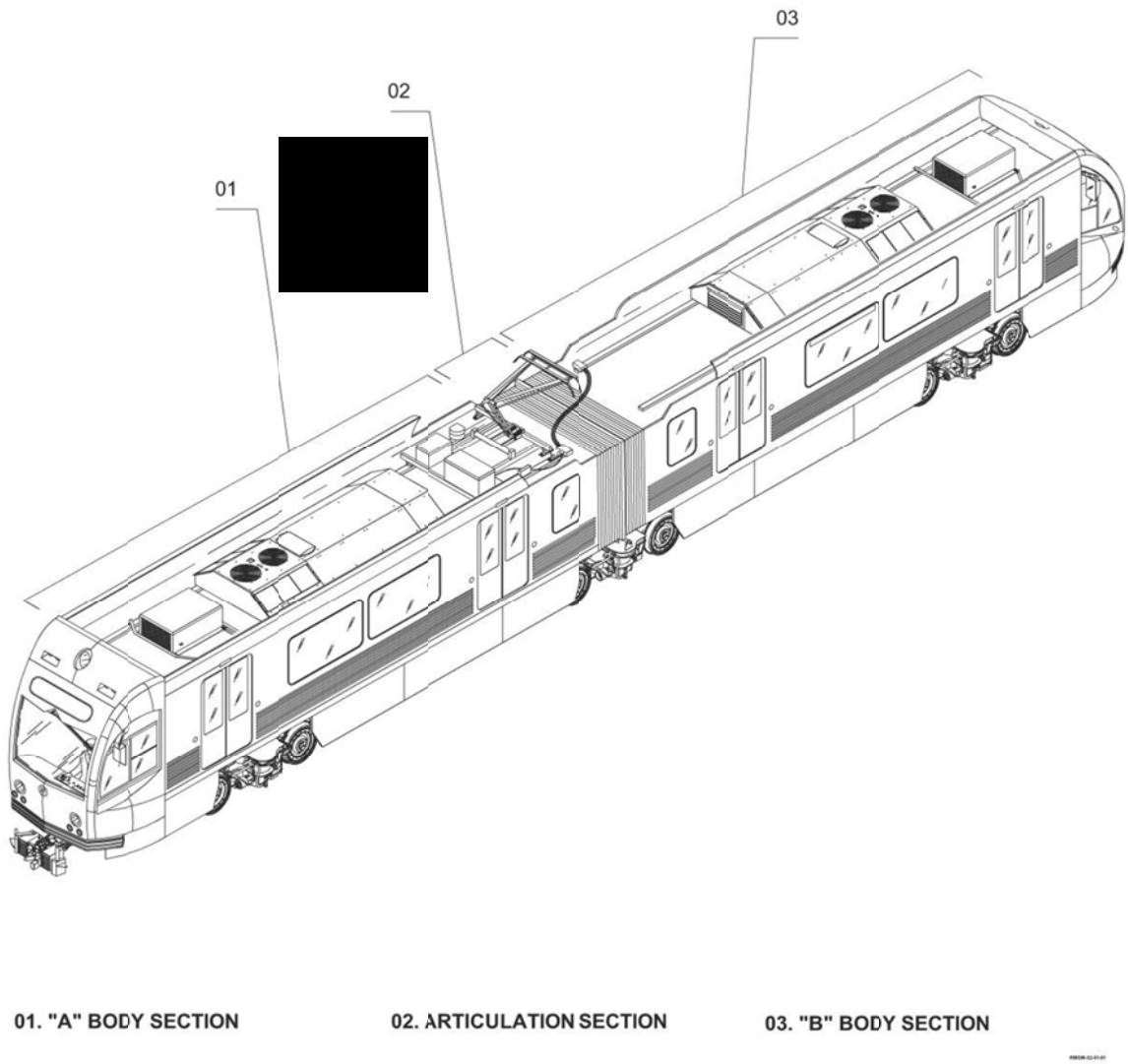


Figure 01-I-02.1 Vehicle Overall View

Power from the 750V dc overhead catenary is collected through the pantograph located on the roof of the "A" car section. The current collected from the pantograph is distributed to the Propulsion Inverter and through this to the traction motors located on the "A" and "B" motor trucks, and to the Auxiliary Inverter which provides the 208Vac and the 37.5Vdc for the low voltage equipment.

The Center Truck is not powered.

The Propulsion System is made up of two IGBT VVVF (Variable-Voltage-Variable-Frequency) Inverters mounted on the vehicle under frame.

Each Inverter supplies the Inverter and two AC Motors in the relevant car section.

The Propulsion and the Dynamic Braking are managed by the Master of Train/Vehicle Traction Control Unit (TCU). Each Inverter is equipped with its own TCU.

The train TCUs are hierarchically arranged.

The vehicle is equipped with Dynamic Braking, Friction Braking, which includes the Track Brakes. The Dynamic Braking (regenerative or regenerative and rheostatic) is carried out by the Propulsion System, while the Friction Braking is provided by electro-pneumatic disk brakes. Service Braking is an electronically blended combination of Dynamic Braking and Friction Braking managed by the electronic control units of the Propulsion System (TCU) and the Friction Braking (ECU) working together.

A sanding system is also provided, to increase braking effectiveness in emergency conditions.

Each car section is equipped with two front doors and two center doors, each one made up of two sliding panels. The total number of doors on a Car Section is eight.

The front doors can be operated from the Operator Console and from the outside, by means of Crew key switches, located at the base of the Front door, to enter or leave an unattended vehicle.

Each door is operated from the Operator Cab through a Door Control Unit (DCU) (located above the relevant door unit) which is interlocked with the Propulsion and ATP systems.

Each door is provided with an Interior Emergency Device (IED) to exit the train in emergency. The front doors are provided also with an Exterior Emergency Device (EED). Each door is also equipped with “Passenger’s door” pushbuttons, to let passengers open the selected door at a station stop, once it has been released by the Operator, and a “Door out of Service” light to indicate the faulty condition of that door, and a “Door open” light to tell the operator that that door is open.

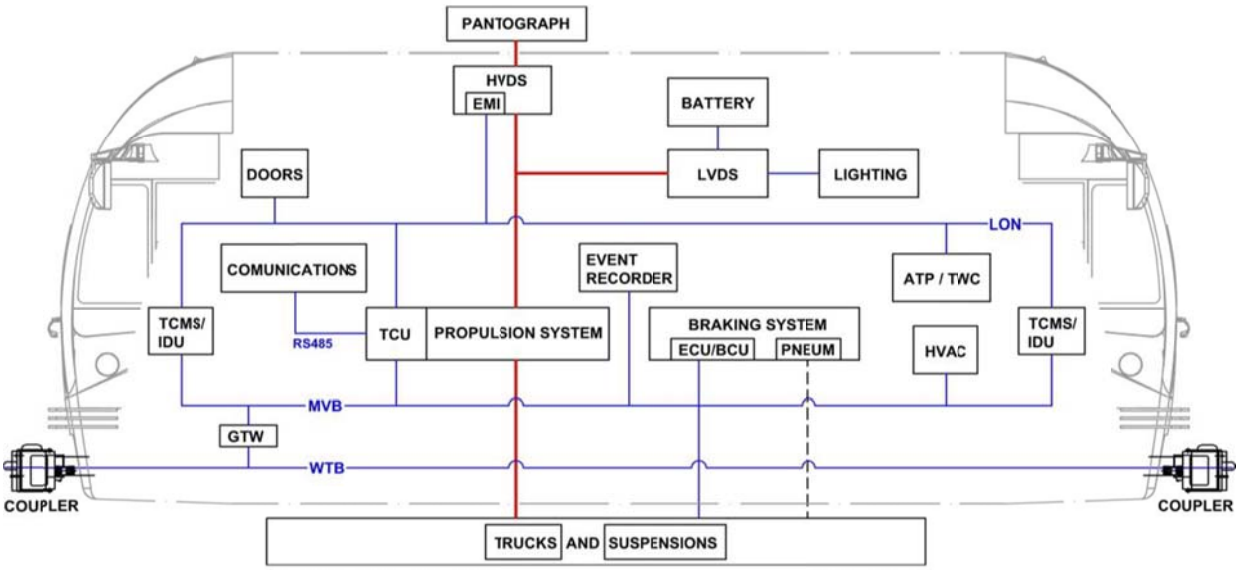
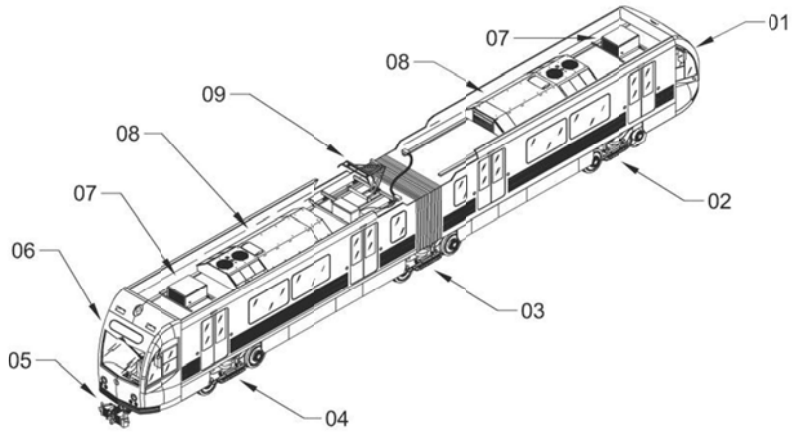


Figure 01-I-02.2 Vehicle Systems Block Diagram

01-I-02.01.01 Exterior



01. OPERATOR'S CAB CAR "B"
02. TRUCK "B"
03. TRUCK "C"
04. TRUCK "A"
05. COUPLER
06. OPERATOR'S CAB CAR "A"
07. BRAKING RESISTOR
08. HVAC
09. PANTOGRAPH

Figure 01-I-02.3 Vehicle Exterior Arrangement

Each front door is provided with a grab handle and an access step to ease operator access from ground level.

Under car equipment is protected by skirts that can be unlocked with the service key and raised to gain access to the equipment.

Each front end has two cab headlights and a roof headlight. The Silent Alarm lamp is located over the roof headlight.

Four amber turn signals, two per each side of the vehicle, are provided for Street Running operations.

Two By-pass lights, which turn on when one by-pass is active, are provided on the left side of the two front ends.

The crew key switch, to access the four front doors, is protected by a hinged access panel.

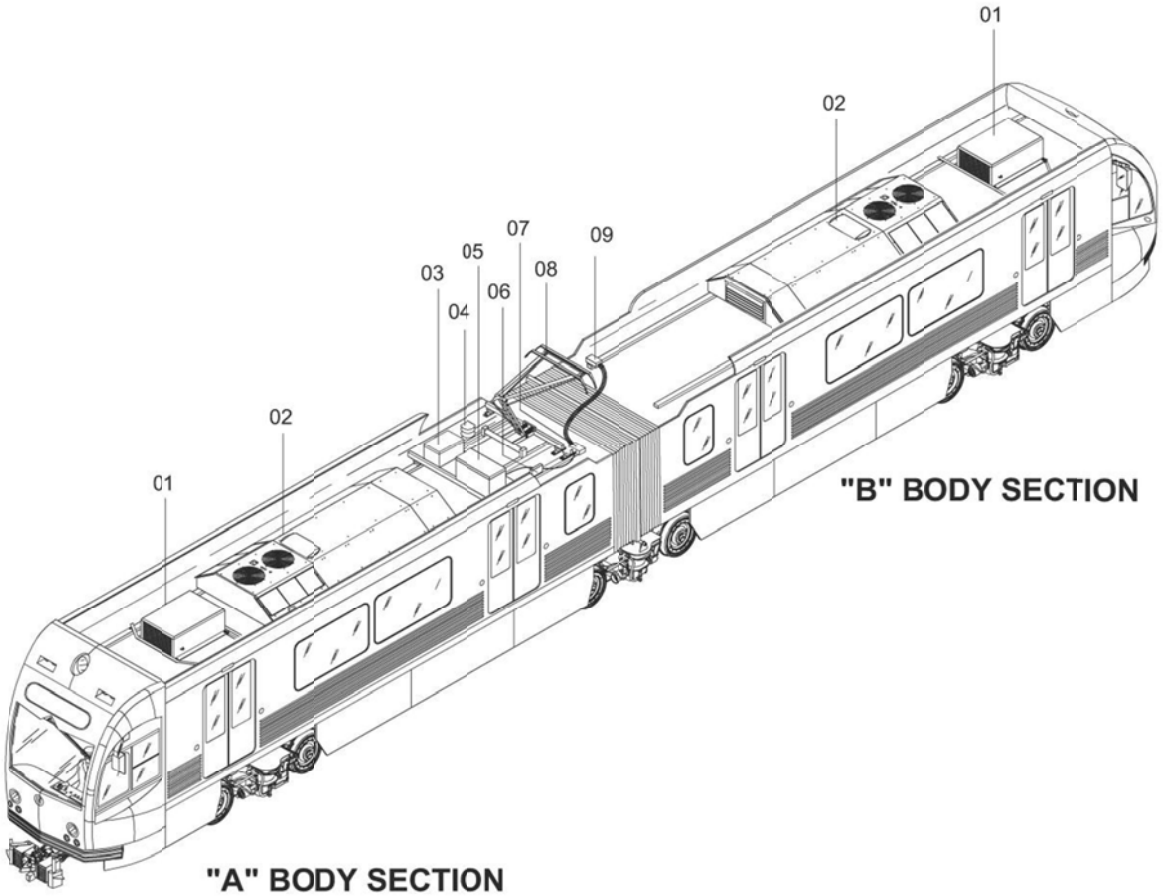
Four exterior loudspeakers are provided on each side of the car body, for communications to passengers on the platform.

The operator's cab is also equipped with electrically operated exterior view mirrors that can be folded against the car body.

The doors are operated from the operator's cab. The operator can either open/close all doors, or release doors in order to allow passengers both from inside and from the platform to open the selected door by means of the "Passenger's door" pushbutton. The door closes automatically after 30 seconds if the "Close" command is not pressed.

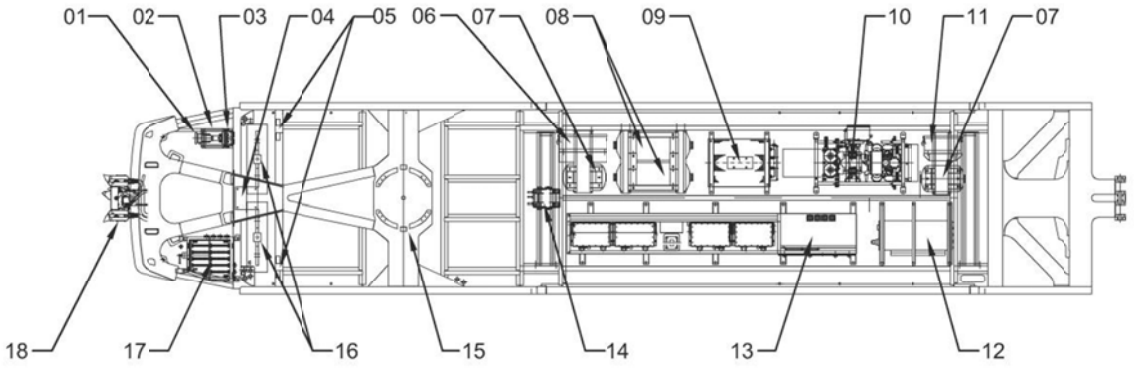
Destination Signs visible from exterior are located on top of the windshield of both cabs and behind the right side windows, close to the center doors of each car section (four destination signs in total).

One HVAC system located on the roof is provided per each car section and can be operated from the Control Box accessible from the passenger compartment, by opening the return air filter.



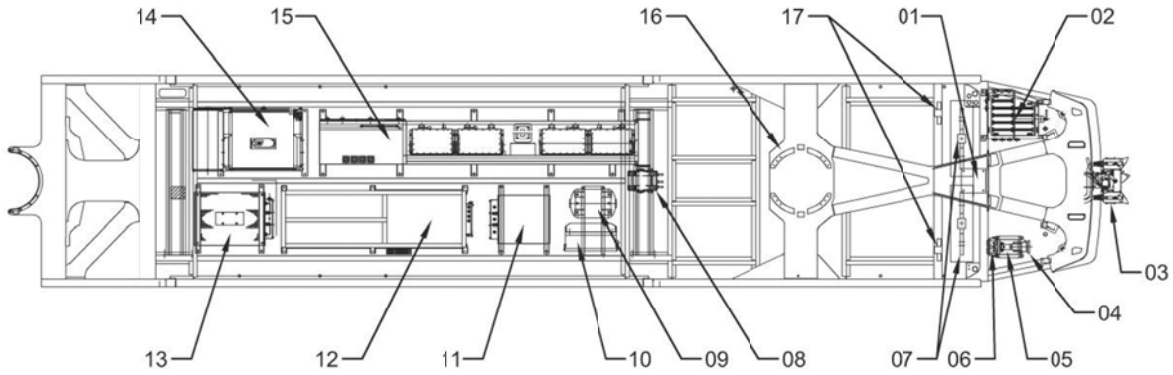
01. BRAKE RESISTOR
02. HVAC
03. HCT
04. LIGHTNING ARRESTER
05. HSCB
06. FUSE BOX
07. JUNCTION BOX
08. PANTOGRAPH
09. JUNCTION BOX

Figure 01-I-02.4 Roof Layout



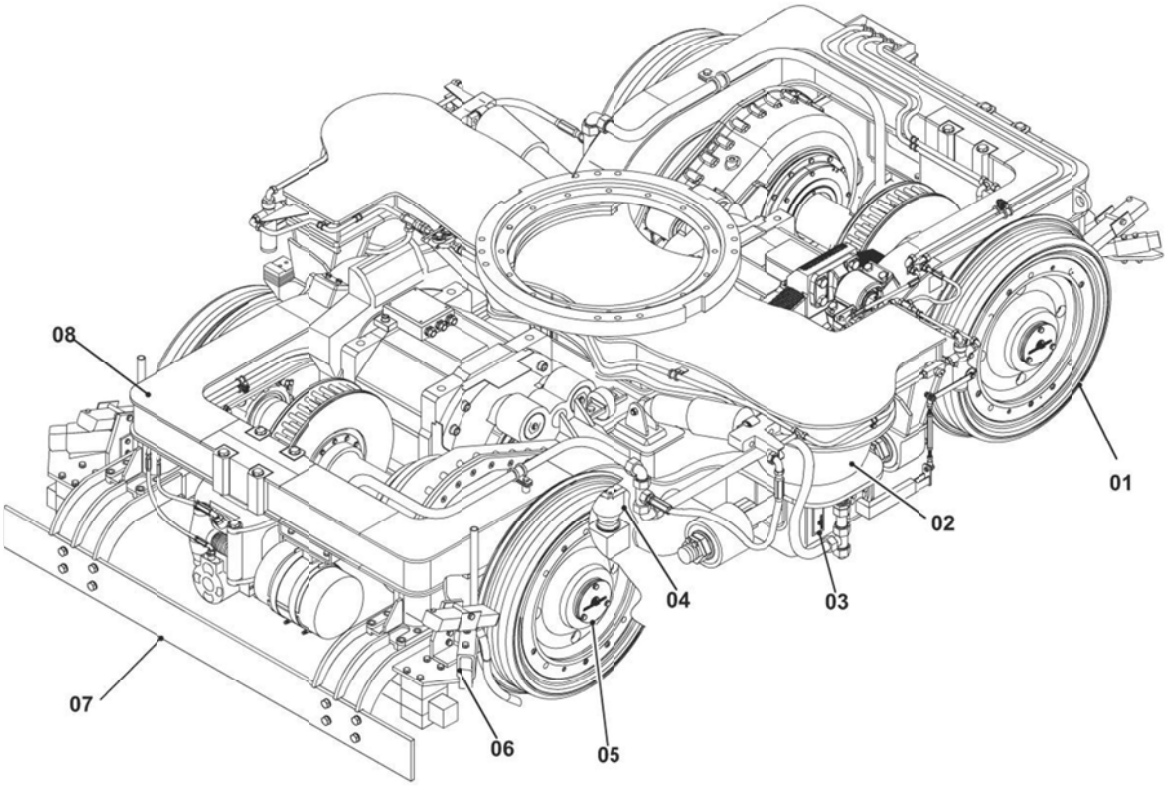
01. HORN/GONG
02. SOLENOID VALVE
03. DUPLEX SOLENOID VALVE
04. TWC ANTENNA
05. ATP ANTENNA (MGL)
06. BRAKE CONTROL UNIT M.T.
07. BCU AIR RESERVOIR (12.8 GALS)
08. MAIN AIR RESERVOIR (30.3 GALS)
09. "A" PROP. INVERTER LINE REACTOR
10. AIR COMPRESSOR UNIT
11. BRAKE CONTROL UNIT C.T.
12. KNIFE SWITCH
13. "A" PROPULSION INVERTER
14. QUICK DISCONNECT BOX
15. "A" MOTOR TRUCK CONNECTION
16. ATP ANTENNA (MBL/PGL)
17. JUNCTION BOX W/DRUM SWITCH
18. COUPLER

Figure 01-I-02.5 Underframe Layout -"A" Car



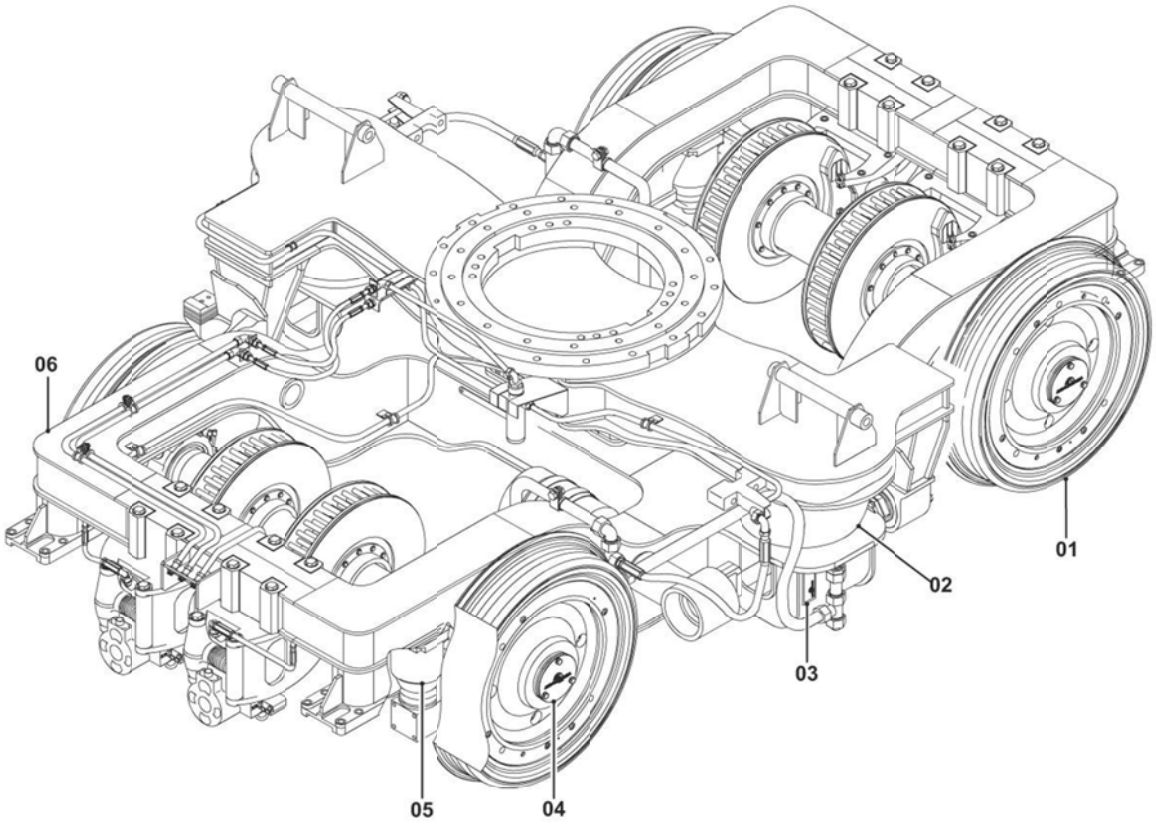
01. TWC ANTENNA
02. JUNCTION BOX W/DRUM SWITCH
03. COUPLER
04. HORN/GONG
05. SOLENOID VALVE
06. DUPLEX SOLENOID VALVE
07. ATP ANTENNA (MBL & MGDL)
08. QUICK DISCONNECT BOX
09. BCU AIR RESERVOIR (12.8 GALS)
10. BRAKE CONTROL UNIT M.T.
11. LINE REACTOR FOR APS_LVPS BOX
12. APS_LVPS BOX
13. "B" PROP. INVERTER LINE REACTOR
14. BATTERY BOX
15. "B" PROP. INVERTER
16. "B" MOTOR TRUCK CONNECTION
17. ATP ANTENNA (MGL)

Figure 01-I-02.6 Underframe Layout -"B" Car



01. TIRE AND WHEEL HUB
02. SECONDARY SUSPENSION
03. LABELS
04. PRIMARY SUSPENSION
05. AXLE COVER
06. FLANGE LUBRICATOR
07. PILOT BAR
08. FRAME

Figure 01-I-02.7 Motor Tr ıck



01. TIRE AND WHEEL HUB
02. SECONDARY SUSPENSION
03. LABELS
04. AXLE COVER
05. PRIMARY SUSPENSION
06. FRAME

Figure 01-I-02.8 Center Truck

01-I-02.01.0 Interior

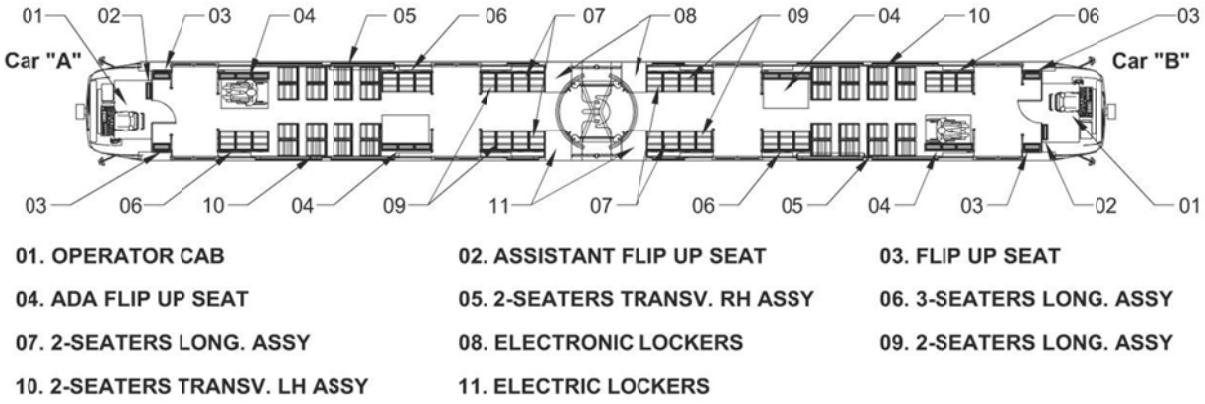


Figure 01-I-02.9 Interior Arrangement

The cab is separated from the passenger compartment by a dividing wall equipped with a lockable door.

The passenger compartment is also equipped with 76 seats, distributed as follows in each car sections:

- 16 (2x8rows) transversal seats
- 2 (2 single) Sand box flip-up seats. The sand box is located under the seat and is accessible from the interior
- 6 (3x2) Flip-up longitudinal seats. A wheelchair can be accommodated when the three seats assembly is flipped-up. Four wheel chairs can be accommodated in total on a vehicle
- 6 (3x2) Longitudinal seats
- 8 (4x2) Longitudinal seats (2 over boxes)

Interior Destination signs, for Next Stop and communications to passengers are located over the cab doors and over the access to the Articulation Section, in both car sections.

One electrical and one electronic locker are located at the end of each car section, at the sides of the Articulation Section.

The two Electric lockers (11) are on the left side of the vehicle, (facing the A cab).

The two Electronic lockers are on the right side (8).

The Electric and the Electronic lockers are on the same side of the vehicle in order to minimize the electrical connections between the two sections.

01-I-02.01.03 Operator Cab

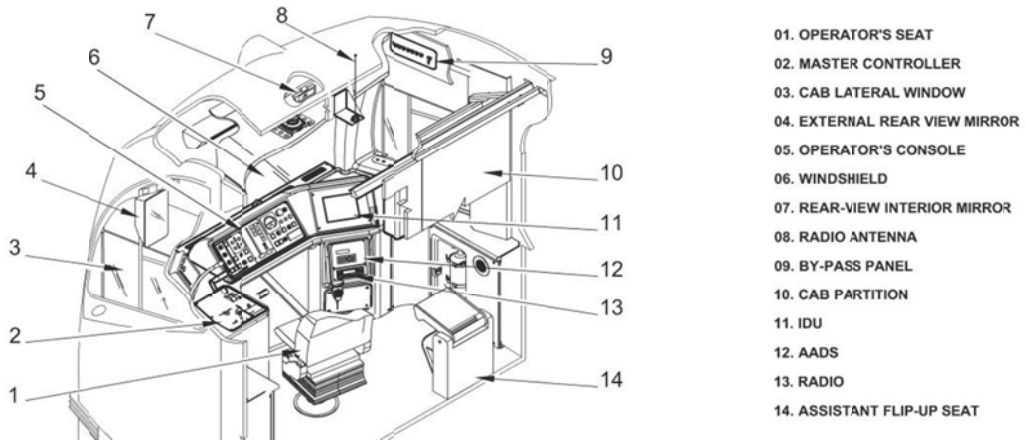


Figure 01-I-02.10 Operator Cab Arrangement

The operator's seat is a fully adjustable, cushioned seat.

A flip-up seat is also provided for the operator assistant.

In front of the operator, an array of panels, indicators, monitors and switches is provided for controlling and operating the vehicle.

In particular, starting from the top (above the windshield):

- Indicator Panels
- Interior Rear View Mirror
- Monitor IDU
- AADS
- VHF Two Way Radio
- Console, with ADU, CCH and pressure gauge
- Master Controller Panel
- TWC Interface Panel
- Gooseneck Microphone

The operator's cab MV and LV Circuit Breakers panels are located at the back of the Operator's seat, on the dividing wall.

They contain the most important circuit breakers that must be available to the Operator for safe train operation.

The other Circuit Breakers are located in the Electrical Lockers, at the center of the vehicle.

Figure 01-I-02.11 shows the LV and MV Circuit Breakers Panels of section "A" and "B".

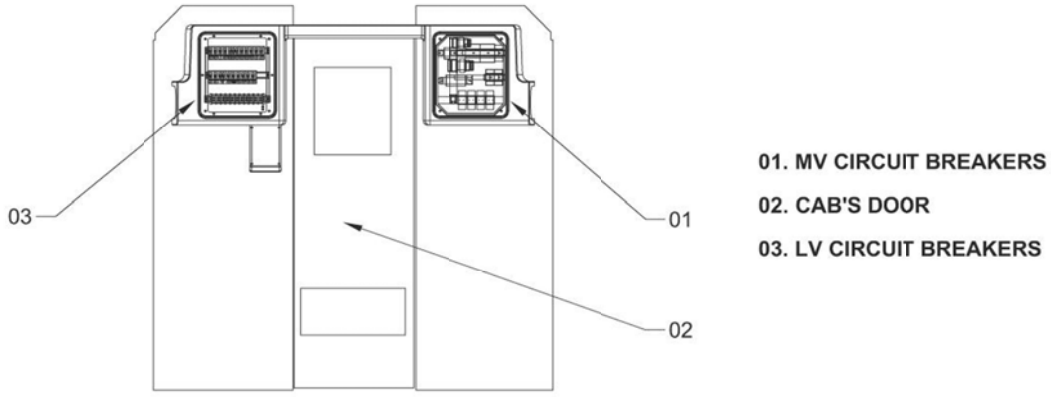


Figure 01-I-02.11 Operator Cab LV-MV CB Panels

For the complete list of LV and MV circuit breakers, refer to Section 10.

The cab is equipped with a defroster/demister system that can be used also for cab heating integration purposes, since the temperature of the conditioned air sent to the cab is regulated by the temperature sensors located in the passenger compartment.

The cab windshield extends across the entire cab width, and is equipped with a single arm wiper.

The operator can monitor the passenger compartment from the inside rear view mirror. Two video cameras located at the end of each car section (on top of the cab door and on the upper part of the Electric lockers of the two car sections) film and record the inside of the passenger compartment.

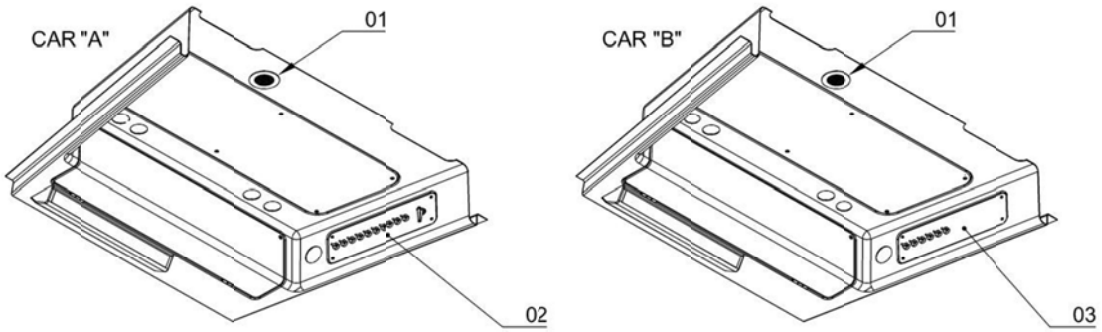
The exterior rear view mirrors are used to monitor the outside of the train, especially the doors. From there the operator can monitor the “Door open” light on top of each door.

A Master Controller Console for enabling the cab, determining the direction of the train’s travel and determining the amount of traction or braking effort to be applied, is located at the left of the operator.

If the operator, for whatever reason, releases the Master Controller Handle, the Dead Man feature intervenes and applies an Emergency Braking.

Each cab is provided with a Communication Control Head (CCH - on the Operator's Console), a VHF two way radio, the AADS (Automatic Announcements and Display System) and a gooseneck microphone, used for vehicle intercom and for public address announcements.

The By-pass panels are located on the right side of the cab ceiling, and are shown in Figure 01-I-02.12.



01. LOUDSPEAKER
02. BY-PASS PANEL CAR "A"
03. BY-PASS PANEL CAR "B"

Figure 01-I-02.12 By-Pass Panels

The IDU (Integrated Diagnostic Unit) gives the operator and maintainers real time information of the various systems' conditions and also any active failures.

01-I-02.01.04 The P2550 LRV Operating Philosophy

The P2550 LRV has been designed to achieve the following main goals:

- Riding **Performance**
- Passengers' **Safety** in all operating conditions
- Passengers' **Comfort**

The Riding Performance is achieved by means of a reliable and powerful Propulsion System (refer to Section 07), which implements the most important Logic Functions for controlling and managing Traction and Dynamic Braking, which is fully integrated with

- The Friction Brake system (refer to Section 13), equipped with three independent subsystems, each one of which is dedicated to the relevant Truck
- The Automatic Train Protection System (refer to Section 15), which supervises the vehicle speed and enables the opening of the doors
- The Door System (refer to Section 04)
- The Communication System (refer to Section 14)

Electronic Control Units dedicated to each System assure the integration and the "talking" among the different systems:

- TCUs (Traction Control Unit) for the Propulsion System; one per Inverter
- ECUs (Brake Electronic Control Unit) for the Braking System; one per Truck
- ATP for the ATP System
- DCUs (Door Control Unit) for the Door System; one per door

All electronic control units are linked together to form an intelligent network that supervises all functions of the vehicle.

Each electronic control unit carries out two main functions:

- Implementing the relevant Logic Functions (acquisition of variables, like speed, current, voltage, or logic status, and system output variables, like commands to obtain the right motor torque or the right air pressure for braking). The Logic Functions are implemented both by software (controllers and microprocessors) and hardware
- Links the Systems one to each other, thus correlating the system output to both the vehicle and the train status

Optimizing performances and increasing safety and comfort to passengers is made possible by means of the vehicle intelligent network.

System Interconnections are made possible through two different networks:

- LV wired connections and Relay Logic (refer to Section 10)
- Bus Networks (refer to Section 18)

LV Wired Connections: implemented by the LVDS (Low Voltage Distribution System), are based on the transfer of status signals from a source system to a receiving system.

These signals have two digital levels: high (37.5 Vdc, battery positive) and Low (0 Vdc, reference to ground).

Through this network, a receiving system can directly acquire the status of a source system or a status signal that is a logic combination of one or more source systems' signals.

In the latter case, the logic combination of signals is directly implemented by the LVDS by means of relays and their contactors (Relay Logic).

For example, the LVDS acquires all by-pass statuses and requires a 35mph speed limit when at least one of them is active.

Bus Networks: allow a fast data transfer between all electronic devices.

Using a bus network exchanged signals have more than one bit available for their message, so they can be more sophisticated than a two level signal (high or low).

The P2550 LRV has two independent networks (refer to paragraphs 01-I-02.01.05 and 01-I-02.02.05 for details):

- LONWorks (Local Operating Network)
- TCN (Train Communication Network) made up of:
    - the Multifunction Vehicle Bus (MVB) and
    - the Wired Train Bus (WTB).

The LONWorks, MVB and WTB buses link together all vehicle electronic systems.

01-I-02.01.05 Vehicle Systems Network

The Systems installed on the P2550 LRV are linked together and exchange commands and/or status information with each other.

The Electronic Control Unit of each system manages the operations related to its own system and "talks" with the Electronic Control Units of the other systems, to manage the vehicle in its entirety.

Thanks to the exchange of information and to the interactions between the systems, the vehicle is always under control and safety and comfort are greatly improved.

The communications between the different systems are realized in two different ways:

- **TCMS** network (refer to paragraph 01-I-02.01.05.02), by means of the WTB, MVB and LONWorks buses;
- **LVDS connections** (refer to paragraph 01-I-02.01.05.02), which connects the systems through the LV cabling and the **Relay Logic** for commands and status.

Table 01-I-02.1 lists the most important commands/information exchanged by the systems (refer to Section 18 for a more complete information on the matter).

Table 01-I-02.1 Communications Between Systems

COMMUNICATING SYSTEMS	COMMANDS, SIGNALS EXCHANGED
ATP - LVDS	Line Switch Status
ATP - LVDS - BRAKING	FSB and EB Request
ATP - LVDS - DOORS	Door Enabling
ATP - LVDS - E.R.	ATP Penalty Brake Status
ATP - LVDS - PROP.	FSB and EB Request, Propulsion Enabling.
ATP - TCMS	ATP Status
ATP - TCMS - PROP.	ATP Status
BRAKING - LVDS	Park/Friction Brake, Track Brake and EB Power Supply Status
BRAKING - LVDS - ATP	Friction Brake Status, Track Brake Status
BRAKING - LVDS - E.R.	Braking Status
BRAKING - LVDS - PROP.	Braking Status
BRAKING - TCMS	Braking Status
BRAKING - TCMS - PROP.	Braking Status
COMM. - COUPLER - COMM.	Communication Data
DOORS - LVDS	Door Status (signal lamps on/off)
DOORS - LVDS - ATP	Door Status
DOORS - LVDS - BRAKING	FSB Request
DOORS - LVDS - E.R.	Door Status

Table 01-I-02.1 Communications Between Systems

COMMUNICATING SYSTEMS	COMMANDS, SIGNALS EXCHANGED
DOORS • LVDS • PROP.	Door Status, FSB Request, Propulsion Enabling
DOORS • TCMS	Door Status
HVAC • TCMS	HVAC Status
HVDS • LVDS	HSCB Status
HVDS • LVDS • E.R.	CEMIPS Status
HVDS • LVDS • HVDS	HSCB Opening Request (EMI Alarm Detection)
HVDS • PROP.	Power Supply
HVDS • TCMS	CEMIPS Status (for system monitoring through the IDU)
HVDS • TCMS • PROP.	Power Reduction Request (CEMIPS Warning)
LIGHTING • LVDS	High Beam and Turn Indicators Status
LVDS • ATP	By-Pass Status, Line Selector Status
LVDS • COUPLER • LVDS	Trainlined Data
LVDS • E.R.	By-Pass and Cut-Out Status
LVDS • HVDS	Propulsion Reset Command
LVDS • LIGHTING	On/Off Commands
LVDS • PANTOGRAPH	Up/Down Motor Command
LVDS • PROP.	Car Wash and Tow Mode Request, APS/LVPS Status
LVDS • TCMS	APS/LVDS Status, Circuit Breaker Status
LVDS • TCMS • PROP.	APS/LVPS Status
PANTOGRAPH • HVDS	HV Power Supply
PROP • LVDS • E.R.	Propulsion Status
PROP. • LVDS	Propulsion/Dynamic Brake Status
PROP. • LVDS • ATP	FWD and REV Status, Power Request Status, Power Status
PROP. • LVDS • BRAKING	Commands
PROP. • LVDS • DOORS	Door Opening Enable (No Motion)
PROP. • LVDS • HVDS	HSCB Opening Request (Software/Hardware Protections)
PROP. • TCMS	Propulsion Status
PROP. • TCMS • BRAKING	Commands (e.g. RateReference, Linear non Linear Blending, Etc.)
PROP. • TCMS • PROP.	TCUs Status and Commands
TCMS • COUPLER • TCMS	WTB Data
TCMS • HVAC	On/Off, Ventilation Only Commands

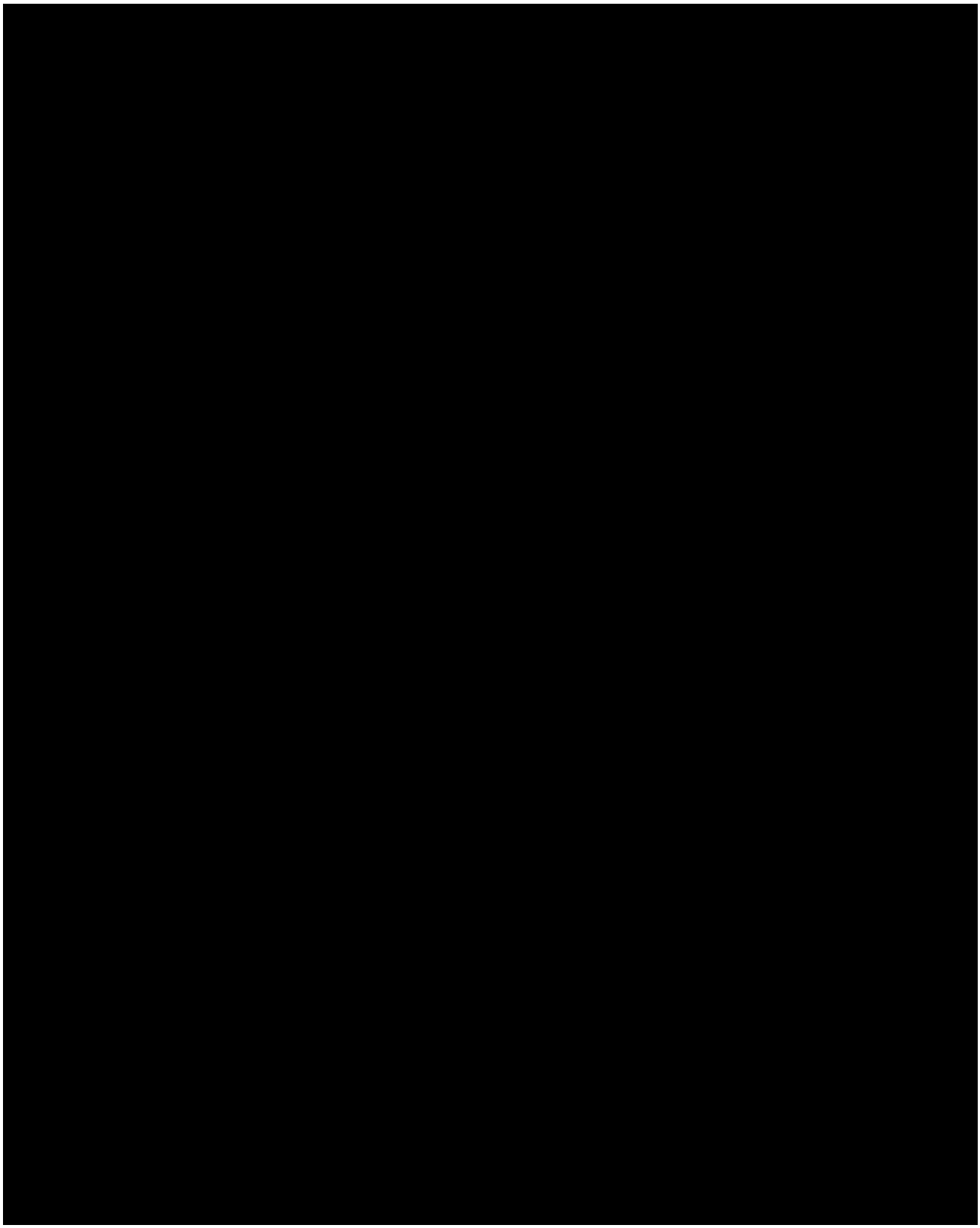


Figure 01-I-02.13 Vehicle System s Network

01-I-02.01.05.01 Relay Logic Connections

The vehicle/train LV system connects all electric and electronic systems one to each other in order to transfer a Logic Status (Low = 0Vdc; High = 37.5Vdc nominal). The connections can be direct or through the Relay Logic hardware.

A Direct connection (refer to Figure 01-I-02.14) is simply a wire that links one system to another. In this kind of connection, the receiving equipment directly acquires the output Logic Status of the source equipment. In this case there are no logic elaborations on the sent Logic Status between the source and the receiving equipment.

Figure 01-I-02.14 Source System - Receiver System Connection

Differently from a direct Connection, where the input Logic Status of the receiver is always the output Logic Status of the source, a connection through the Relay Logic can change this value and, most important, can combine more than one input equipment Logic Status to obtain a receiver input Logic Status.

Through the Relay Logic the LVDS is capable of carrying out logic operations and can link two or more devices in a more sophisticated way than the direct connection.

Figure 01-I-02.15 shows some simple examples of how the Relay Logic, starting from one or more output equipment Logic Status, can modify an input equipment Logic Status.

Equipment #1 and Equipment #6 are sources and when their output Logic Status is High they energize a relay coil.

In particular, Equipment #1 energizes the A relay coil and Equipment #6 energizes the B relay coil. Each relay has some NO (Normally Open) and some NC (Normally Closed) contacts: the NO contact is closed when the relevant coil is energized, vice versa, the NC contact is closed when the relevant coil is not energized.

Through these contacts, the Relay Logic is able to manage the input receiver equipment Logic Status:

- The input Logic Status of Equipment #2 is the same of the output Logic Status of Equipment #1.
- The input Logic Status of Equipment #3 is the negation of the output Logic Status of Equipment #1.

- The input Logic Status of Equipment #4 is the logic AND of the output Logic Status of Equipment #1 and the output Logic Status of Equipment #6. (High if both of them are High).
- The input Logic Status of Equipment #5 is the logic OR of the output Logic Status of Equipment #1 and the output Logic Status of the Equipment #6. (High if one of them is High).

Figure 01-I-02.15 Source System - Receiver System, Relay Logic Connection

For more details on how to read the Functional Schematics and the relevant Relay Logic refer to Section 00.

01-I-02.01.05.02 TCMS Equipment Connections

The data networks installed on the P2550 LRV are of two types:

- The **LON** (Local Operating Network), and
- The **TCN** (Train Communication Network), made up of the MVB and the WTB buses.

The LON Network (refer to Figure 01-I-02.16) is made up of the LONWorks Bus which connects:

- DOORS
- EMI Detector
- IDUs
- TCUs
- APS/LVPS
- ATP

Figure 01-I-02.16 LON (Local Operating Network)

The TCN Network, (refer to Figure 01-I-02.17) is made up of two buses:

- MVB (Multifunction Vehicle Bus), which connects:
  - GTW
  - IDUs
  - ECUs
  - TCUs
  - HVAC.
  - EVENT RECORDER
- WTB (Wired Train Bus), which permits exchange of "datasets" between vehicles by interconnecting the GTWs.

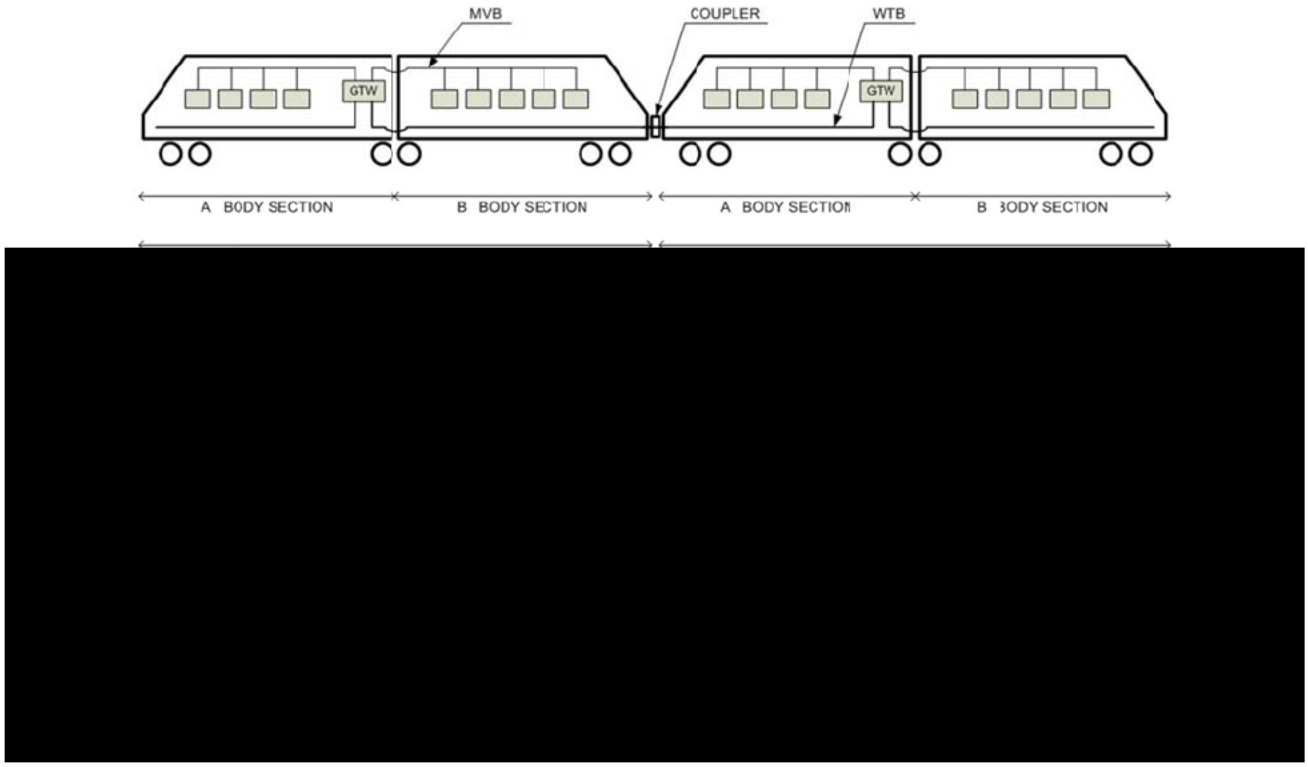


Figure 01-I-02.17 TCN (Train Communication Network)

By means of a bus, the connected Systems exchange “datasets”.

A dataset is a group of related signals collected and forwarded onto the bus as a single package.

Through a bus, the connected systems can exchange data more sophisticated than a simple status (high or low).

For example, it can also exchange analog data (a voltage or a current value) or digital data whose description needs more than one bit (e.g.: the RateReference value).

A System dataset (both a LON dataset and a TCN dataset) is made up of two important blocks:

- The “payload bits”
- The “check bits”

The “payload bits” block contains the information to be transmitted or to be acquired. The “check bits” block contains bits that permit to check the correct dataset reception. The LON has also bits for “Receiver System Address”.

This block contains information to identify the system unambiguously (or systems that must acquire the “payload bits”).

The LON and the TCN Networks present two different ways to forward and acquire a dataset:

- **LON**: All connected elements are hierarchically at the same level. When a connected system has a new dataset to be forwarded, it is capable of forwarding it directly without any delay due to an authorization from a hierarchically superior equipment. Thanks to the “Receiver System Address”, contained in the dataset forwarded by the source system, all connected systems can acquire the dataset “payload bits” made available on the LONWorks bus, in accordance with what is “written” on the dataset “Receiver System Address.”

- **TCN**: not all connected elements are hierarchically at the same level. The vehicle GTW (gateway) manages the MVB Bus of each vehicle while the Master GTW (the gateway on the vehicle with the active Cab) manages the WTB Bus. Following a time cycle, the GTW asks all connected systems for their specific dataset. Only after the request the interrogated system is authorized to forward the requested dataset onto the MVB bus. These datasets do not carry the “Receiver System Address”. In this way all systems can acquire the dataset that is made available on the bus. Similarly, the Master GTW interrogates the slave GTWs to have them forward the requested dataset onto the WTB bus.

Refer to Section 18 for a more detailed description of the TCMS and of the way the networks work.

01-I-02.02 Overview of the Systems of the P2550 LRV

The systems that operate on the vehicle are listed below, in alphabetical order:

- ATP/TWC (Sections 15 and 16)
- Low Voltage and Battery (Sections 10 and 11)
- Braking and Pneumatic System (Section 13)
- Car Body (Section 02)
- Communications (Section 14)
- Coupler (Section 03)
- Doors (Section 04)
- Event Recorder (Section 19)
- High Voltage Distribution (Section 09)
- HVAC (Section 05)
- Lighting (Section 06)
- Pantograph (Section 08)
- Propulsion (Section 07)
- TCMS (Section 18)
- Trucks and Suspensions (Section 12)

All of them contribute to the efficient, safe and comfortable ride of the vehicle.

They are connected together in order to give the operator the information needed to safely operate the vehicle and the maintainer the means to eliminate the faults.

The specific function of each one of them, starting from the High Voltage Distribution and their integration is detailed in the following. More detailed information is available in the relevant Section.

The TCMS is not actually a system: it is rather a network that permits the exchange of data and commands among systems and collects data from all systems in order to inform the operator (or the maintainer) of the condition of each system/subsystem.

All items not included in the above-mentioned systems are gathered in the Miscellaneous Section (17).

01-I-02.02.01 Pantograph

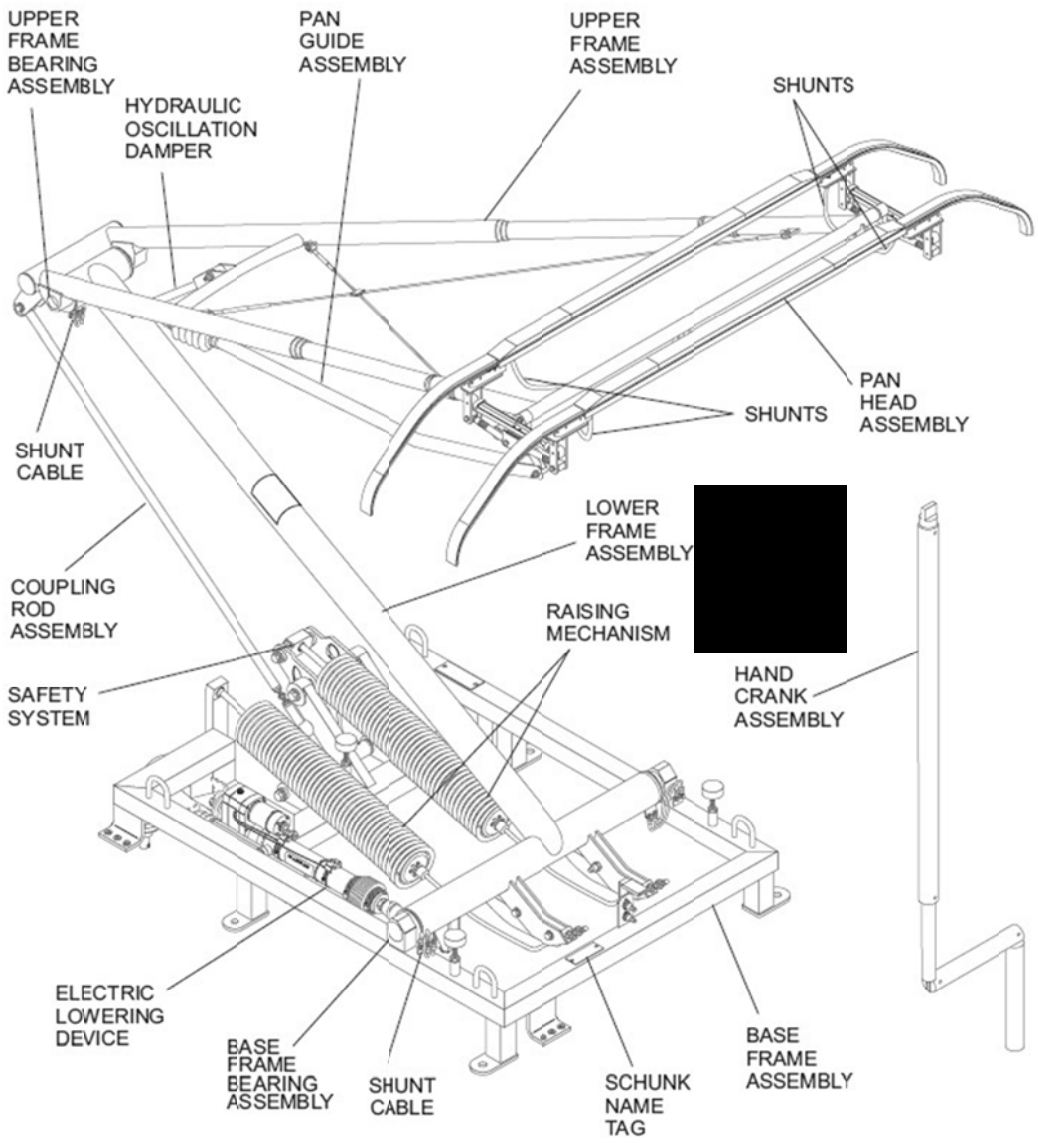


Figure 01-I-02.18 Pantograph Assembly

The pantograph is mounted on the roof, on the A Body Section, close to the Articulation Section.

The orientation of the Pantograph is with the knee pointing the A cab.

The purpose of the pantograph is to collect current from the overhead catenary to power the vehicle.

The pantograph must be raised to collect current. When not in use, the pantograph is lowered to its rest position.

The pantograph can be raised and lowered using an electrical (console switch) or a mechanical device (hand crank).

The switch controls the operation of the DC motor and gearbox of the electrical lowering device.

The switch selects the operational direction of the motor to either raise or lower the pantograph.

The Pantograph Command circuitry is provided with a diode (installed in the Electrical Locker "A") to eliminate the motor braking effect during the pantograph manual lowering.

The pantograph incorporates a safety system that lowers the pantograph if an obstruction is encountered.

When in the raised position, the pantograph collects electrical current from the overhead conductor (catenary) for use as the vehicle high-voltage power supply.

The carbon strips of the pantograph (or horns if overhead is severely off center) contact the catenary.

The metal-to-metal contact of the assemblies and electrical shunts provide a current path to the contact plate (high-voltage connection) on the side of the pantograph, where the vehicle wiring receives the current and connects it to the vehicle systems.

The shunts provide a low resistance path between the assemblies, allowing the current to by-pass the bearings at the pivot points.

Figure 01-I-02.19 Pantograph Block Diagram

In the absence of sufficient battery power (or a power loss), the pantograph can be raised or lowered from inside the vehicle by means of the hand crank.

An opening in the vehicle interior enables the hand crank to engage the coupling of the roof interface.

A flexible shaft connects the gearbox to a roof interface.

Rotation of the hand crank turns the flexible shaft and drives the gears in the gear box, causing movement of the pantograph.

The hand crank has an insulator to prevent injury in the event it contacts an electrified portion of the pantograph. It is located on the wall inside the A Cab.

01-I-02.02.02 HVDS (High Voltage Distribution System)

The main components of the HV Distribution System (refer to Section 09) are (Refer to Figure 01-I-02.20):

- Lightning Arrester (refer to Section 8)
- EMI (Electro-Magnetic Interference) system (HCT + EDU) (refer to Section 9)
- Auxiliary Fuse (refer to Section 10)
- HSCB (High Speed Circuit Breaker) (refer to Section 7)
- Junction Boxes (refer to Section 9)
- Knife Switch (refer to Section 9)

The HVDS supplies the following systems:

- Propulsion System (refer to Section 07)
- APS/LVPS Converter through the APS/LVPS Line Reactor (refer to Section 10)

The return path is provided via car-body ground.

The Car Body Grounding System connects also all train metal parts to the ground.

Figure 01-I-02.20 shows the functional block diagram of the HV Distribution.

The 750 V dc is collected from the catenary by the pantograph, located on the roof of the “A” Section of the vehicle.

From the Pantograph the 750Vdc passes through the HCT and then goes to two parallel circuits:

- Traction Inverters, through the HSCB and the Knife Switch;
- Auxiliary Power Supply, through the Auxiliary Fuse and the Knife Switch.

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 and are protected by the High Speed Circuit Breaker (HSCB) against over-currents, filter over-voltages, ground faults and IGBT failures. The HSCB can also be opened by the TCU logic or if an EMI is detected.

The Auxiliary Power Supply (APS - “B” section underframe) circuit, together with the LVPS circuit, is protected by the Auxiliary Fuse 01F02 (250A) and supplies the Auxiliary subsystems.

The Lightning Arrester is a transient surge suppressor isolated from the car-body.

The Knife Switch has four positions (refer to Figure 01-I-02.20):

- Normal (Pantograph supplies both Propulsion and APS/LVPS Systems)
- Auxiliary (Pantograph supplies the APS/LVPS System only)
- OFF (Pantograph, even if raised up, does not supply any system)
- Shop (the APS/LVPS System is supplied through an external Socket)

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 and the

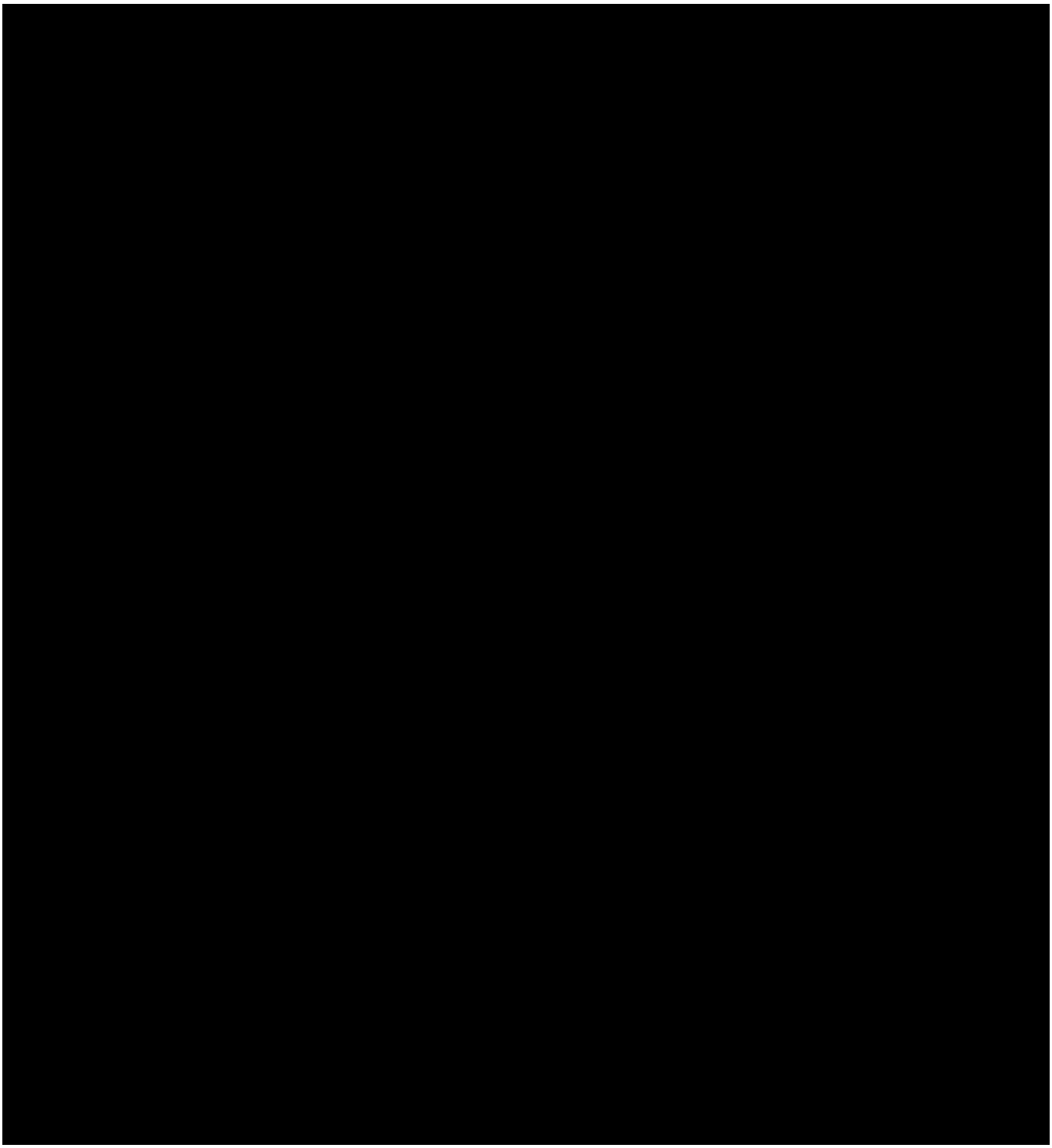
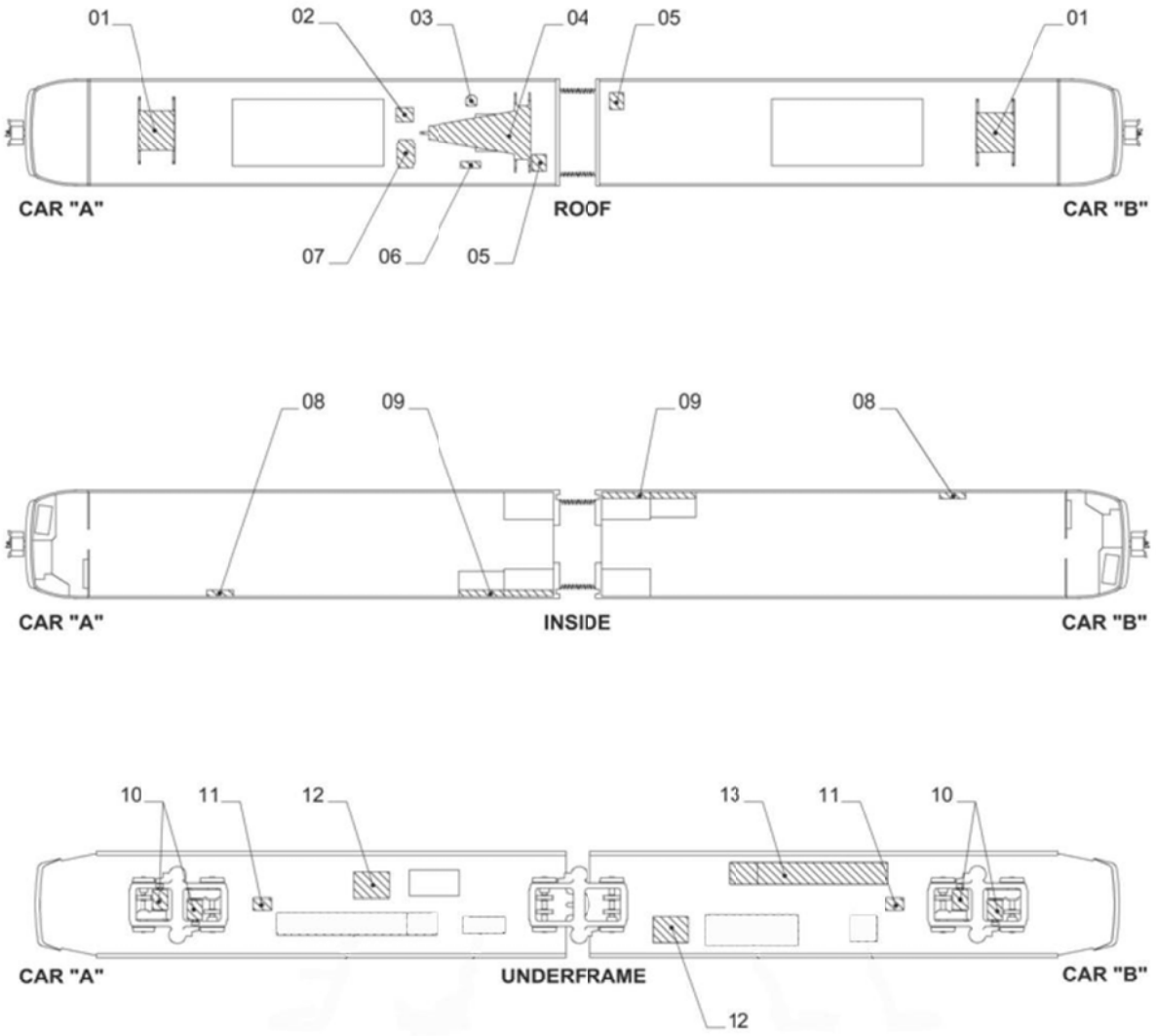


Figure 01-I-02.20 HV Distribution System



OTHER SYSTEMS	HVDS
01. BRAKING RESISTOR	02. HCT
04. PANTOGRAPH	03. LIGHTNING ARRESTER
10. TRACTION MOTOR	05. JUNCTION BOX
11. DISCONNECT BOX	06. AUXILIARY FUSE
12. PROPULSION LINE REACTOR	07. HSCB
13. PROPULSION INVERTER	08. BRAKE RES. CABLE PSGW
	09. CABLE PASSAGEWAY

Figure 01-I-02.21 HV Equipment Location

01-I-02.02.02.01 Electro Magnetic Interference (EMI) System

The EMI System is made up of the HCT (Harmonic Current Transducer - mounted on the roof) and the EDU (EMI Detector Unit, located in the A Section Electronic Locker).

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.

In case of emission exceeding the threshold, the EDU will trip the High Speed Circuit Breaker to isolate the offending devices from the catenary and towards the environment.

Whenever the limit is exceeded, a diagnostic event is generated and recorded in a non-volatile memory.

The EDU system is connected to the vehicle logic and can request an HSCB opening. It is also connected to the LONWorks Bus to request a Propulsion Reduction to the Propulsion System and to send its status to the TCMS.

It is also possible to connect the AnsaldoBreda PTU to the Data Download Panel to have a real time monitoring of the harmonic content of the line current and to download the event log database.

01-I-02.02.02.02 Grounding System

The Ground Return path is made up of two separated systems connected to ground by means of ground brush assemblies mounted on the axles of the three trucks.

The ground brush assemblies provide a common node path to ground through the axle and wheel assemblies to the running rails. The two systems are:

- Traction Inverter Ground System
- Car Body Ground System

The Traction Inverter Ground System permits the Electric and Electronic devices functioning. In fact, it defines a current return path for the electronic devices (HV, MV and LV - refer to Figure 01-I-02.22).

The Car Body Ground System has a safety purpose: to eliminate electrostatic charges that may accumulate on the vehicle metallic parts. To achieve this goal, all metallic components are connected to Ground (usually they are connected to the Car Body which is connected to Ground). 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.

Figure 01-I-02.23 Car Body Ground System

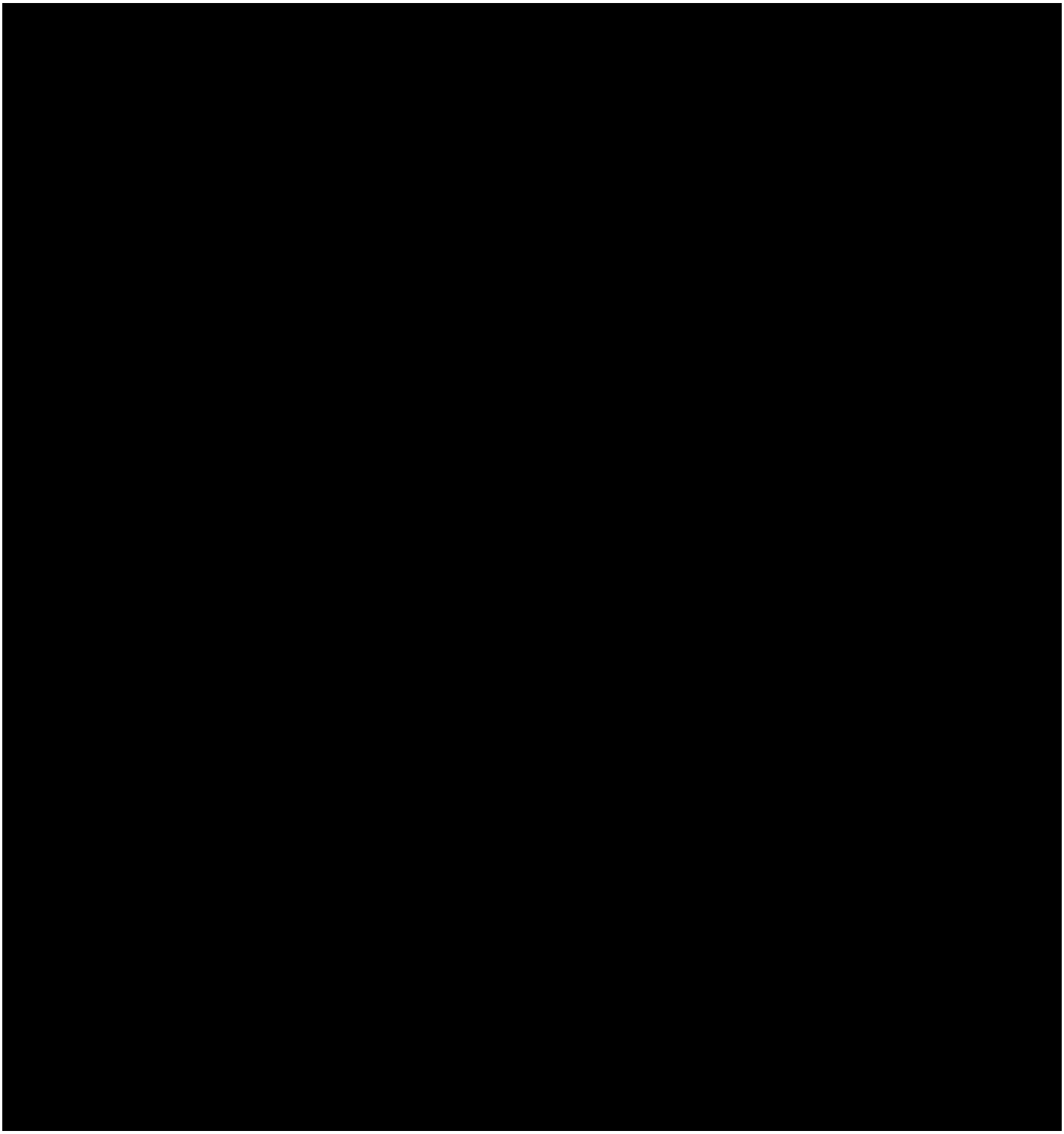


Figure 01-I-02.24 HV Grounding System

01-I-02.02.03 LVDS (Low Voltage Distribution System)

The Low Voltage Distribution System consists of the power distribution system downstream from the High Voltage Power Distribution System, through the Auxiliary Fuse and the Knife Switch (or from the Shop Power Socket), again through the Knife Switch (refer to Figure 01-I-02.20).

The Low Voltage Distribution System main tasks are:

- Transforming the HV into MV and LV for supplying the MV and LV electric and electronic equipment.
- Transferring the MV and LV to all MV and LV electric and electronic equipment with the proper current path segments.
- Implementing the LV System data exchange (directly and by means of the Relay Logic). (Refer to paragraph 01-I-02.01.05.01).

It includes:

- APS/LVPS Line Reactor

- APS/LVPS System:
  - Auxiliary Power Supply (APS)
  - Low Voltage Power Supply (LVPS)
  - APS/LVPS Fan
- Electric and Electronic Lockers
- Operator's Cab Electric Equipment:
  - CB Panels
  - By-Pass Panel
  - Operator Console
  - Indicator and Switch Panels

01-I-02.02.03.01 APS/LVPS Line Reactor

The Line Reactor is an inductance (20 mH -0%, +10 %) for the input Low-Pass filter of the APS/LVPS System.

It is located in the B Body Section Underframe next to the APS/LVPS System.

01-I-02.02.03.02 APS/LVPS System

The APS (refer to Section 10) converts the 750 Vdc line input into the 208 Vac 3-phase/60Hz and the 120Vac 1Ø/60Hz (for the convenience outlets and Cab Heaters, by using a single phase voltage to neutral). In this way, it provides auxiliary power to the vehicle.

The LVPS System (Refer to Section 10 for more details), converts the 750Vdc into 37.5 Vdc at the (+L) and (+B) outputs.

- Through the (+L) connector this system supplies the LV Loads
- Through the (+B) connector this system supplies the Battery and the Track Brake

The maximum start-up time from when the APS/LVPS receives a high voltage input between 450 and 1050 Vdc, is 5 sec.

If the input voltage exceeds the maximum input voltage of 1,050 Vdc, or falls below the minimum input voltage of 450 Vdc, the Auxiliary inverter shuts down.

However, as soon as the inverter input voltage falls within the range again, the inverter restarts automatically.

The battery voltage (from the LVPS or directly from the Battery) feeds the converter control and adjustment circuits. In the event that the battery is completely discharged, the converter is capable of starting up using only the HV input, thanks to the autostarter device (SUC: Start Up Circuit).

Once started the converter feeds itself.

The vehicle HV three-phase Loads are:

- HVAC loads
- Propulsion Inverter Fans
- Air Compressor
- APS/LVPS Fan

The vehicle HV one-phase Loads are:

- The Windshield Defroster/Demister (in each Cab)
- 8 Convenience Outlets (2 per Cab and 2 per Electric Locker)

All vehicle LV Loads, Battery and Track Brakes are shown in Figure 01-I-02.25.

The APS/LVPS static converter box contains (refer to Figure 01-I-02.26):

- APS Transformer
  (MV output regulation and galvanic isolation between HV and MV)
- APS/LVPS Fan (APS Inverter Module and LVPS Inverter Module cooling)
- LVPS Transformer
  (LV output regulation and galvanic isolation between HV and LV)
- Component Assembly (electric components)
- Connection Box (HV and MV connectors)
- Active Clamp Circuit (Voltage regulation)
- Control Stack (APS/LVPS regulating equipment)
- LVPS Inverter Module (DCDC converter)
- APS Inverter Module (DCAC converter)
- Air Inlet (APS/LVPS Fan air duct)

The current path through the APS/LVPS System is described in Figure 01-I-02.27.

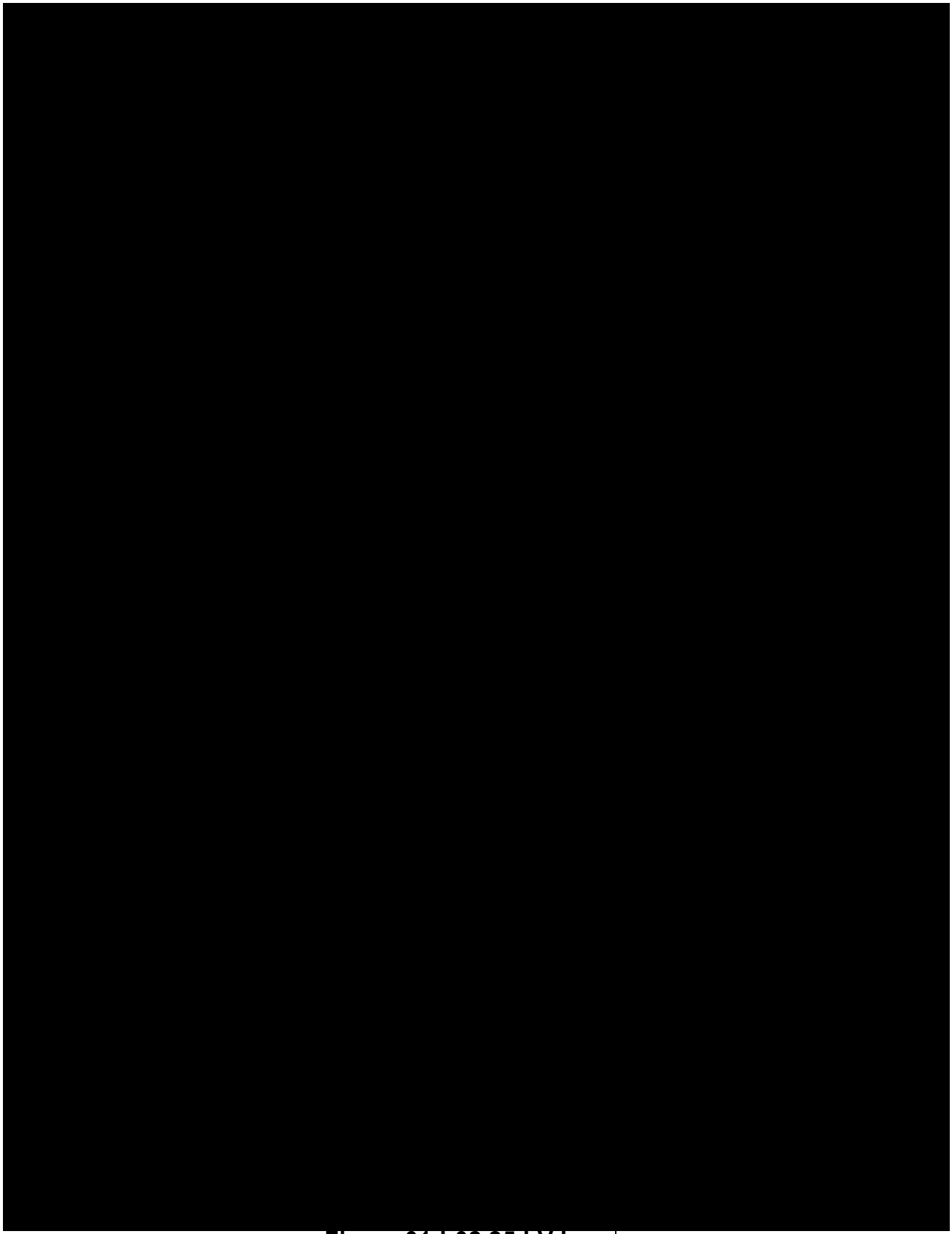
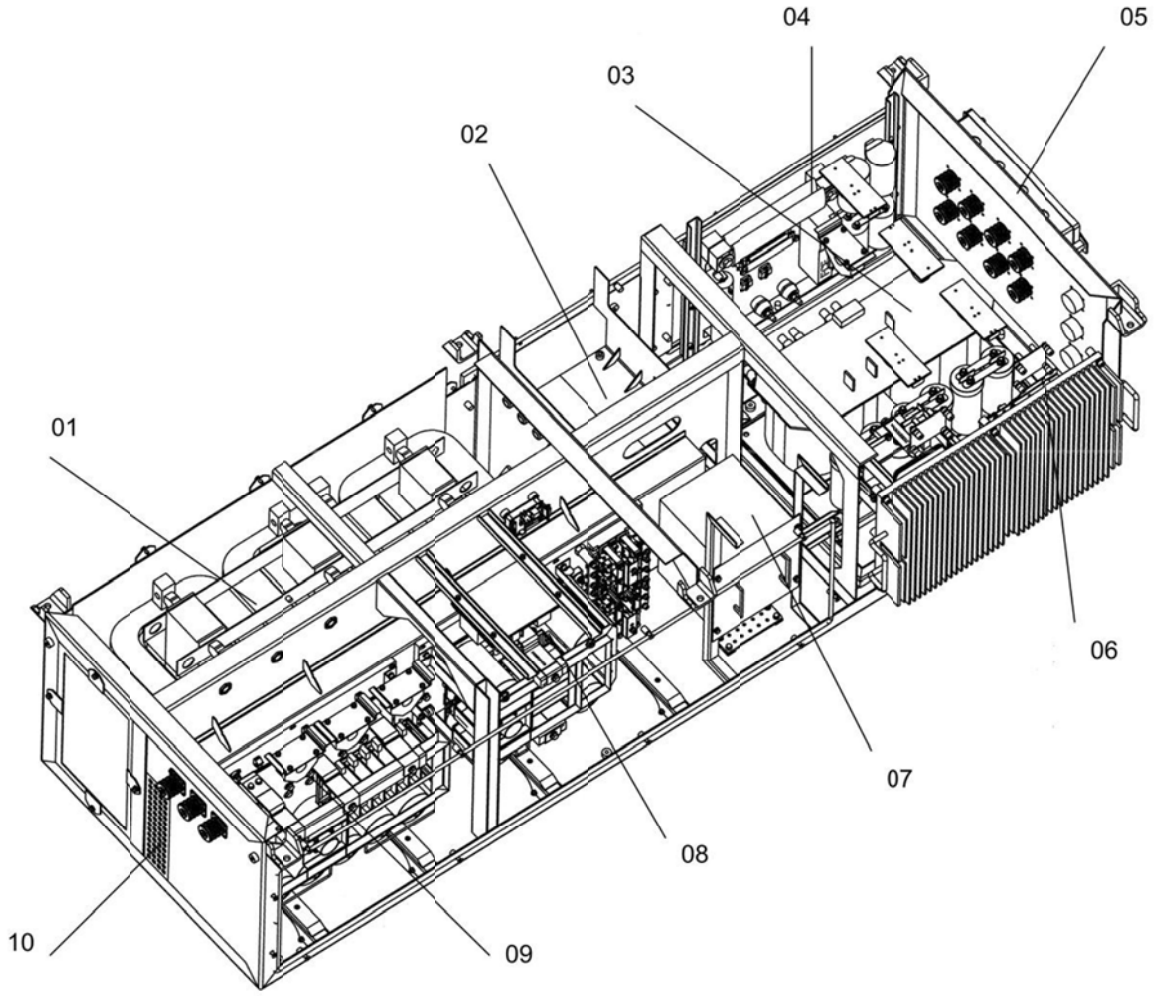


Figure 01-I-02.25 LV Loa s



01. APS Transformer
02. APS/LVPS Fan
03. LVPS Transformer
04. Component Assembly
05. Connection Box
06. Active Clamp Circuit
07. Control Rack
08. LVPS Inverter Module
09. APS Inverter Module
10. Air Inlet

Figure 01-I-02.26 APS/LVPS Component

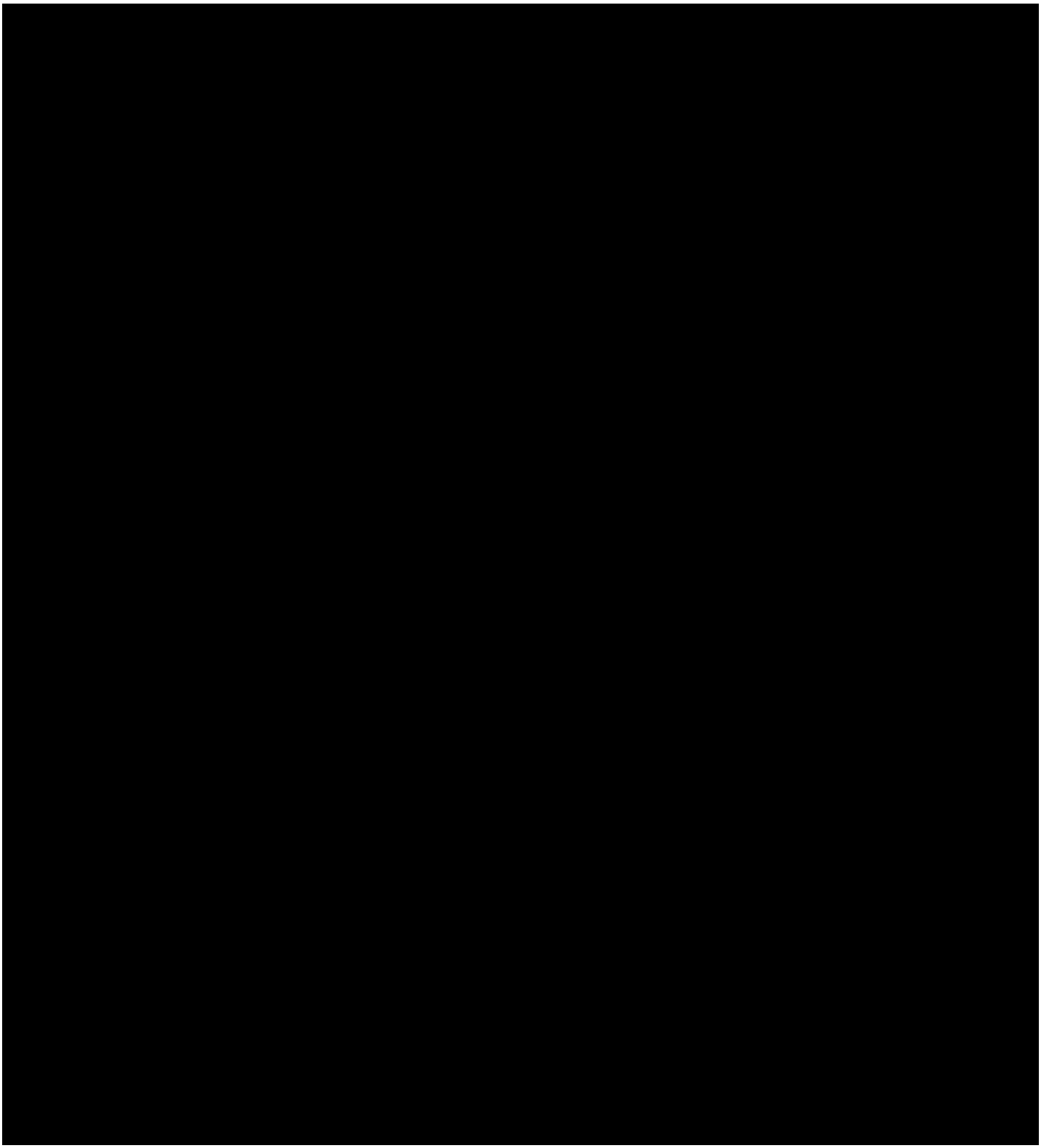
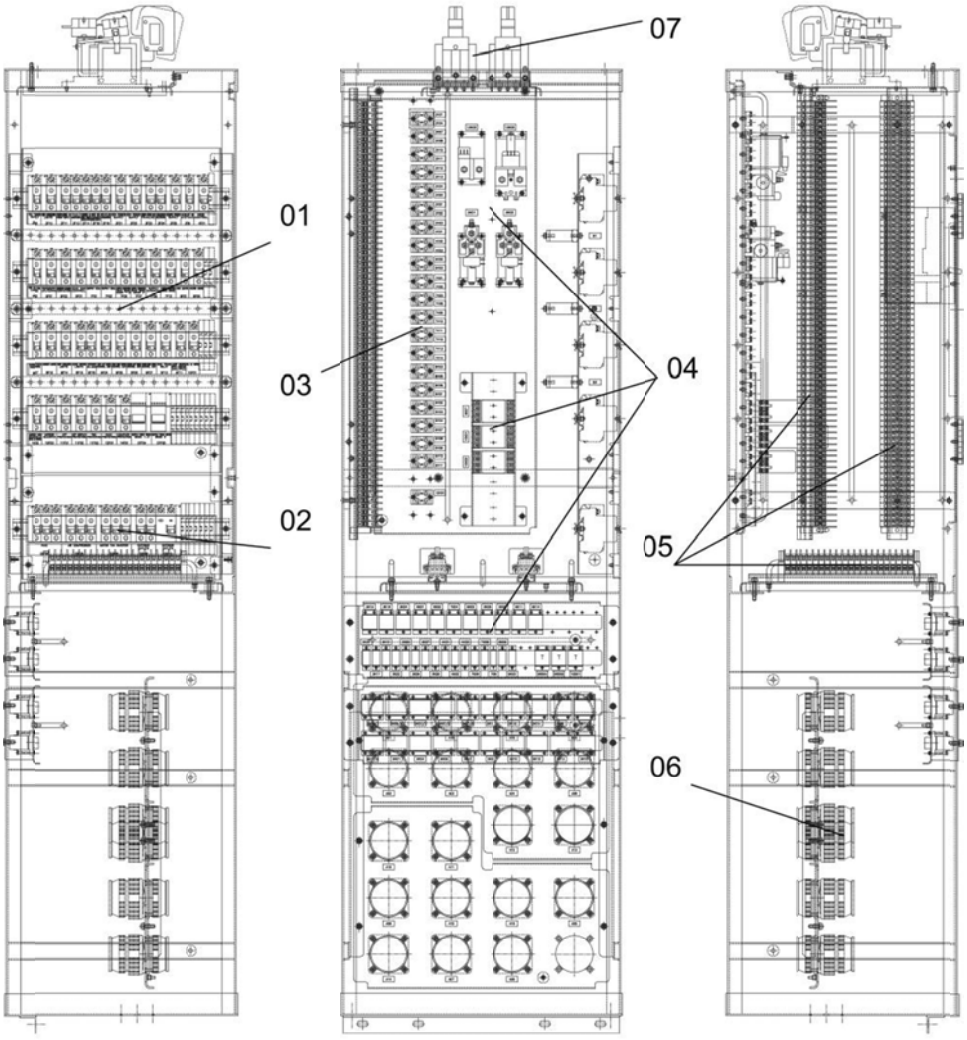


Figure 01-I-02.27 APS/LVPS Diagram

01-I-02.02.03.03 Electric and Electronic Lockers

The two Electric Lockers (one per Body Section, at the center, on the left side of the vehicle, looking towards the A cab) contain electric components for the LV Distribution System of the relevant Body Section.

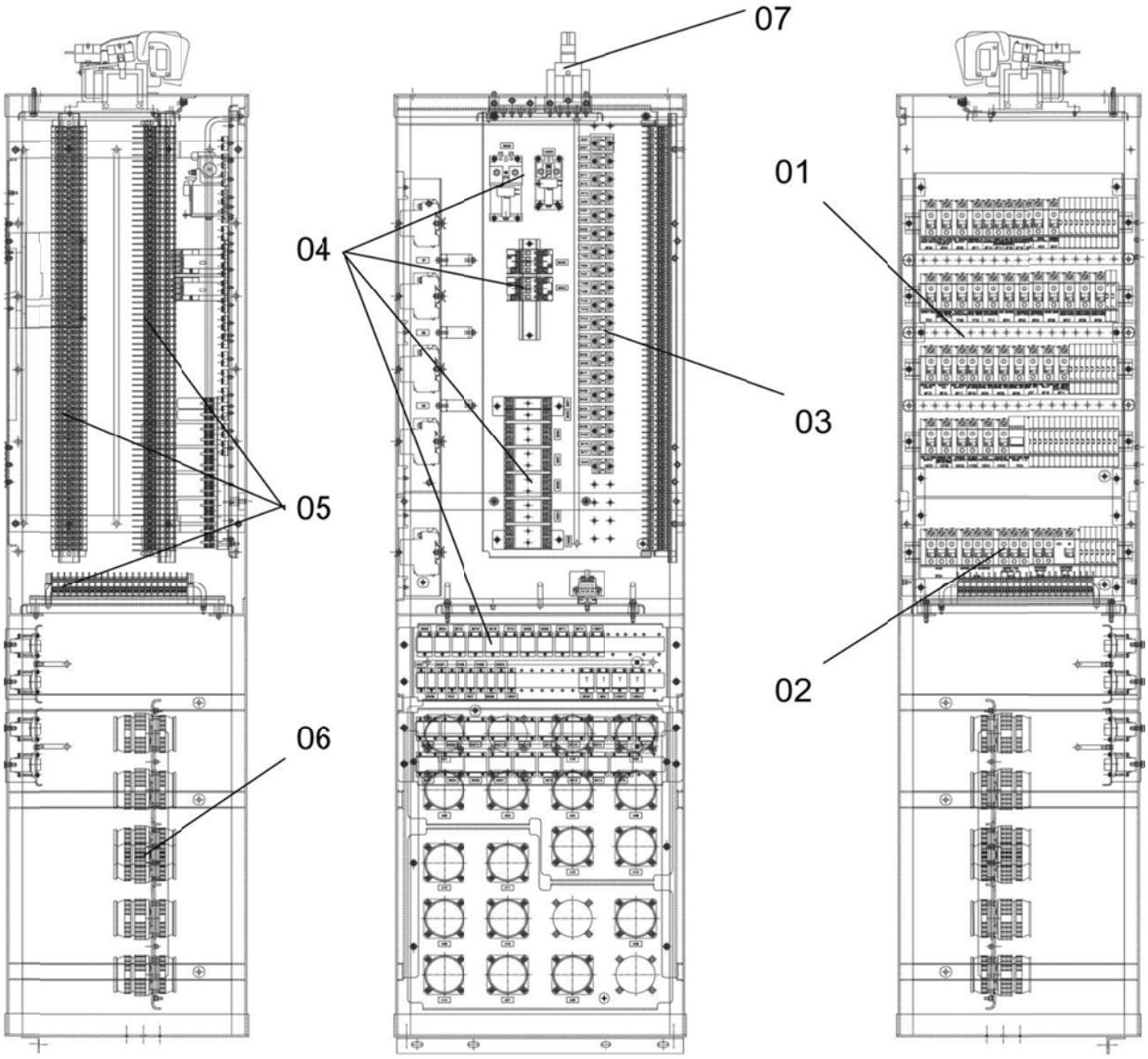
An overview of the two Electric Lockers is given in Figures 01-I-02.28 and 01-I-02.29.



01. LV CIRCUIT BREAKERS
02. MV CIRCUIT BREAKERS
03. DIODES
04. RELAYS
05. TERMINAL BOARDS
06. CONNECTORS
07. CONTACTORS

[redacted]

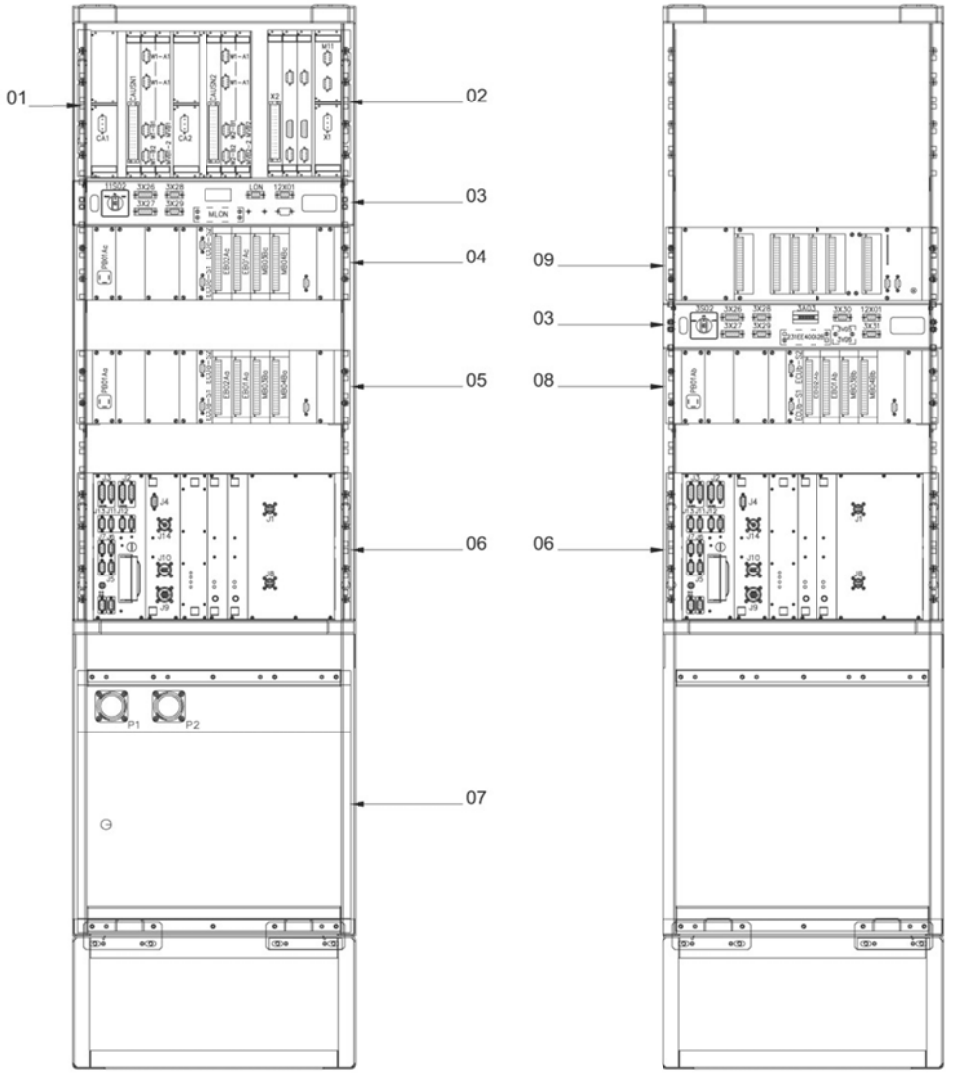
Figure 01-I-02.28 A Body Section Electric Locker



01. LV CIRCUIT BREAKERS
02. MV CIRCUIT BREAKERS
03. DIODES
04. RELAYS
05. TERMINAL BOARDS
06. CONNECTORS

Figure 01-I-02.29 B Body Section Electric Locker

The two Electronic Lockers, one in each Body Section, do not contain the same electronic equipment:: the GTW and the ATP systems are located in the A Locker only, while the Event Recorder is located in the B Locker only, as shown in Figure 01-I-02.30.



01. GTW
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 01-I-02.30 Electronic Lockers

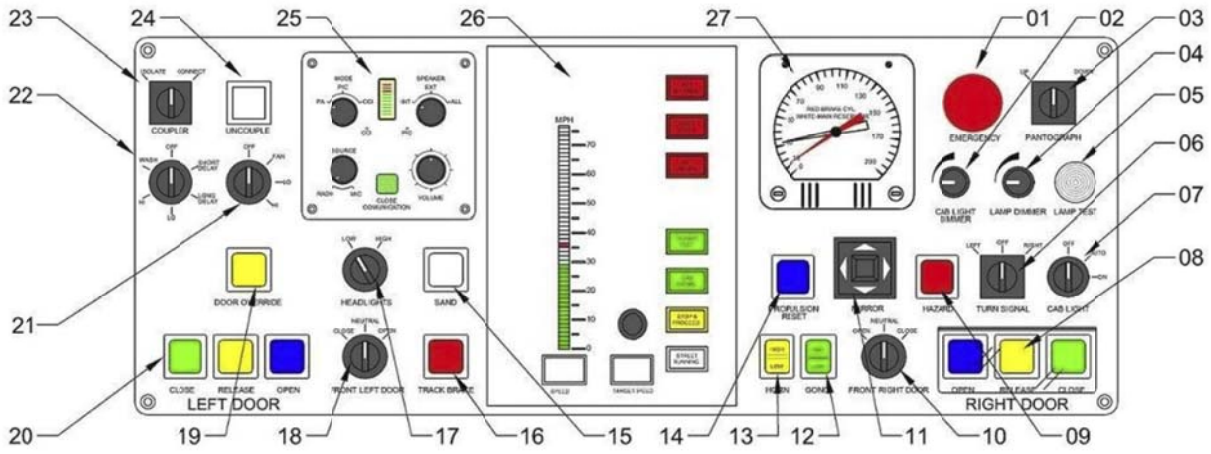
01-I-02.02.03.04 Cab Electrical Equipment

The Electrical Equipment mounted in the each Operator Cab is listed below, with the relevant location of each component:

- Operator Console
- LV and MV Circuit Breakers (on the wall near the Cab Door)
- By-Pass Panel (on the wall between the ceiling and the Right Window)
- Indicator and Switch Panels (above the Windshield)

a) Operator Console

The Operator Console contains the all Pushbuttons and Switches needed by the Operator for operating the vehicle. Refer to Figure 01-I-02.31 for an Operator Console overview.



1.	EB PUSH BUTTON (MUSHROOM)	10.	FRONT RH DOOR SWITCH	19.	DOOR OVERRIDE
2.	CAB LIGHT DIMMER	11.	MIRROR ADJUST SWITCH	20.	LH DOORS CONTROL PANEL
3.	PANTOGRAPH UP/DOWN SW.	12.	GONG (High/Low)	21.	HEATER/DEMISTER
4.	LAMP DIMMER	13.	HORN (High/Low)	22.	WIPER/WASHER
5.	LAMP TEST	14.	PROPULSION RESET	23.	COUPLER ISOLATE/CONNECT
6.	TURN SIGNAL SWITCH	15.	SAND	24.	UNCOUPLE SWITCH
7.	CAB LIGHT	16.	TRACK BRAKE	25.	COMMUNICATION CONTROL HEAD
8.	RH DOORS CONTROL PANEL	17.	HEADLIGHT	26.	ASPECT DISPLAY UNIT
9.	HAZARD	18.	FRONT LH DOOR SWITCH	27.	DUPLEX AIR PRESSURE GAUGE

Figure 01-I-02.31 Operator Console Overview

b) LV and MV Circuit Breakers

The Operator Cab LV and MV Circuit Breakers are listed in the following Tables, with the relevant description and location:

Table 01-I-02.2 Operator Cab MV Circuit Breakers

Code	Description	Location
2F13	Cab Convenience Outlet	Cab "A" and Cab "B"
2F14	Cab Convenience Outlet	Cab "A" and Cab "B"
2F07	Exterior Outlet switch	Cab "A" and Cab "B"
2F08	Exterior Outlet switch	Cab "A" and Cab "B"
2F11	Windshield Defroster/demister Switch	Cab "A" and Cab "B"
10F04	Protective Switch for Defroster	Cab "A" and Cab "B"
10F05	Cab Heater/Demister Fan Motor	Cab "A" and Cab "B"

Table 01-I-02.3 Operator Cab LV Circuit Breakers

Code	Description	Location
12F02	HVAC Supply Car "A"	Cab "A" and Cab "B"
13F01	Communication System Car "A"	Cab "A" and Cab "B"
13F02	Radio Comm. System Car "A"	Cab "A" and Cab "B"
13F03	Signs Comm. System	Cab "A" and Cab "B"
3F05	Desk Enabling Contactor	Cab "A" and Cab "B"
3F06	Cab Enable Contactor	Cab "A" and Cab "B"
3F08	Cab Enable Relays	Cab "A" and Cab "B"
3F12	Dynamic Brake Cut-out	Cab "A" and Cab "B"
3F20	Master Controller	Cab "A" and Cab "B"
5F02	Pantograph Motor Control	Cab "A" only
6F02	6A02 Power Supply	Cab "A" only
6F03	Emergency Brake Loop	Cab "A" only
7F09	Brake System Supply	Cab "A" and Cab "B"
7F14	BCU Valve Supply	Cab "A" and Cab "B"
7F15	BCU Valve Supply	Cab "A" only
8F02	Compartment Light	Cab "B" only
8F05	Emergency lighting	Cab "B" only
8F11	Headlights	Cab "A" and Cab "B"
8F12	Roof Headlight	Cab "A" and Cab "B"
9F02	Door Control & Supply Car "A"	Cab "A" and Cab "B"
9F08	Doors Emergency Loop	Cab "A" only
9F09	Doors Closed&locked Loop	Cab "A" and Cab "B"

c) By-Pass Panels

The By-pass Panels are located close to the ceiling of each Cab.

The By-pass switches of the A and the B cab are listed in the following Tables.

By means of the By-pass switches, the Operator can bypass the relevant system and continue operating the vehicle.

Every time a system is by-passed, the internal logic of the Propulsion System applies a 35mph of Speed Limit (unless a more restrictive Speed Limit is active).

Table 01-I-02.4 By-Pass Panels

A Cab By-Pass Panel		B Cab By-Pass Panel	
3S07	TCU Cut-out Switch	3S07	TCU Cut-out Switch
3S08	No-motion By-pass	3S08	No-motion By-pass
3S09	EM Monitor	7S03	By-pass ECUa/b Switch
6S01	SA02 Power Supply By-pass Switch	7S05	Brake Apply By-pass
7S03	By-pass ECUa/b Switch	9S11	Right Doors By-pass
7S04	By-pass ECUc Switch	9S12	Left Doors By-pass
7S05	Brake Apply By-pass		
9S11	Right Doors By-pass		
9S12	Left Doors By-pass		
11S03	TWC By-pass Switch		
11S01	ATP By-pass Switch		

d) Indicator and Switch Panels

Three Indicator and Switch Panels are mounted above the Windshield.

The one on the far left has four switches, to start and stop the HVAC system, to close and open the HVAC dampers, to start/stop the Car-wash Mode and the Tow Mode.

The Indicator Panel in the middle, called “Indicator Panel B”, and the third Indicator Panel, on the right, called “Indicator Panel A”, contain warning lamps related to the status of the most important functions of the vehicle (refer to Table 01-I-02.5), to help the Operator carrying out a basic troubleshooting of the vehicle:

Table 01-I-02.5 Indicator Panels

Indicator Panel B	Indicator Panel A
HSCB Open	Left Doors Closed & Locked
Bypass Active	Left Doors Released
Friction Brake Fault	Right Doors Released
EB Loop Power Supply Fault	Right Doors Closed & Locked
Prop/Dyn Brake Fault	Park / Friction Brake On
LVPS Fault	Track Brake
APS Fault	Left Turn
Fresh Air Dampers	High Beams
Gold Line Set Up	Right Turn
Blue Line Set Up	
Green Line Set Up	

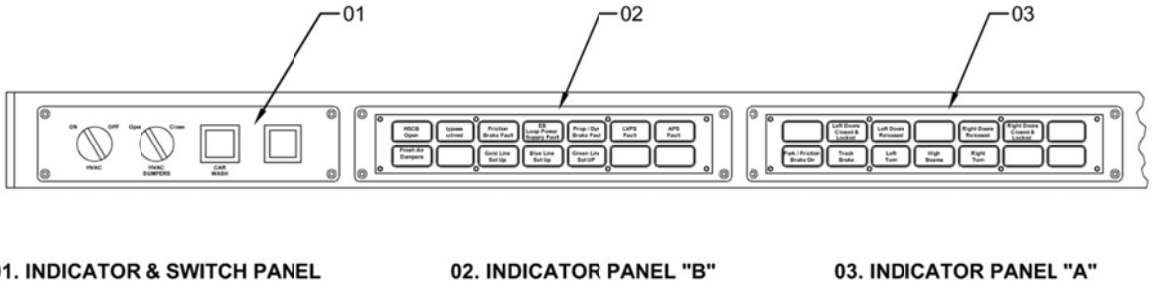


Figure 01-I-02.32 Indicator and Switch Panels

01-I-02.02.04 The Propulsion System

The Propulsion System, is the most important system on the vehicle, since it actually "moves" the vehicle, interfaces and coordinates all vehicle systems while assuring performance, safety and comfort.

The LRV Propulsion System is made up of two separate, identical Propulsion Subsystems; one for each Body Section.

Each sub-system has two AC motors mounted on the two Motor Trucks, in the A and the B car section.

The two sub-systems and the relevant equipment are totally interchangeable.

The hierarchical tree structure of the Propulsion System, with all subsystems and relevant equipment, connected together in a parent-children relationship, is shown in Figure 01-I-02.33.

The Propulsion Inverter is the heart of the Propulsion System and manages the supply to the traction motors during acceleration and braking operations.

The Propulsion Inverter converts the nominal 750 V dc of the Catenary Line (which travels through the Pantograph (refer to Section 08 - Pantograph), the HSCB and the Knife Switch (refer to Section 09 - HV Distribution System) into a Variable Voltage Variable Frequency (VVVF) three-phase Alternate Current (AC) to power the relevant AC Motors. Each Propulsion Inverter is in an enclosed housing which prevents water and dirt from entering and contacting the electronic components.

The management of traction and braking is assured by the Traction Control Unit (TCU), one per car section, located inside the relevant Inverter Control Module together with all contactors, voltage and current transducers, filter charge switches, etc. needed to manage the Inverter operations.

Each TCU manages traction, by controlling the Propulsion System and driving the Propulsion Inverter to obtain the requested torque value from the motors.

The Propulsion system operates in response to the operator actions on the Master Controller Handle or on the Emergency Push button.

The Master Controller Handle has two different types of connection with the TCUs:

- Six trainlines (high/low signals) for: POWER, COAST, FULL SERVICE BRAKE, HIGH RATE SERVICE BRAKE and a double line for SLIDE CONTROLLED EMERGENCY BRAKE.
- Analog connection for a 4-20mA current signal to generate the right intermediate motor torque between MAX POWER and FULL SERVICE BRAKE.

For safety reason the TCU also receives indications from other systems and, depending on them, can override the Master Controller commands.

The Systems and commands interfaced with the TCU are:

- ATP system and EB pushbutton (to force an EMERGENCY BRAKE)
- DOOR and ATP systems (to force a FULL SERVICE BRAKE)
- EMI Detector Unit (to force a Power reduction)
- ATP, By-Passes, CarWash Mode (to define a speed limitation)

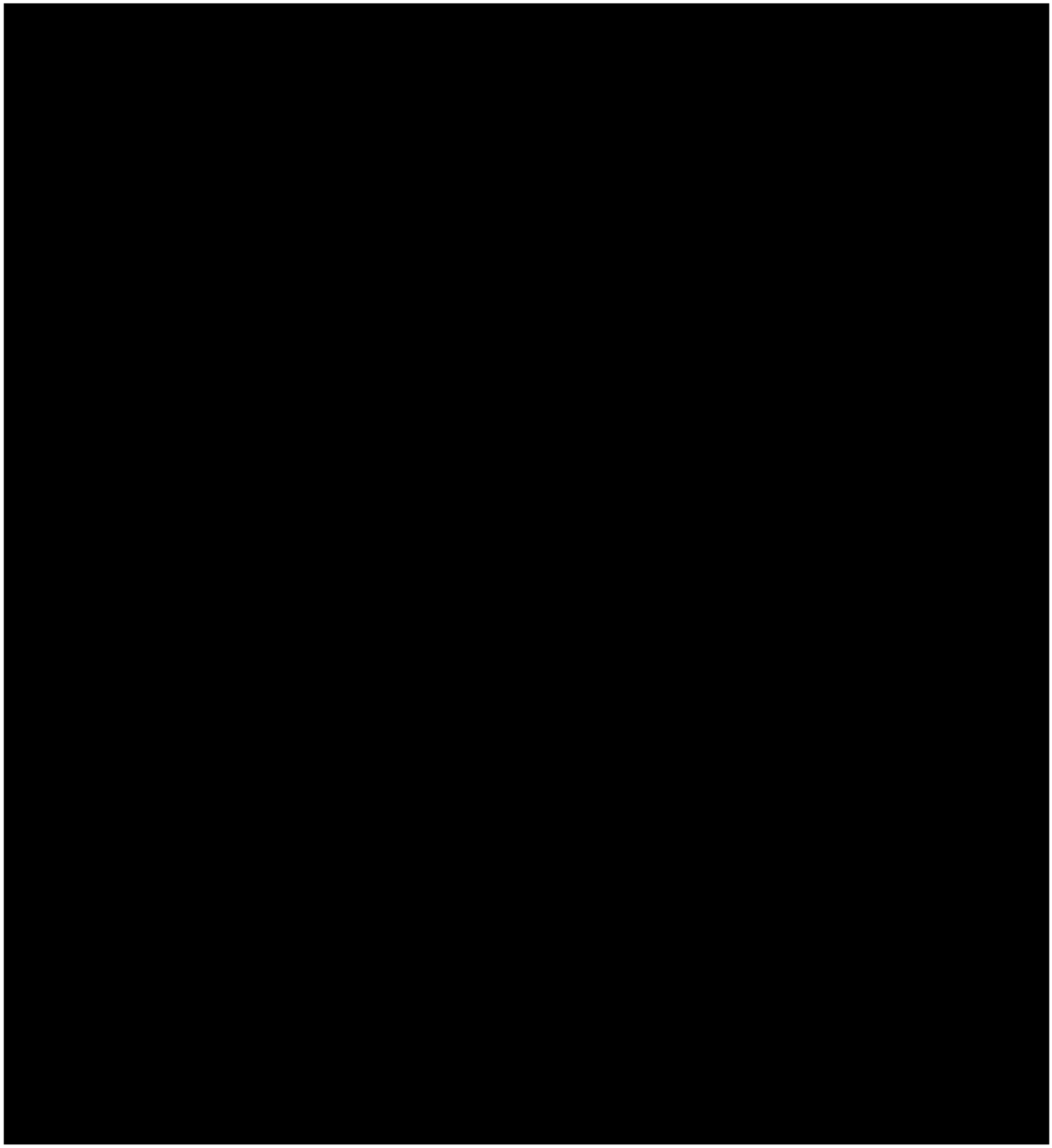


Figure 01-I-02.33 Propulsion System Current Path

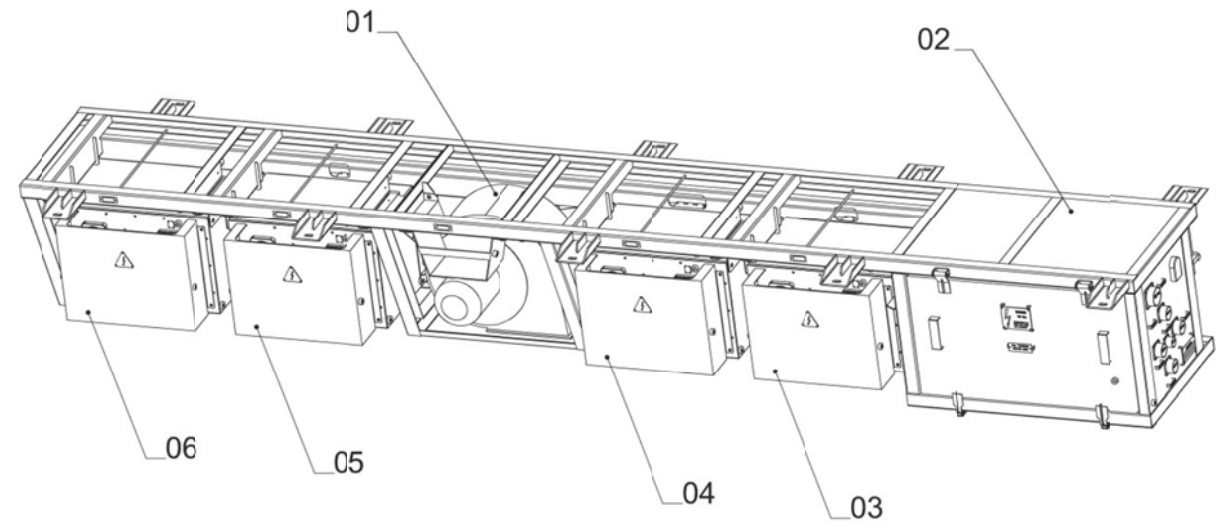
01-I-02.02.04.01 Propulsion Inverter

The Propulsion Inverter carries out two important functions:

- During motoring: it converts the Catenary Voltage coming from the HV System into a 3-phase current for the relevant AC Motors
- During braking: it returns the current generated by the AC Motors to the Catenary or to the relevant Braking Resistor if the Catenary line is not receptive

It is made up of three Inverter Phase Modules, a Braking Chopper Module, an Inverter Fan, an Air Duct and an Inverter Control Module, containing the TCU (Traction Control Unit) which controls the entire Propulsion System.

The two Propulsion Inverters are identical (and the four IGBT modules are identical) and interchangeable. They are used to create the three phase inverter output during Motoring or for returning current to the line when the line is receptive during Dynamic Braking (Phase Modules); or for sending current to the Braking Resistors when the line is not receptive during Dynamic Braking (Braking Chopper).



01. INVERTER FAN
02. CONTROL MODULE
03. PHASE MODULE A
04. PHASE MODULE B
05. PHASE MODULE C
06. BRAKING CHOPPER

Figure 01-I-02.34 Propulsion Inverter Structure

01-I-02.02.04.02 Phase Module and Braking Chopper

The three Phase Modules and the Chopper Module are identical, even if their function is different: Each Phase Module generates one phase current for the relevant AC motors, while the Braking Chopper Module returns the current generated by the motors during non-regenerative dynamic braking to the Braking Resistors if the Catenary Line is not receptive at all; or, only partially receptive in the case of blended regenerative/non-regenerative braking. The Chopper Module is also used to connect the roof resistors to the Catenary (via the TMs) during motoring; if the Line Voltage is getting too high.

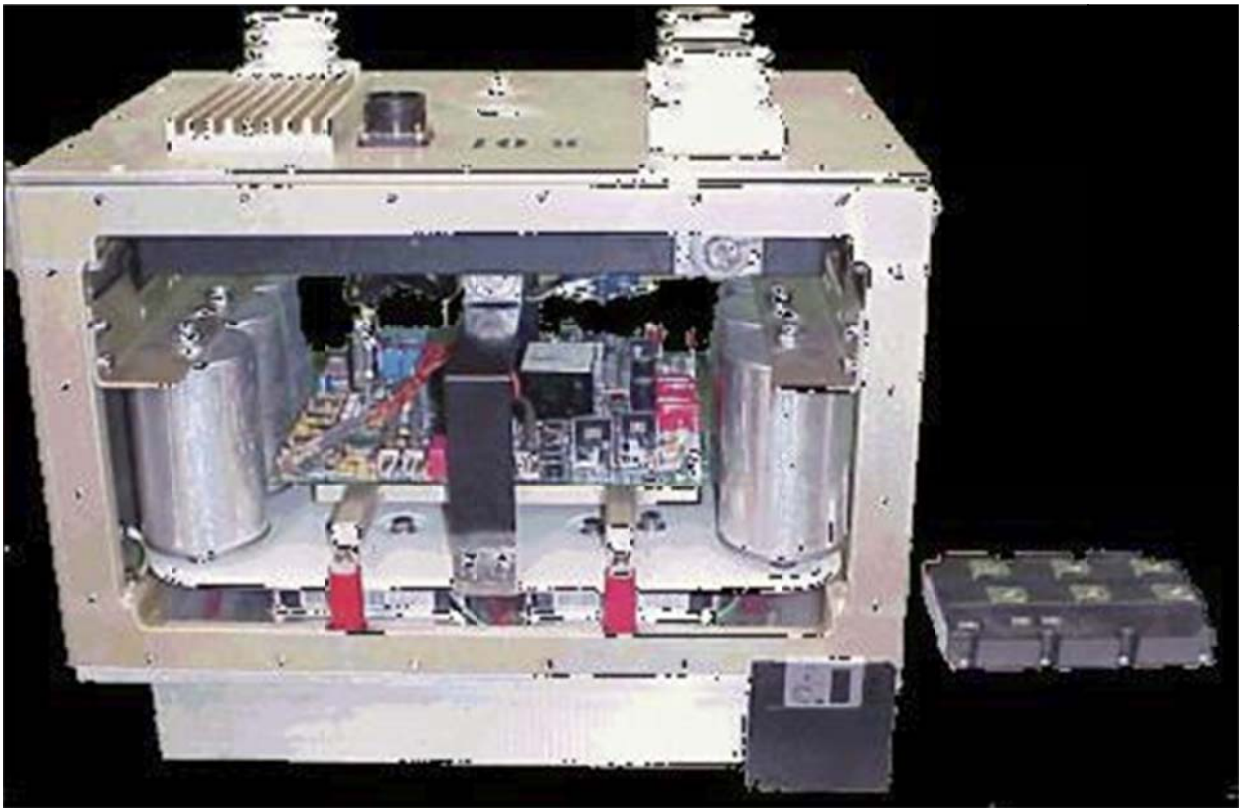


Figure 01-I-02.35 Inverter Phase Module / Braking Chopper

Each Inverter Phase Module consists of the power semi-conductor IGBT assembly and the relevant circuits and drive electronics.

These power modules can be easily withdrawn or replaced without removal of the entire converter unit, significantly improving maintainability and increasing vehicle availability.

01-I-02.02.04.03 Inverter Control Module

The Inverter Control Module is a water proof enclosure.

It contains electromechanical and high-voltage devices, such as line switches, filter charge switches, voltage and current transducers and the low-voltage Traction Control Unit (TCU), which controls the entire Propulsion System.

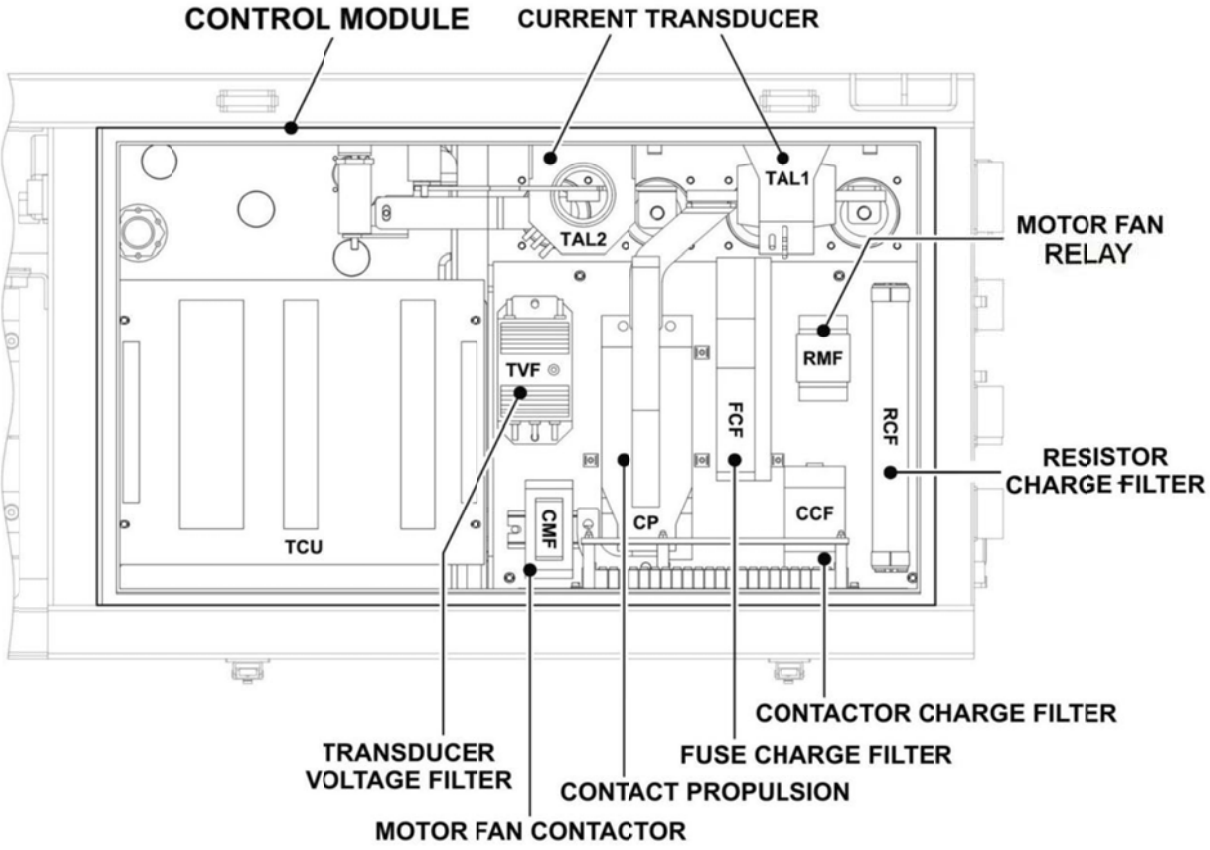


Figure 01-I-02.36 Inverter Control Module

a) The Traction Control Unit (TCU)

The Traction Control Unit (TCU) controls the relevant propulsion inverter and the associated Braking Chopper.

It is based on 32 bit microprocessors with associated peripherals and I/O and it can be considered the brain of the Propulsion System.

Each vehicle is equipped with two TCUs (as well as two Inverters), one per Body Section. They are hierarchically arranged.

All TCUs manage the relative Body Section Propulsion System specific commands; the MoV (Master of Vehicle) manages the vehicle propulsion commands (one MoV per vehicle), and the MoT (Master of Train) manages the common train propulsion commands.

At start-up, the TCU of the vehicle with the active cab, if working, becomes the MoV (Master of Vehicle).

If the vehicle is not coupled with other vehicles, the MoV TCU is automatically also the MoT (Master of Train) TCU. In a train consist the MoT TCU is the MoV TCU located in the controlling vehicle.

The MoT TCU generates all train commands, while the MoV TCU generates the vehicle commands and the Slave TCU originates only commands related to the body section where it is located. TCUs communicate to each other by means of the MVB bus.

When two (or more, up to four) vehicles are coupled together in a train consist, the exchange of Propulsion signals between vehicles is guaranteed by means of Trainlines for the MC Handle and EB status, and by means of MVB and WTB buses for MoV and MoT TCU commands.

Through the TCUs, the Propulsion System exchanges signals with the other systems, like the Friction Braking System, the Automatic Train Protection (ATP) system, the Door system, the Train Control and Monitoring System (TCMS) and the communication system.

The main important functions carried out by the TCU are:

- MoT TCU train commands handling
- MoV TCU vehicle commands handling
- IGBT driving waveforms (Command Pulses) for the Inverter Phase Modules and for the Braking Chopper
- Detecting power and control circuits Faults and implements the proper protections;
- Transferring diagnostic and status information to the IDU
- Communicating with the PTU by means of an RS232 link in order to monitor the propulsion system
- Storing the diagnostic faults

The TCU is made up of standard PCBs.

All TCU PCBs can be swapped with the corresponding PCBs of another TCU without the need for any adjustments.

TCU Motherboard:

The TCU Motherboard connects all TCU boards by means of the VME Bus (X1 connectors) and a wired structure (X2 connectors).

The TCU Motherboard also receives the +5Vdc and the ±15Vdc from the Low Voltage Power Supply to feed all TCU boards.

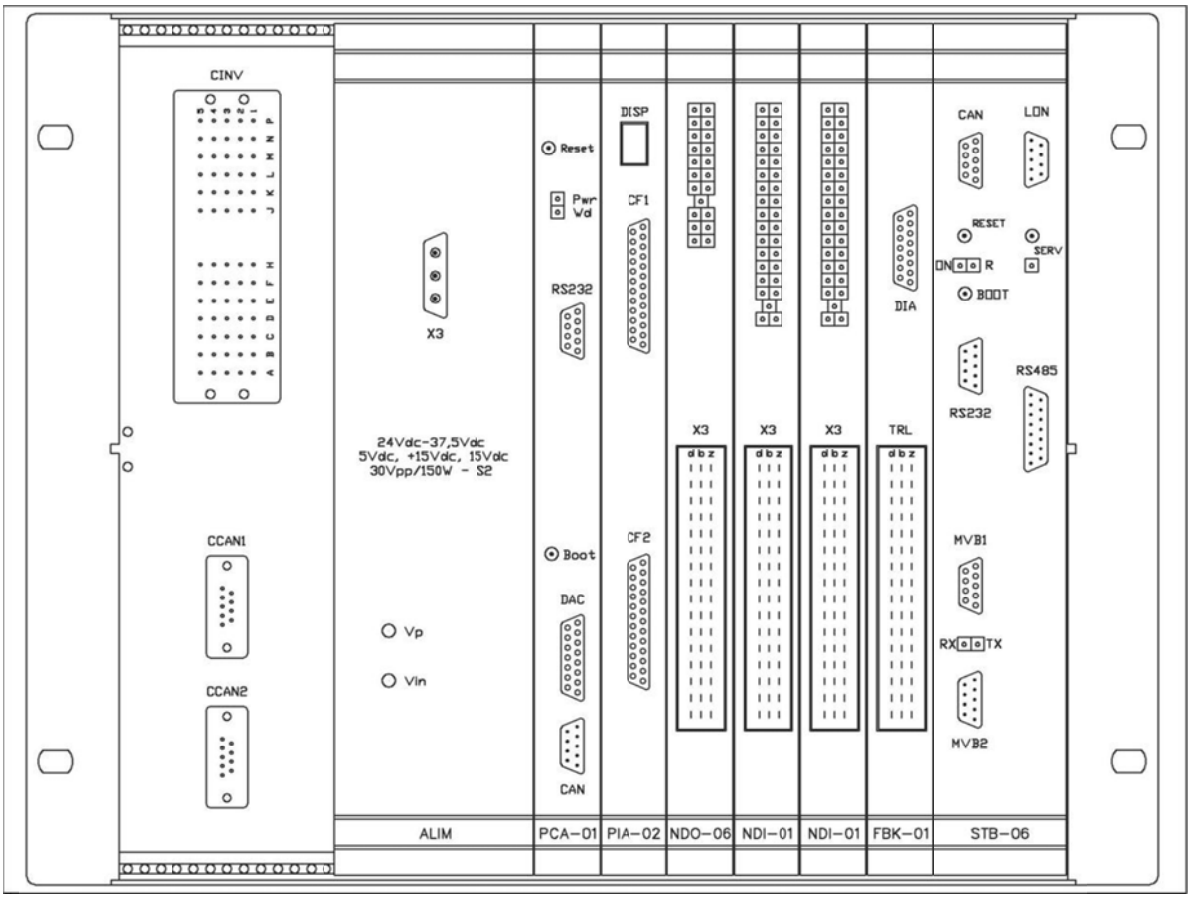


Figure 01-I-02.37 TCU Front View

Low Voltage Power Supply:

Starting from the vehicle battery voltage, the Low Voltage Power Supply generates the regulated DC voltages used by the TCU boards.

All transducers are also fed by this unit, including the current transducers located inside the Phase Inverter Modules. The generated voltages are +5V, +15V/-15V.

PCA board:

The PCA board is a high performance microprocessor board.

It is the most important board of the rack. By means of its DSP and micro-controller it supervises and regulates all propulsion aspects.

PIA board:

The PIA board interfaces the Inverter Phase Modules with the TCU (in particular, with the PCA board).

The PIA board also acquires diagnostic signals from the motors and the HV line and uses them to implement hardware protections.

NDO board:

The NDO board is a digital input/output standard interface that communicates with the PCA and STB boards through the VME bus.

The NDO board is provided with 19 digital input/output channels to Interface the TCU with the Relay Logic.

This board opens or closes the output channels (so the relevant relay is respectively active or inactive) depending on the PCA command received via the VME bus.

NDI boards:

The TCU is provided with two identical NDI boards.

The board on the left (facing the rack) is denominated NDI_A, while the one on the right is denominated NDI_B. Each NDI board is provided with 31 digital battery level input channels.

Their function is to check the digital battery status and send the information to the PCA board by means of the VME bus.

FBK board:

The FBK is a non-standard interface board (specifically made for the P2550 LRV).

It interfaces both digital and analog signals. It interfaces the TCU with the Master Controller Encoder in order to acquire the 4-20mA signal and manage the No Motion relays.

STB board

The STB board, like the PCA Board, is a microprocessor board and implements software elaborations. In particular, it interfaces the Propulsion system with the Networks (LON and MVB and WTB) and manages some control logic (Car Speed evaluation, No Motion detection, Odometer implementation, Wheel diameter calculation…).

01-I-02.02.04.04 Line Reactor

The Line Reactor (located in front of the Inverter Module) is an Inductor used to form a single cell L-C input filter (L = 4 mH and C = 5.8 mF).

This capacity is obtained directly from the Capacitors of the Inverter Phase Modules.

The input filter prevents damage to the solid-state equipment from very large voltage transients.

01-I-02.02.04.05 Braking Resistor

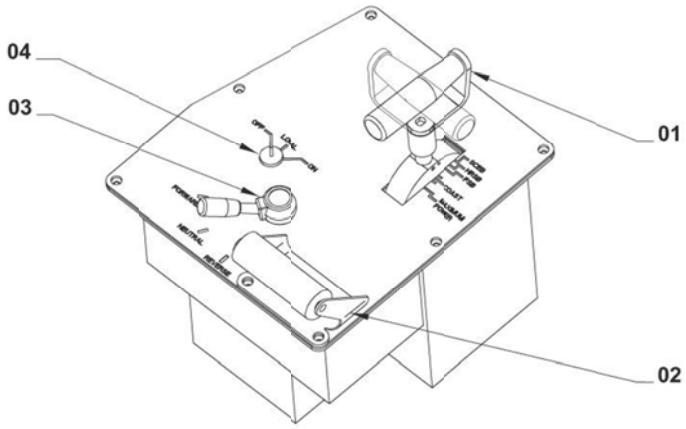
The two Braking Resistors (one per Propulsion Inverter) are mounted on the car roof (one per car section) in a stainless steel frame.

It is not used during a Braking session when the unused energy is sent back to the line:

if the line is receptive, the breaker remains closed so that the energy can be returned to the Catenary.

If the line is non-receptive during braking, a line breaker, housed in the inverter enclosure, will open forcing the current to flow through the Dynamic Brake Resistors (via the Chopper Module). The Braking Resistors will dissipate the energy in the form of heat.

01-I-02.02.04.06 Master Controller Console



01. MASTER CONTROLLER HANDLE
02. ARM REST SUPPORT
03. REVERSER SWITCH
04. TRANSFER SWITCH

Figure 01-I-02.38 Master Controller Console

The Master Controller (MC) Console is installed in each operator's cabs, on the left of the Console.

The MC Console is made up of the following components:

- Transfer Switch (3-position)
- Reverser Switch (3-position)
- Master Controller Handle
- Encoder Interface

Through the Master Controller Console the operator can enable the cab, by means of the Transfer Switch, select the direction of travel, by means of the Reverser Switch, determine the amount of traction or braking effort and the desired Operating Mode, through the position of the MC Handle (Power, Coast, Service Brake, Full Service Brake (FSB), High Rate Service Brake (HRSB), Slide Controlled Emergency Brake (SCEB) (MC Handle).

The Operating Mode and the traction/braking effort are sent from the Master Controller to the TCU.

The TCU uses this information to drive the Inverter Phase Module and, through the Inverter Phase Module, drives the AC motors.

The Master Controller Handle is directly connected to the TCUs by means the Trainline Signals generated by its position. The Encoder translates the position of the MC Handle into a current output (analog 4-20mA).

a) Operating Modes

The Master Controller Handle defines the Propulsion Operating Mode. The operating modes correlated with the position of the MC Handle are:

- Max Power
- Power
- Coast
- Service Brake
- Full Service Brake
- High Rate Service Brake
- Slide Controlled Emergency Brake

The only Operating Mode that is not related to the position of the MC Handle is the
- Emergency Brake, implemented by the Mushroom ("panic Button") on the Console or by the ATP System through the use of the Vital Relay.

Max Power and Power Mode:
Motors receive a traction effort signal from the relevant Propulsion Inverter and apply a positive torque to the axles.

Coast Mode:
Motors do not apply any torque or braking.

Service Brake and Full Service Brake (FSB):

Motors apply a negative torque and the vehicle tends to decelerate at a rate ranging from 0 to 3,5mphps depending on the requested rate. The requested rate is obtained with the dynamic brake and friction brake blended together. Passing from dynamic to friction braking, the brake effort does not change.

High Rate Service Brake (HRSB):

This braking mode is defined as a Full Service Brake with the addition of Track Brakes.

Slide Controlled Emergency Brake (SCEB):

This braking mode is defined as a Full Service Brake with no jerk limitation and with the addition of track brakes and sand. TCUs also open the HSCB.

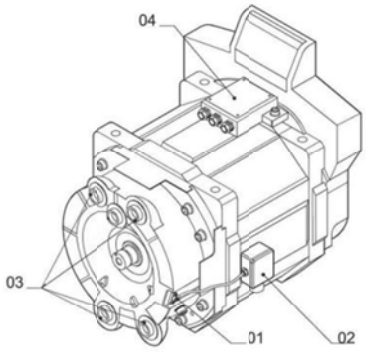
E ıergency Brake (EB):

The vehicle r educes its speed until it stops.

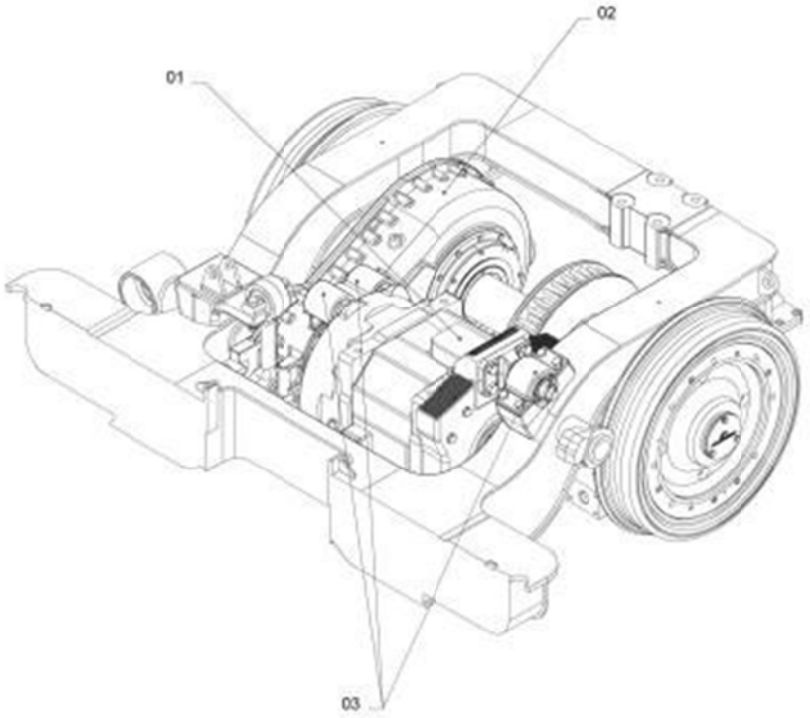
To reduce the speed, it uses the track brak , sand, no jerk limitation, no slide control, and friction b ake at its maximum.

01-I-02.02.0 .07 Motor

Each Propul sion Inverter supplies two par llel-conne cted induction motors, one per M otor Truck Axle.

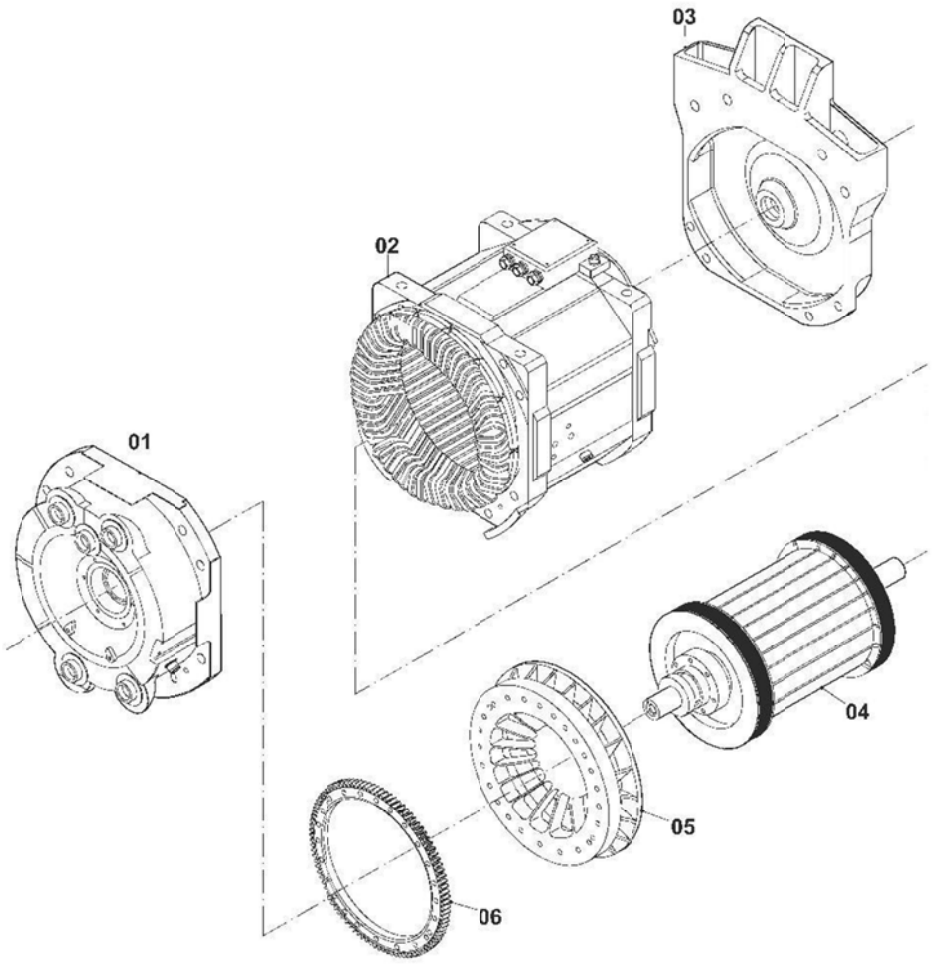


01. MOTOR SPEED SENSOR
02. TEMPERATURE SENSOR
03. TRACTION MOTOR ULTRA BUSHINGS
04. CABLE BOX



01. TRACTION MOTOR
02. GEAR UNIT
03. TRACTION MOTOR ULTRA BUSHINGS

Figure 01-I-02.39 Motor External View and Location



01. ENDSHIELD
02. STATOR ASSEMBLY
03. ENDSHIELD
04. ROTOR ASSEMBLY
05. FAN
06. TOOTHED ATTACHING PARTS RING

Figure 01-I-02.40 Motor Internal View

Table 01-I-02.6 Propulsion Motor Characteristics

Parameter	Value
Nominal Voltage (fundamental RMS)	585 Volts
Supply frequency range	0 - 140 Hz
Starting Torque	1,608 Nm
Max Service Speed (worn wheel)	4,200rpm = 65.24 mph (105 kmph)
Max Design Speed (worn wheel)	4,550rpm = 70.21 mph (113 kmph)
Continuous Rating Output Power	145 kW
Traction Maximum Rating Output Power	200 kW
Braking Maximum Rating Output Power	406 kW
Mechanical transmission Efficiency	0.975
Weight	1,323 lb (600 kg)
MTBF	800,000 hrs
Ambient temperature range	20°F to 115°F (-7°C to 46°C)

The Inverter Module supplies the relevant motors with a three-phase alternate current. This current, by flowing in the Stator coils, generates a magnetic field, which depends on the applied current, has a constant amplitude, and rotates inside the motor.

The Rotor, coaxial with the motor, is immersed in the rotating magnetic field.

The magnetic field, generated by the Stator current, generates a current along the Rotor Bar and, as a consequence, a second magnetic field (Rotor magnetic field) that follows the Stator magnetic field rotation trying to oppose it.

The Rotor magnetic field makes the Rotor itself rotate. In this way an electric energy is transformed into a mechanical energy.

Each Motor (two per Propulsion Inverter) is equipped with a forced air cooling system implemented by a Rotor Coaxial Fan.

The revolution speed is controlled by the TCU through a Speed Sensor, which monitors a phonic wheel (Rotor coaxial).

Two Thermal Sensors, immersed in the Stator Coils are both monitored by the TCU.

01-I-02.02.04.08 Gear Unit

A Motor Truck is equipped with two drive units.

A drive unit is made up of one traction motor, one Gear Unit, one curved tooth coupling and one Reaction Rod.

The drive torque, developed by the truck-mounted motor, is transmitted over the curved tooth coupling and the Gear Unit to the axle and to the driven wheels.

The Function of the Gear Unit is to reduce the revolution speed of the Wheel Axle with respect the revolution speed of the Rotor Axle.

This function is achieved by means of two rotating stages.

The ratio between the Axle Speed and the Rotor Speed (Gear Ratio) is **1/4.943**.

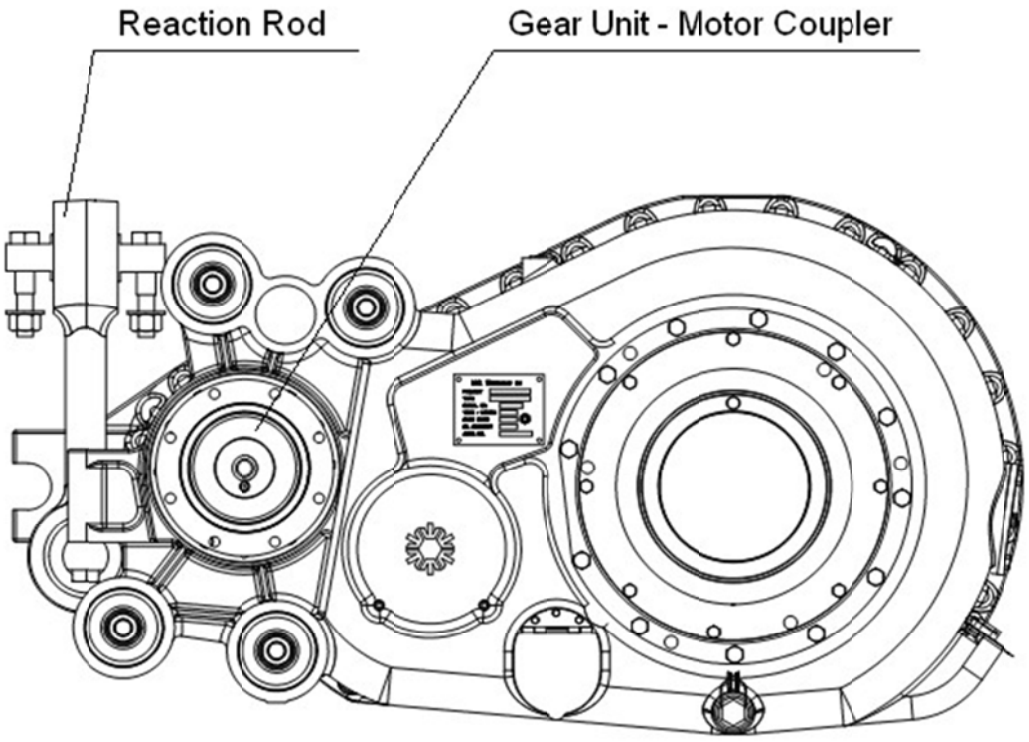


Figure 01-I-02.41 Gear Unit

The purpose of the Reaction Rod is to withstand the mechanical shocks introduced into the wheel set caused by the track-wheel contact during normal operations.

If the wheel set moves in accordance to the truck frame, the mounted ultrabush in the Reaction Rod will allow the axle mounted Gear Unit to move in accordance with the displacements of the wheel axle, without interfering with other parts.

01-I-02.02.05 TCMS (Train Control and Monitoring System)

The P2550 LRV is equipped with a Train Control and Monitoring System (TCMS), designed and produced by AnsaldoBreda, which provides a network for exchanging data between the Electronic Control Units of the same vehicle and between the vehicles of the same train consist.

The TCMS of a Vehicle is made up of the following components:

- One Vehicle Network
- One Train Network
- Two Integrated Diagnostic Units (IDU), located in the Operator cabs, at the right of the Console
- Data Ports to connect the PTU to the Vehicle Network

The data exchanged are both commands and diagnostic information.

The network is made up of three buses: two of them are vehicle buses (for exchanging data on the same vehicle), the third one is a train bus (for exchanging data between coupled vehicles).

The Vehicle Buses are:

- **MVB** (Multifunction Vehicle Bus): Used to exchange both Commands and Diagnostic Information. Vehicle motion functions rely on data exchanged by means of this bus and for this reason the MVB is fully redundant (double bus)
- **LONWorks bus**: used for Diagnostic Information only. This bus is not redundant

Both vehicle buses are connected to the IDUs (Integrated Display Unit). In this way, the IDU can collect information from all equipment, regardless of the bus they are connected to.

The Train Bus is the **WTB** (Wired Train Bus).

This bus is used to exchange both Diagnostic Information and Commands between coupled vehicles. The WTB is a fully redundant bus (double bus) for reliability purposes.

The WTB is connected to the vehicle MVB of each vehicle by means of a redundant WTB/MVB Gateway (GTW).

The Gateway is a bridge between the MVB and the WTB.

The WTB includes all train bus functions, such as bus inauguration and train sequencing.

This system automatically detects new vehicles connected: when coupling or uncoupling, the vehicles reconfigure themselves automatically.

Critical signals are sent through wirings or trainlines to the electronic control units in order to achieve a “degraded” operating mode in case of bus failure.

The “degraded” operating mode will let trains move with a predefined rate reference when in power mode and with the full service brake rate when in brake mode.

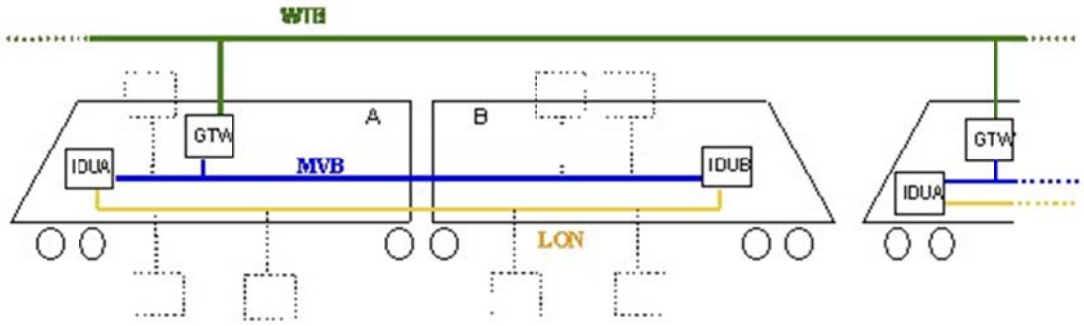


Figure 01-I-02.42 TCMS network

Diagnostic information transferred through the MVB and collected by the IDUs, are saved on non-volatile memory and will be available for the Operator or Maintenance people.

When a fault occurs, the Electronic Control Units not provided with a local Fault log function will trigger an IDU memorization request, sending all relevant information to be saved through the bus.

The Master Controllers of the two cabs are wired to the Traction Control Units (TCU) which are responsible for the propagation of the Rate Request on the bus.

Door Control Units (DCU), ATP system with the relevant ADU, TWC, EMI and APS/LVPS systems are interfaced to the IDUs by means of the LONWorks bus.

The Communication System is interfaced to TCU_A and TCU_B through an RS485 channel. In this way, the TCUs act as gateways between the RS485 bus and the MVB (refer to Figure 01-I-02.43).

Figure 01-I-02.43 Vehicle Network

01-I-02.02.05.01 IDU (Integrated Diagnostic Unit)

The IDU (Integrated Diagnostic Unit) collects, through the MVB and the LONWorks Buses, the status of all systems and presents this information on the IDU screen, available for the Operator and the Maintenance people, depending on the way it is accessed.

The monitored Systems are:

- ADU – Aspect Display Units
- APS/LVPS
- ATP/TWC
- Brakes
- Communication
- Doors
- EMI Detector Unit
- Event Recorder
- HVAC
- IDU
- Propulsion

The IDU starts up automatically at Vehicle start-up and integrates the following functions:

- Train Operator Display (TOD)
- Diagnostic Data Recorder
- Real Time Clock
- Vehicle Network Controller (VNC)
- Bridge between MVB and LON

The IDU can be accessed in two operating modes:

- **Operating Mode**: this mode is used by the operator during train operation. In this mode, only the most relevant information is made available.
- **Maintenance Mode**: this mode can be accessed by maintenance people only by means of a numeric password. In this mode, more detailed information is made available to facilitate troubleshooting and train testing.

All IDUs of the train are powered up as soon as the train is keyed up (TS in ON position). In order to save the IDU screens, only the enabled cab IDU screen is illuminated; all others are in stand-by and can be turned on by touching the upper righthand corner of the screen.

They turn off automatically five minutes after the last activity has ended.

a) **Operating Screen:**

By touching the upper right screen corner, the IDU monitor lights up showing the "Operating Screen", the default screen (refer to Figure 01-I-02.44)

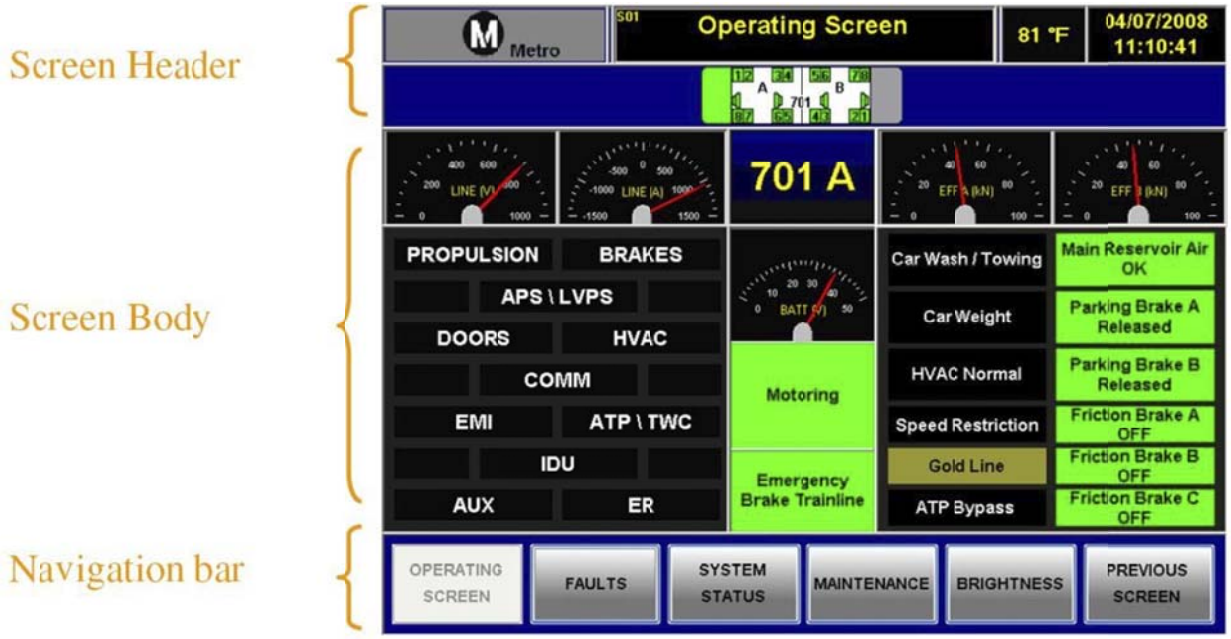


Figure 01-I-02.44 Operating Screen Structure

The Operating Screen is made up of three main parts:

- Screen Header
- Screen Body
- Navigation Bar

Screen Header:

This section is always visible as a top header of all screens.

In **Operating Mode (default)** the Screen Header shows the MTA logo on the upper left, the screen identification title string in the middle, the actual outside air temperature and an actual time calendar/clock on the upper right.

In **Maintenance Mode** the "Maintenance Mode" tag replaces the MTA logo.

The lower part of the Header shows the actual composition of the train consist, with the actual orientation of the vehicles in the train consist, their ID number, the status of the door panels, the IDUs accessed, the "Faults", the enabled cab and the direction of the train, the HSCB status and the status of the Intercoms.

Only in Maintenance Mode, by touching a vehicle shape, the "Vehicle Status Screen" is displayed (refer to paragraph 01-I-02.02.05.01d).

Screen Body:

The Screen Body is the main area at the center of the screen.

While the Screen Header and the Navigation Bar are the same for all screens, the Screen Body changes depending on the screen being accessed and contains data pertinent to the actual selected function.

Whenever a new screen is selected (by means of the buttons on the Navigation Bar) and shown, its identification title is shown in the Screen Header.

Navigation Bar:

This section is always visible at the bottom of the screen. It is made up of six buttons that are used to "navigate" through the IDU screens.

The buttons are always in the same position and with the same function.

When a screen is displayed, the relevant button is disabled (gray).

The first five buttons on the left are used to access the "OPERATING", "FAULTS", "SYSTEM STATUS", "MAINTENANCE MENU" and "BRIGHTNESS" Screen respectively.

The last button on the right is used to recall the previously displayed screens.

b) Faults Screen

The second button of the Navigation Bar is the "Faults" button. By touching it, the currently active Faults on the train are listed on the "Faults" Screen.

By using the UP and DOWN arrows, the operator can select the train active Fault to be investigated.

Each line shows the following information:

- The Fault Code
- Date and Time of the occurrence
- System/sub-system involved
- Description of the Fault

Additional Information on the selected Fault can be acquired by touching the "ADD INFO" button. This description is a short Troubleshooting procedure.

In Maintenance Mode faults are more specific than in Operating Mode and the Additional Information is more detailed than in Operating Mode.

The Faults Screen lists all the detected faults, they are ordered by the time they occurred.

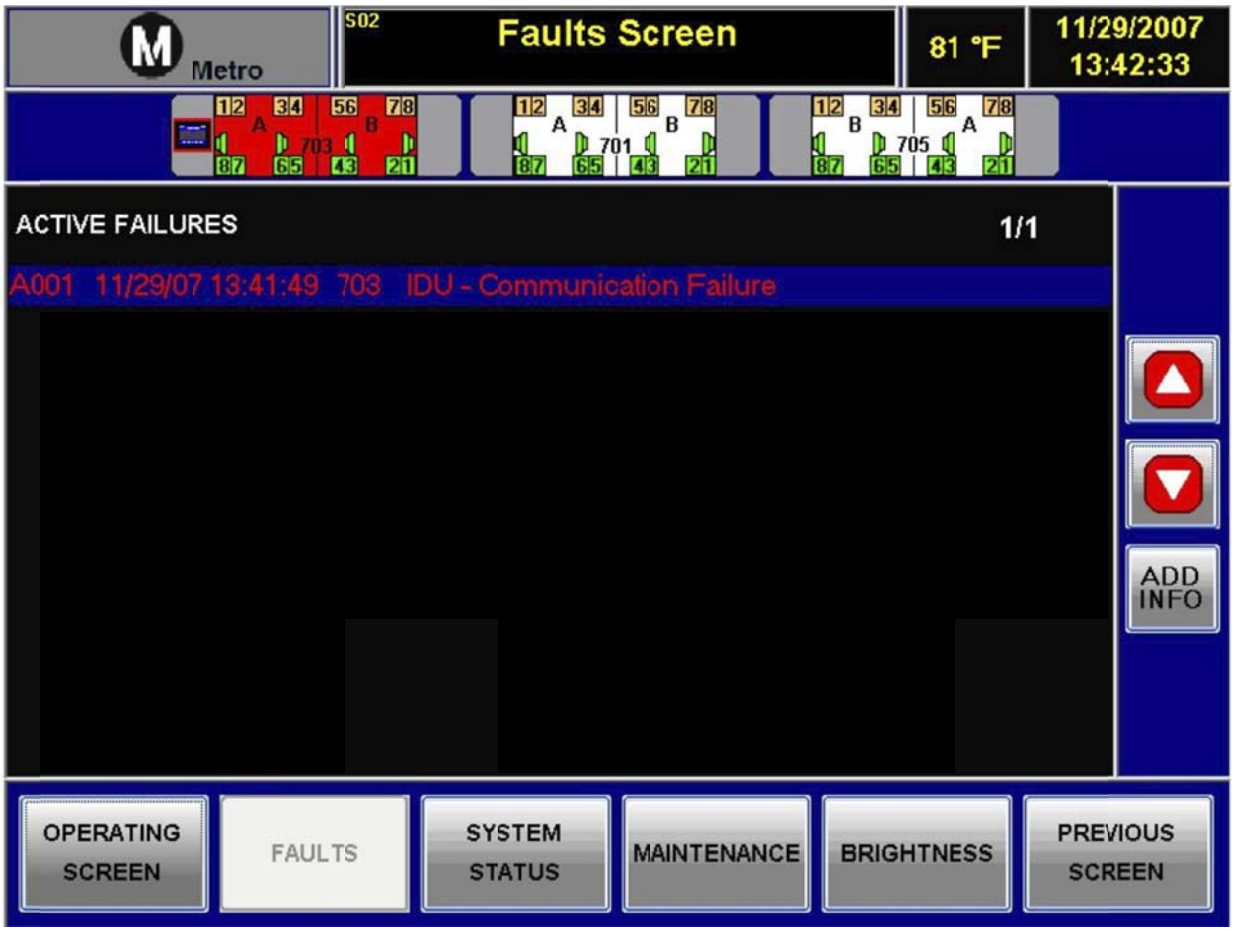


Figure 01-I-02.45 Faults Screen - Operating Mode

c) System Status Screen

The “System Status Screen” shows the most relevant information regarding the main equipment of a specific train system.

The System Status information in Maintenance Mode is more detailed that in Operating Mode.

For example the Propulsion System Status Screen in Operating Mode (refer to Figure 01-I-02.46) shows, for each vehicle, only the system general status (OK or Fault).

Whereas in Maintenance Mode (refer to Figure 01-I-02.47) the System Status Screen considers the A and B Body Section.

It also shows the analog values from current transducers, the thermal sensors and the Rate reference Value.

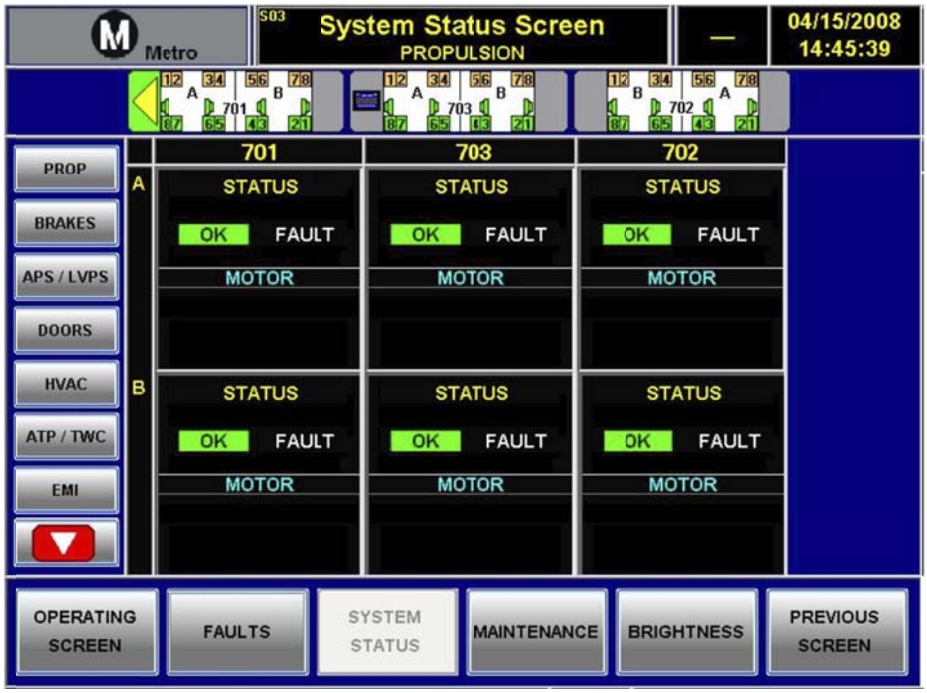


Figure 01-I-02.46 Example of System Status Screen - (Propulsion) (Operating Mode)

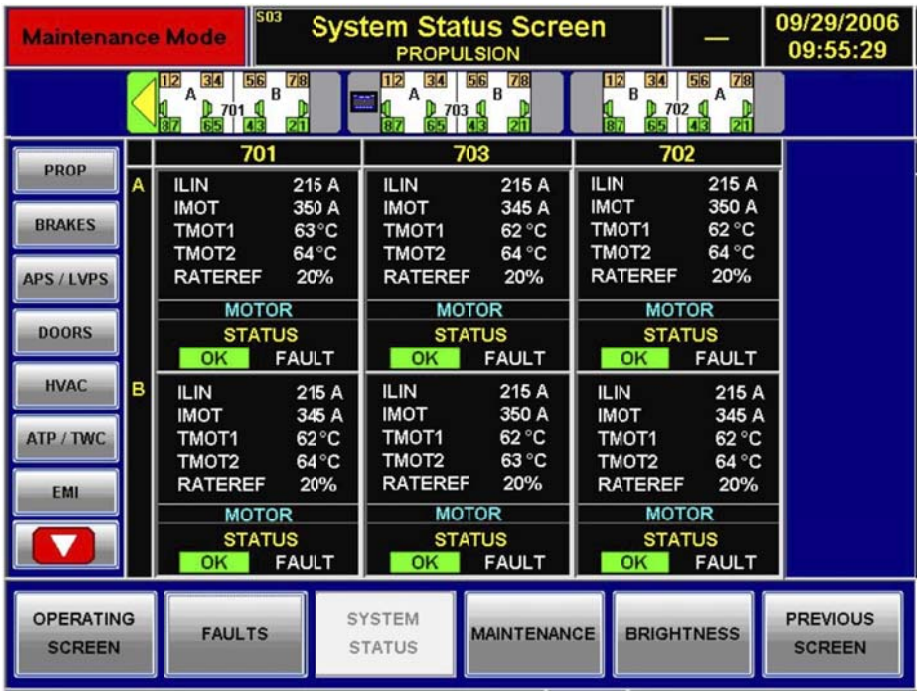


Figure 01-I-02.47 Example of System Status Screen - (Propulsion) (Maintenance Mode)

d) Vehicle Status

The "Vehicle Status Screen" can be accessed, in Maintenance Mode only, by touching the shape of the vehicle under investigation in the Screen Header.

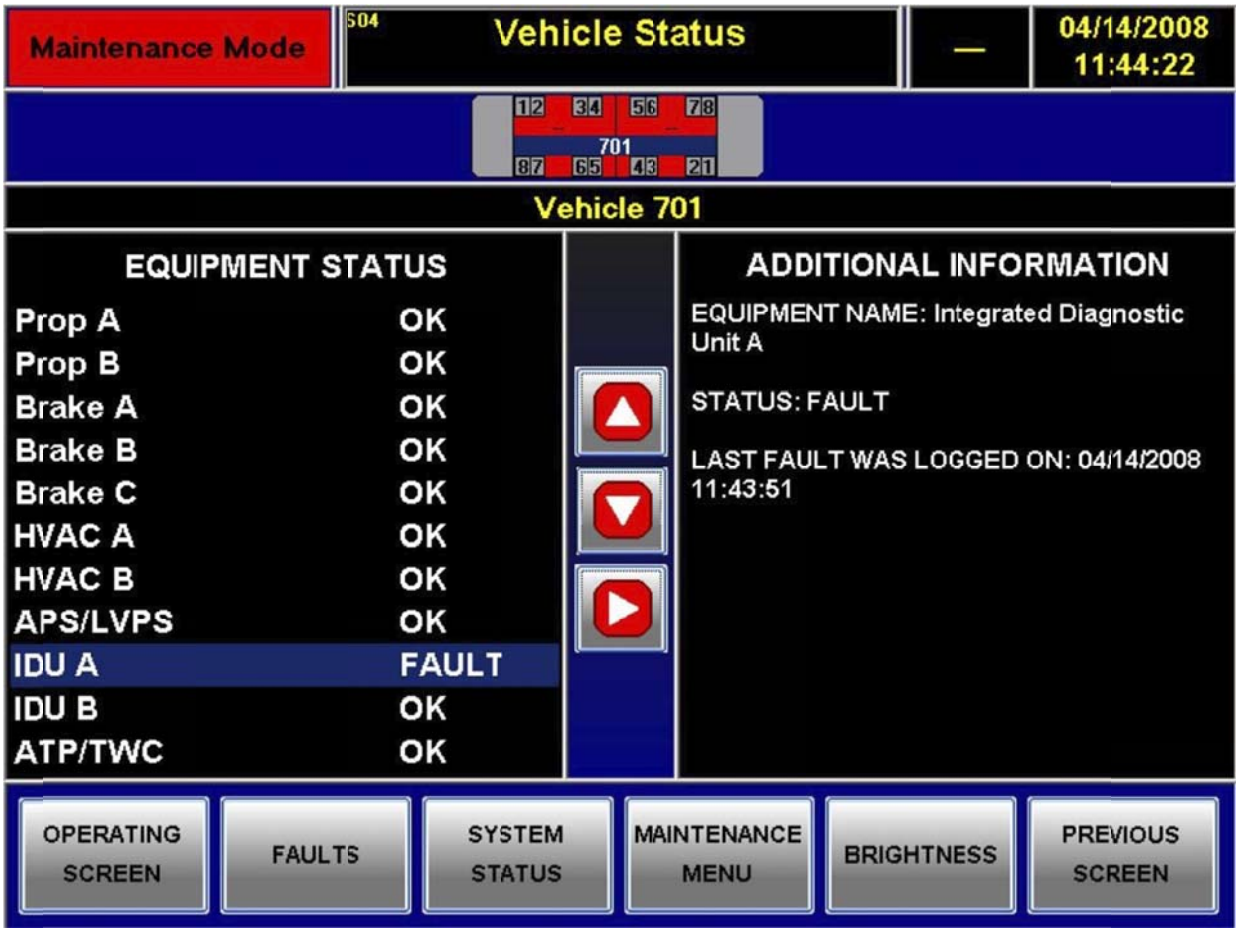


Figure 01-I-02.48 Vehicle Status Screen

By touching the vehicle shape, the relevant System Status Screen opens, showing the list of all sub-systems and their status. In case a fault occurred, the status will be "FAULT" instead of "OK" (refer to Figure 01-I-02.48).

The vehicle being investigated is shown, on the Header Screen, with a blue bar highlighting the vehicle ID#.

At the right of the "Equipment Status" panel, the "Additional Information" panel shows all detailed information available.

By touching the right arrow button, the Equipment Status Screen of the selected item can be displayed and detailed information about the status of each system is shown.

e) Maintenance Menu

The Maintenance Menu can be selected by means of the relevant button on the Navigation Bar and is only shown in Maintenance Mode.

The information and interactions made available by the Maintenance Menu are listed below:

- INFO: coupling history;
- MONITOR:
  - MVB Bus and LONWorks Bus monitoring and connected equipment
  - Digital I/O: GTW digital input and output signals monitoring
  - Trainline status
  - System Resources: IDU Memory overview
- SETTING:
  - Date and Time regulation (when TCU is not working or disconnected)
  - Touchscreen calibration
  - Parameter setting
- UTILITY:
  - Wheel Diameter Screen
  - LON Config Screen
  - IDU RESET

01-I-02.02.06 ATP and TWC Systems

This paragraph describes both the ATP System and the TWC.

For a detailed explanation refer to Section 15 for the ATP System and to Section 16 for the TWC System.

The US&S ATP and TWC car borne system is a microprocessor and electronic based cab signaling package designed and configured specifically for installation on the P2550 LRVs and operation on the Metro Green, Metro Blue, and Pasadena Gold Lines.

This ATP/TWC package integrates various hardware and software components of US&S MicroCab systems.

The list below provides a brief description of the main components of the car borne system:

- A single modular Train Control Equipment Rack (ATP/TWC) per cab set
- Two Aspect Display Units (ADU), one per cab
- Two TWC Interface Panels, one per cab
- Four FSK Pick-Up Coils, two per cab end
- Four Track Receivers, two per cab end
- Two active speed sensors (second and fourth axle)
- Two TWC Antennas, one per cab end

The ATP/TWC System has the important function of maintaining a high safety level under train operation.

The ATP/TWC system monitors the vehicle position along the line, controls the vehicle speed and enables the door opening only with the train stopped at a station. In case of overspeed, the ATP system sends a request for a braking session to the Propulsion System.

The ATP (located in the A Body Section Electronic Locker) elaborates vehicle protections; the TWC interfaces this system with the outside and with the operator to acquire the train ID, and the Route.

The Operator can interface the ATP directly through the ADU on the Console.

The ATP performs the following main functions across all three lines (Line Selector Switch on the vehicle provides the method for properly configuring the ATP for operations on the desired line):

- Cab Signal Reception and Decoding
- Vehicle Speed Determination
- Over Speed Protection
- Braking and Propulsion Control
- Input/Output Processing
- Door Control
- ATP Operating Modes
- Departure Test

The primary function of the TWC subsystem is to provide compatible two-way communication with the TWC Systems currently installed on the MBL, PGL, and MGL. The wayside transmits and receives non-vital information using the TWC loops located at selected track locations.

The vehicle TWC sub-system transmits and receives information through the use of TWC antennas mounted on the under frame at each end of the vehicle.

The TWC performs the following main functions for the three lines:

- Route Control and Indication
- Overloop Indication
- Train Identification (MGL Only)
- Departure Test

01-I-02.02.06.01 ATP Rack

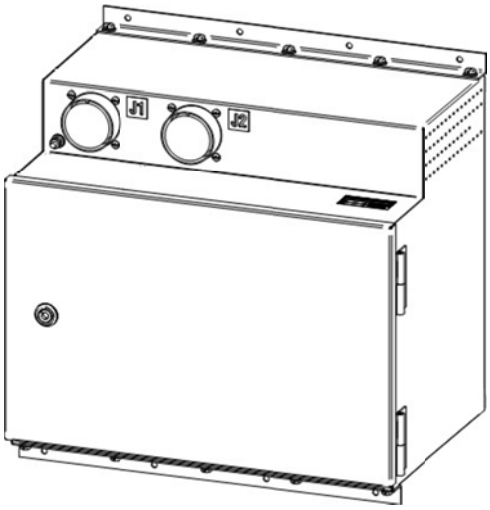


Figure 01-I-02.49 ATP Box

The heart of the ATP System is the ATP Rack, located inside the Electronic Locker of the A Body Section.

This rack implements all ATP functions and connects the system with the related vehicle systems.

In particular, it contains the following electric/electronic components:

- Relays (to provide hardware protections)
- Decelerometer (for comparison ATP input signals: from speed sensors…)
- An ATP Power Supply (Provides +5.2 and ±12 Vdc supplies for system operating circuits and +15 Vdc supply for each ATP speed sensor)
- A Conditional Power Supply (for Vital Outputs and to apply a 500Hz signal for the ATP Logic CPU)
- Ten (10) Electronic Boards (for all software ATP protection activities and for TWC functions)

01-I-02.02.06.02 ADU (Aspect Display Unit)

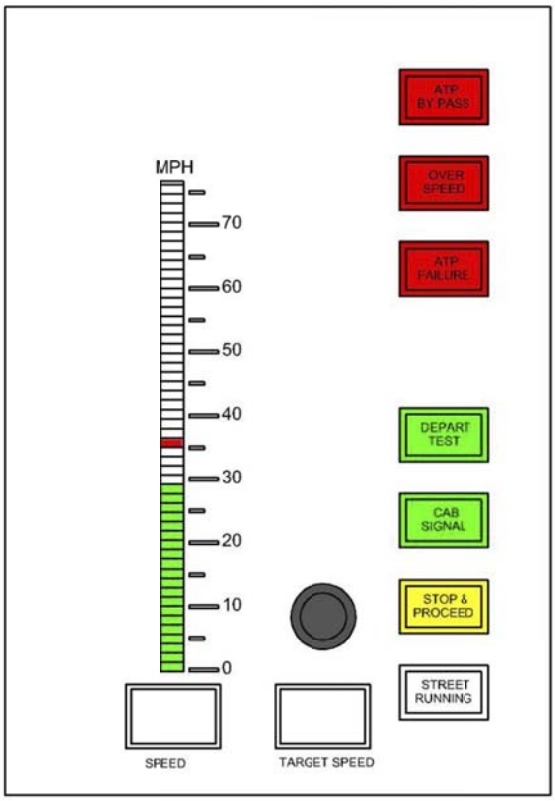


Figure 01-I-02.50 ADU (Aspect Display Unit)

The ADU is the primary ATP - Operator Interface. It is made up of:

- Two actual speed indicators: a digital indicator and an analog indicator. The analog indicator (from 0 to 75mph) is made up of LEDs. The actual speed limit is identified by a red LED. The actual speed is identified by green LEDs if under the limit speed, red LEDs if over the limit speed. The digital speed is indicated on the “SPEED” display, below.
- A Target Speed Indicator shows the Target Speed value (only for MGL)
- A Dimmer: for ADU console lights brightness
- Indicators: for ATP By-Pass, Over Speed, ATP Failure and Cab Signal
- Switch/Indicators: for Departure Test, Stop and Proceed and Street Running Modes

01-I-02.02.06.03 TWC (Train to Wayside Communication)

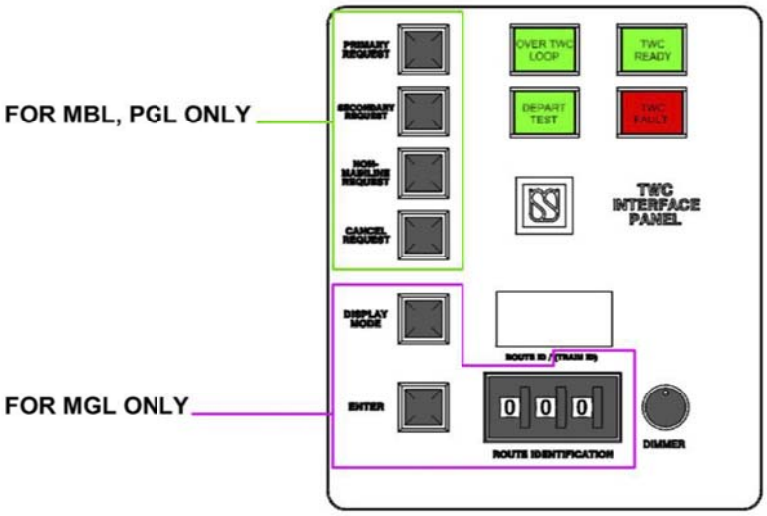


Figure 01-I-02.51 TWC Control Panel

The primary function of the TWC System is to provide compatible two-way communication with the TWC system installed on the MBL, PGL and MGL.

The wayside transmits and receives information to/from the TWC loops placed between the rails at selected track locations.

The vehicle TWC subsystem transmits and receives information from/to a TWC antenna mounted at each end of the vehicle, on the under frame, under the relevant cab.

The selection of the active antenna is based upon which cab is actively keyed.

The Line Selector switch located in the Electronic Locker of the A section provides the method for properly configuring the TWC for operation on the desired line.

The TWC performs the following major functions across all three lines:

- Route Control and Indication
- Overloop Indication
- Train Identification (MGL only)
- Departure Test

The TWC Control Panel (refer to Figure 01-I-02.51) is the primary Operator interface with the TWC System.

It enables the TWC antenna-to-wayside loop alignment, and to initiate, monitor or cancel route requests. Since the MGL configuration is different from the MBL/PGL configuration, the Operator will manage differently according to the line selected. through the Line Selector (11S02) located in the Electronic locker A, in the Data Download panel.

01-I-02.02.06.04 ATP/TWC System Configuration and Functions

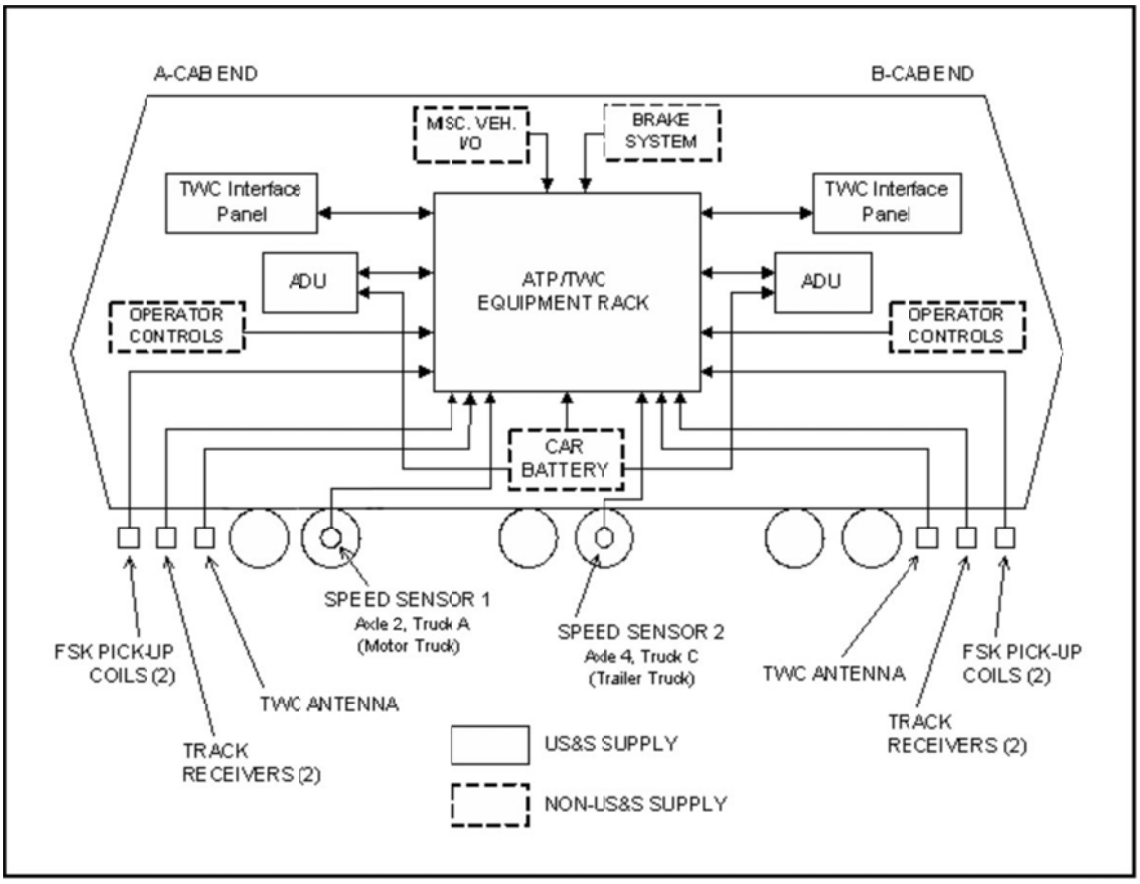


Figure 01-I-02.52 ATP/TWC System Configuration

Receivers and Coils mounted on the under frame are used for determining the position of the vehicle.

For a correct operation, the ATP System needs to know the vehicle position with respect to the line.

For this reason, each line (MBL, PGL and MGL) is divided into blocks.

A transmitter is mounted at the beginning of each block, to transmit the new block code and inform the running vehicle that a new block, with different characteristics, started.

The two most important block characteristics are:

- Overspeed threshold
- Station / Non-station Block

For MBL and PGL, the P2550 LRV acquires the block data through the Track Receivers. Each vehicle is equipped with two Track Receivers per Car Section.

MGL block data are more sophisticated and need specific receivers: FSK Pick-Up Coils (two per Body Section).

a) Speed Sensors and Overspeed Management:

The ATP System has two speed dedicated sensors: one on axle 2 (“A” Motor Truck) and the second one on axle 4 (Center Truck).

The system monitors the car speed through these speed sensors and requests a FSB or an EB if the detected speed exceeds the overspeed threshold.

The overspeed threshold depends on the relevant block and its value is acquired by means of the Track Receivers (for MBL and PGL) and the FSK Coils (for MGL).

The ATP manages the overspeed detection in two different ways:

- MBL and PGL: as soon as the LRV passes over a loop (new block), the overspeed threshold is immediately updated (refer to Figure 01-I-02.50). The transition between a speed threshold and the next one has a sudden change of value and keeping the speed below the threshold requires more reactivity.
- MGL: on this line the ADU shows the Operator a Target Speed (refer to Figure 01-I-02.50) and updates the speed threshold continuously (applying a “Speed Limit Profile”) in order to have the Target Speed reached at the beginning of the next block.

As soon as the threshold is exceeded, the ATP first activates an audible alarm and then requests a propulsion cut. Then if the braking effort is not enough to maintain the deceleration rate below the threshold, the ATP requests an EB application.

The ATP also implements the “Stop and Proceed” and the “Car Wash” Speed Limits.

The “Stop and Proceed” speed limit is 8mph for MGL and 10 for MBL and PGL.

The “Car Wash” speed limit implemented by the ATP system is 5mph (while the TCU applies a 1.5 mph limit). In this case the ATP protection is redundant since a CarWash speed limit of 1.5mph is directly applied by the Propulsion System.

b) Door Enabling

The Operator can Open, Close or Release the train doors from the Console.

Releasing the vehicle doors means to permit the passengers to open a door by pushing the relevant “passenger’s door” pushbutton.

The ATP enables the passenger door opening only when the train is stopped in a station. In the MGL the ATP system decides also what doors (right or left) can be released depending on the side of the platform with respect to the vehicle (Berthing).

b) ATP - Vehicle Communication

For the implementation of its protection activities, the ATP must be communicating with the Propulsion, Braking and Door Systems.

The ATP can request the Propulsion and the Braking Systems to apply a FSB or an EB.

This can be obtained by means of the Relay Logic of the LVDS (refer to Section 10): the FSB trainline can be de-energized (FSB applied) only if the ATP opens an internal contact.

Similarly, by opening an internal contact, the ATP can de-energize the EB Relay for an Emergency Brake Application even if the EB Mushroom is not pressed.

The Relay Logic also links the ATP to the Door System. In fact, the Door Enabling Command, from the active Cab, passes through the ATP first and then gets to the Doors.

The ATP is also connected to the LON (Local Operating Network) and, by means of the LONWorks Bus, sends its status to the Propulsion System and to the IDUs.

01-I-02.02.0 Doors

The vehicle is made up of 2 car sections. Each car section is provided with 4 access doors (2 on each side), located directly across from each other. Doors are numbered from the relevant panels, clockwise per car section starting from the right front door of each car section.

Therefore, the two front doors of the “A” section are door A1-A2 and A8-A7.

The two front doors of the B section are B1-B2 and B8-B7.

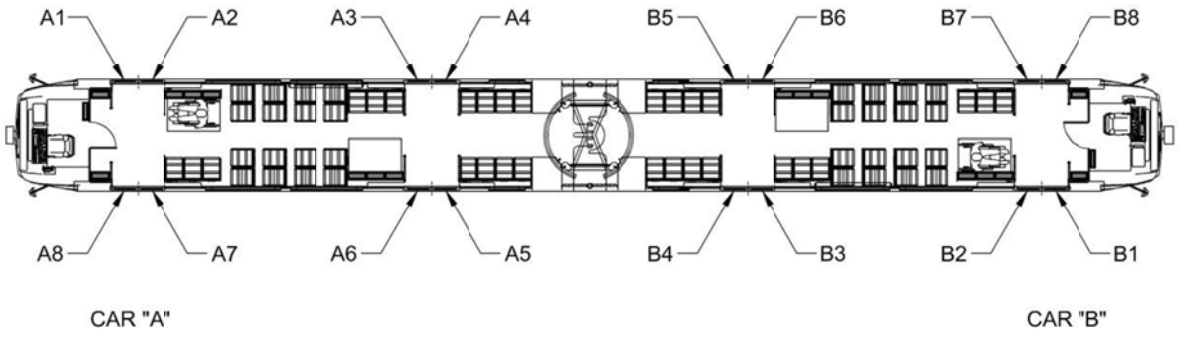


Figure 01-I-02.53 Door Numbering

A passenger door assembly consists of separate sub-assemblies mounted on the car body (refer to Figure 01-I-02.56):

- A Door Operator (DCU) attached to the car above the doorway, concealed by a door compartment cover
- An external Crew Switch (CS) (front doors only)
- An External Emergency Device (EED), located inside the car body, at the side of the front door (front doors only)
- An Internal Emergency Device (IED), located on the vehicle, at the side of each door
- Two Door Leaves (RH & LH) attached to the door operator at their top and to the bottom guiding rail at their bottom
- A short and a long EED Bowden cable as mechanical link to the motor unlocking pulley
- A Bowden cable as mechanical link between EED and IED
- Two external Open Push Buttons (PB) and Out of Service indicating light
- Two internal Open Push Buttons mounted on stanchions close to the doors
- An ADA lamp
- A Bottom Guiding Rail
- An external Door Open Indicating light
- An internal Out of Service Indicating Light
- A Front Door Switch

Only the front doors are equipped with the Crew Switches (on the outside of the vehicle), the Front Door switch (on the Console) and Emergency Access Device (EAD).

The others components are common to all doors:

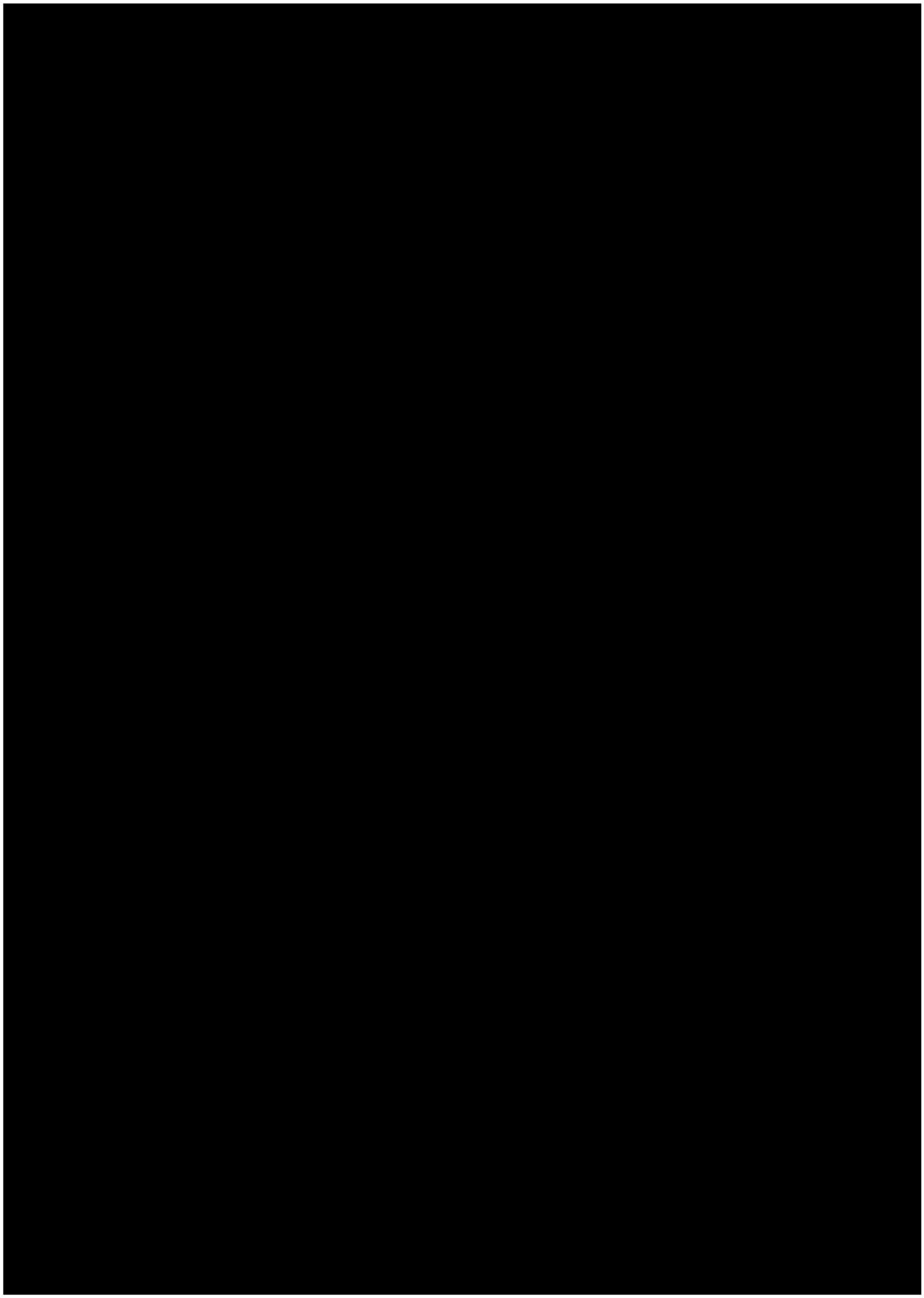
The purpose of each door assembly is to:

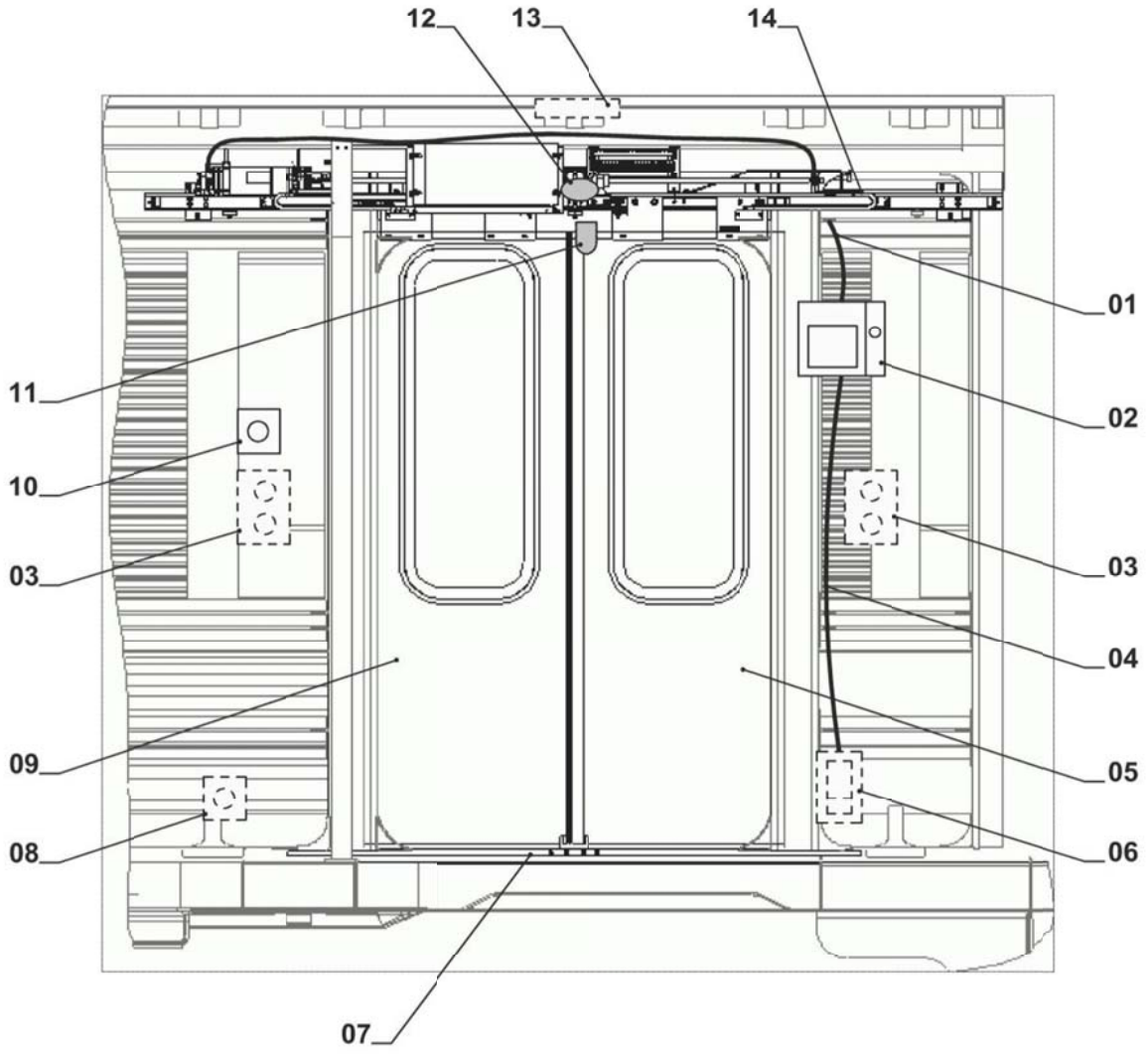
- Enable the passengers to embark or disembark the vehicle only when authorized by the Operator
- Provide passengers with sufficient comfort and protection with regard to the outside environment, e.g. noise and weather conditions

The doors are actuated from the operator console.

Door assemblies are equipped with safety features in order to:

- Isolate one door set if it cannot be controlled satisfactorily and safely at all times
- Permit a manual opening of the (left and right) doors both from the inside and the outside of the car, when the vehicle is stopped





01. IED Long/Short Bowden Cable	02. IED with a Reset Switch EDRS	03. External Push Button
04. IED Bowden Cable	05. RH Door Panel Assembly	06. EED
07. Bottom Guiding Rail	08. External Crew Switch	09. LH Door Panel Assembly
10. Door Open Switch	11. ADA Lamp	12. Out Of Service Indicating Light
13. Open Indicating Light	14. Door Operator with DCU	

Figure 01-I-02.56 Door System Arrangement

01-I-02.02.08 Friction Brake and Pneumatic System

The Friction Brake and Pneumatic System (refer to Figure 01-I-02.57) is made up of four important sub-systems and the relevant components:

- Friction Brake System:
    - Electronic Control Unit (ECU)
    - Brake Control Unit (BCU)
    - Sanders
    - Caliper and Disc
    - Track Brakes
- Air Supply Unit:
    - Compressor
    - Air Dryer
    - Starter Box
- Air Reservoirs:
    - Main Reservoir (MR)
    - Brake Supply Reservoir (SR)
    - Duplex Air Pressure Gauge
- Auxiliary Systems:
    - Air Suspension (refer to Section 12)

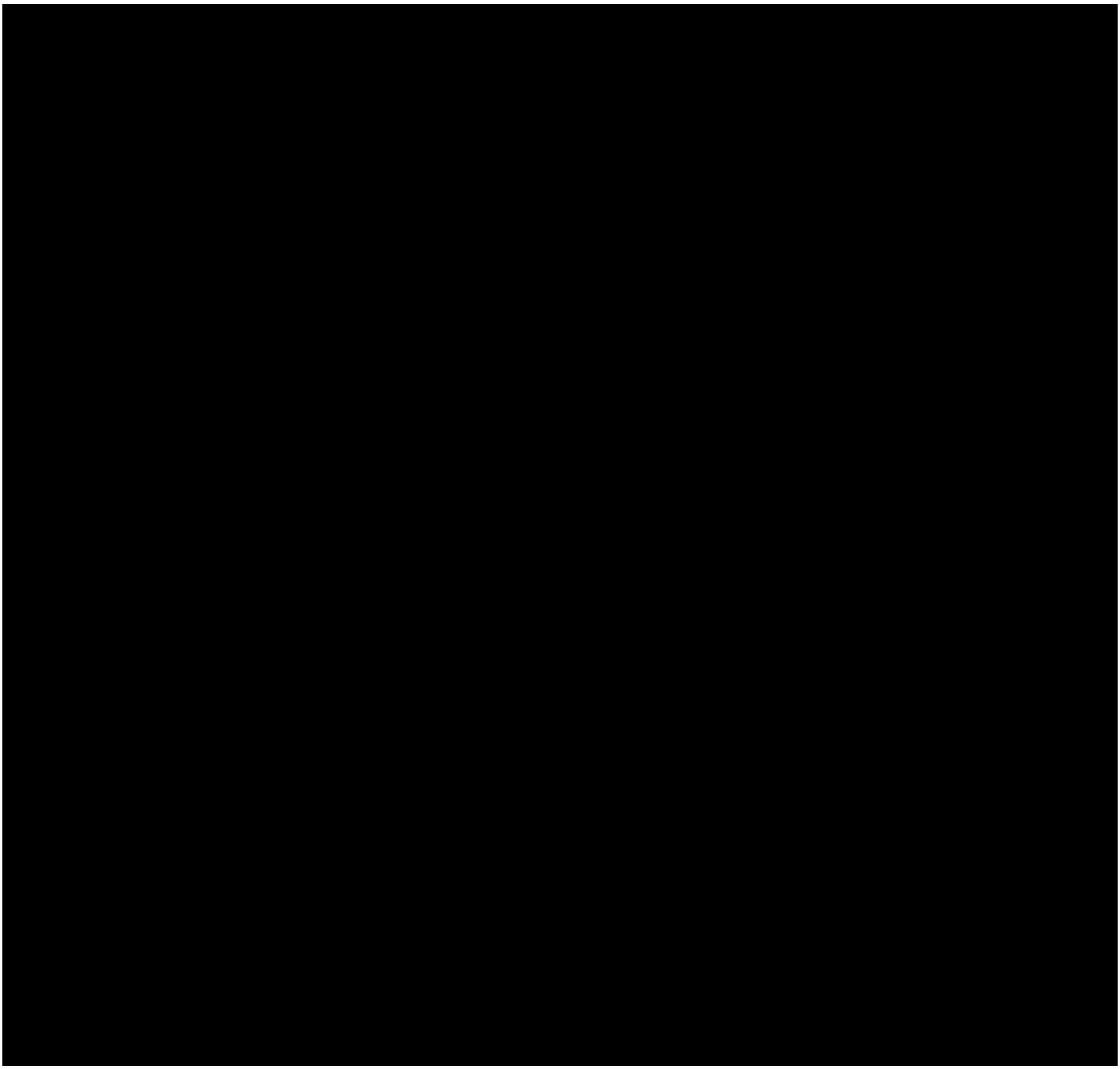


Figure 01-I-02.57 Friction Brake and Pneumatic System

01-I-02.02.08.01 Friction Brake System

a) ECU and BCU

The Friction Brake system is made up of an electronic device (ECU: Brake Electronic Control Unit) and a mechanical/pneumatic device (BCU:

Brake Control Unit) for each truck. ECU_A and ECU_C are located in the A Body Section Electronic Locker, while ECU_B is located in the Electronic Locker of the B Body Section.

BCU_A and BCU_C are mounted on the underframe of the A Body Section near the relevant truck.

The BCU_B is located on the underframe of the B Body Section, near the B Truck.

The BCU regulates the air pressure destined to the Braking system of the relevant Truck; the ECU drives and controls the BCU applications and "talks" with the electronic control units of the other systems, with special regard to the TCU (refer to Propulsion).

The BCU applies air to the Friction Brake Calipers without the ECU control only in case of EB (Emergency Brake).

1 ECU: Electronic Control Unit

The ECU is a Microprocessor Controlled Device that implements both Software and Hardware functions.

It is made up of A battery Power Supply, a Motherboard and six Sliding PC Boards with frontal connectors.

The ECU includes the logic and electronic interfaces between the Brakes and the Vehicle. Its main functions are:

- Interpreting trainline Brake Commands
- Receiving feedback from the Propulsion system for the dynamic brake effort achieved
- Commanding and receiving feedback from the Brake Control Unit (BCU)
- Powering and receiving feedback from the Brake Control Unit (BCU)
- Powering and receiving feedback from the pneumatic system sensors
- Detecting and correcting wheel slip during braking
- Monitoring faults and diagnosing the Friction Brake and Pneumatic systems
- Sending the Braking System Status to the IDUs (refer to Section 18)

Each ECU is connected to the MVB (Multifunction Vehicle Bus) and, through this bus, communicates with the Propulsion System and with the IDUs.

For example, it receives the Rate Reference value and, according to it and to the amount of friction brake requested, provides the right air pressure to be applied.

2 BCU: Brake Control Unit

The BCU of each Truck manages the air pressure for the pneumatic system of that truck.

The BCU is made up of Valves, Filters, Pressure Analog converters, Relay Valves and Cut-Out Handles.

BCU_A and BCU_B are related to the relevant Motor Truck and are equipped with electro-mechanical components to manage the Service and the Parking Brakes.

The EB (Emergency Brake), applied by the Mushroom (Panic button) or by the ATP, is a pneumatic-only application and is applied directly via the BCU, by-passing the ECU. The EB cannot be removed before the vehicle has reached zero speed. ECUs are not involved in an EB application.

The Friction Brake System uses the compressed air generated by the Pneumatic system (refer to Section 13) for the braking applications (refer to paragraph 01-I-02.02.08.02).

Track Brakes and Horn & Gong are electric applications (supplied by the LVDS by means of a 37.5Vdc nominal).

b) Sanders

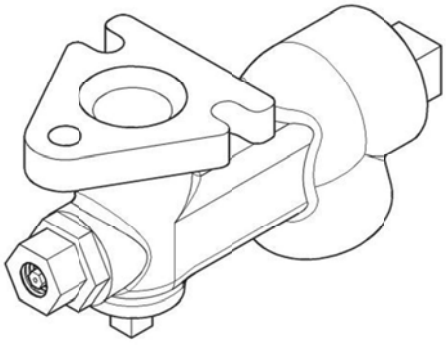


Figure 01-I-02.58 Sanding Nozzle

The sanders are mounted in front of the wheels (considering the direction of the vehicle) of axle one and axle six of the P2550-LRV.

The system automatically operates the ones in front, in the direction of the vehicle.

The operator can command a sand drop directly from the Operator Console, by means of the relevant pushbutton.

The sand can also be dropped by the Relay Logic when a SCEB or an EB is requested and the train speed is above the zero speed.

c) Caliper and Disc

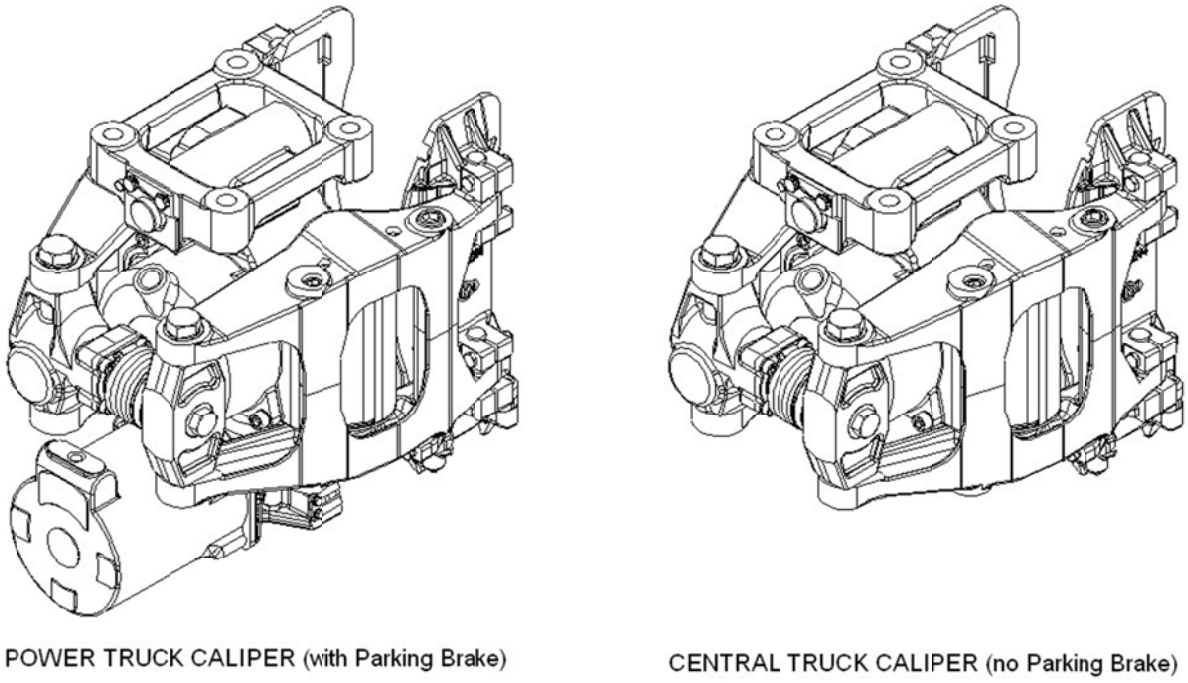
The WZK Brake Caliper Unit is an air-operated assembly used, together with axle-mounted brake discs, for service braking in rail vehicles.

It is a compact combination of brake cylinder, slack adjuster, caliper levers and brake shoes.

Eight calipers are required per vehicle one caliper with park brake per axle on the two Motor Trucks and two service brake calipers per axle for the Center Truck.

The Brake Pads are 350 cm^2 KRS style pads.

The material is non-asbestos friction pad developed for passenger railway disk brakes.



POWER TRUCK CALIPER (with Parking Brake)

CENTRAL TRUCK CALIPER (no Parking Brake)

Figure 01-I-02.59 Power and Center Truck Calipers

Friction Brakes are applied by compressed air and released by springs.

Parking Brakes are applied by springs and released by compressed air or mechanically through the dedicated handle in the Operator Cab.

The Brake Disc consists of a split 520x110 mm gray cast iron friction ring bolted to a steel hub via a 12 bolt plan seat interface.

This plan seat interface, with a specific bolt torque, allows free thermal expansion of the friction ring resulting from braking. The steel hub is pressed against the axle.

d) Track Brakes

Each vehicle contains two articulated Magnetic Track Brake assemblies per truck. Each Track Brake assembly is mounted between the wheels and over the relevant track.

The maximum contact area is provided between the brake shoe and the rail head when energized by 37.5Vdc nominal.

Each Track Brake is designed to contact the rail through a magnetic coil winding pulling the shoe down to the rail when energized, and held up off the rail head by a spring-operated retrieving mechanism.

The Track Brake magnet is basically an electromagnet. It consists of a coil which, when energized with direct current, generates a magnetic field. Soft-iron parts attached to the magnet determine the closing of the path of the magnetic force lines around the rail head.

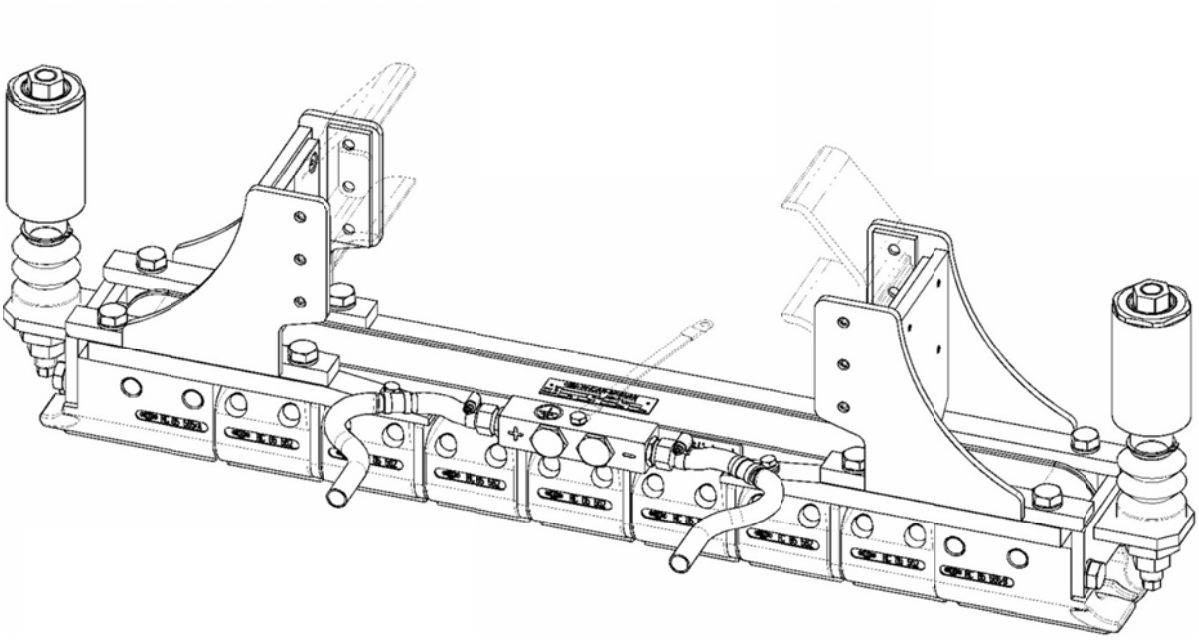


Figure 01-I-02.60 Track Brake

The Track Brakes can be applied by the operator (through the dedicated pushbutton on the Operator Console), or by means of the Relay Logic when an EB, a SCEB or an HRSB is requested.

For the time the Track Brakes are applied, a Track Brake Acoustic Alarm remains active.

01-I-02.02.08.02 Air Supply Unit

The Air Supply Unit (ASU) is located on the Underframe of the A Body Section.

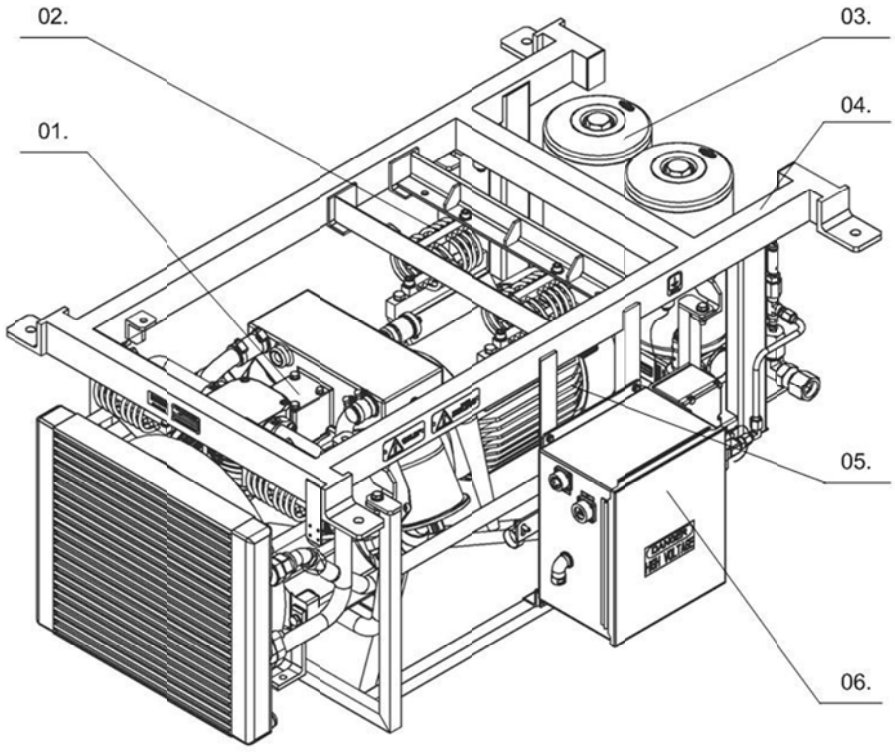
It is a compact, self-contained unit for production of clean, dry compressed air and includes a Two-stage Reciprocating Compressor, a Dual Chamber air Dryer and a Three-Phase AC Motor.

The ASU:

- Supplies clean, dry, compressed air for all pneumatic loads: friction and park braking, suspension and sanding systems
- Supplies the 2 Main Reservoirs and the Supply Reservoirs (one for each BCU) through the MR line for friction braking (both service and park brake circuits)

A steel frame safety-hung structure supports the ASU.

Steel wire spring mounts are used to secure the motor/compressor assembly to the frame.



01. VV120 COMPRESSOR
02. STEEL WIRE SPRING MOUNTS (SUSPENSION)
03. TWIN TOWER AIR DRYER
04. WELDED-STEEL FRAME
05. 10 HP 230 Vac MOTOR
06. STARTER BOX

Figure 01-I-02.61 ASU Overview

a) ASU Compressor

The Compressor Motor is a 208 Vac Three-Phase, 10 amp, alternating induction motor. It is coupled to the compressor using a permanent metallic flexible coupler.

To reduce the EMI emissions the Motor Coupling is equipped with a “flywheel”.

The Compressor has two stages with 3 pistons. The first two pistons work at low pressure, the last one works at high pressure.

The ASU Compressor has also LP (Low Pressure) and HP (High Pressure) Safety Valves.

- LP Safety Valve: 58psi. HP Safety Valve: 189psi.

The ASU Compressor air passes through an intercooler and an aftercooler that refrigerate the compressed air.

b) The ASU Twin Tower Air Dryer

The LTZ-015H Air Dryer is a twin tower, regenerative oil and air separator.

The two twin towers, that contain desiccant and oil separator material, have a reciprocating work functioning; in this way when a tower is used for cleaning and drying the air, the oil separator and desiccant material of the other one is regenerated and made ready for the next session.

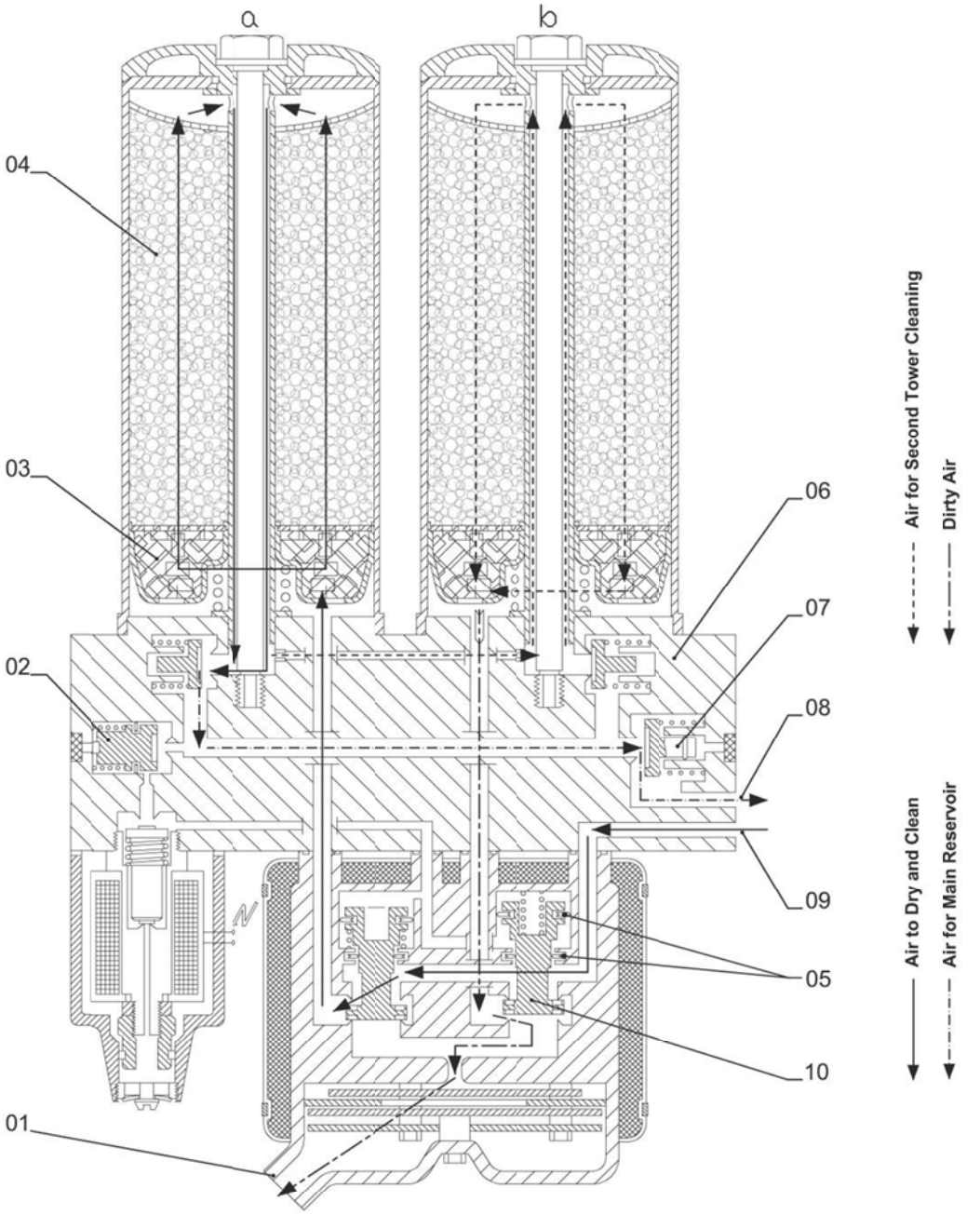
The operation of the Drying and Regenerating Tower (refer to Figure 01-I-02.62) can be summarized as follows:

- The air coming from the Compressor enters a Duplex Piston Valve and proceeds to the Twin Tower.
- The air passes through one of the Twin Towers in the direction from bottom to top. Along the path, the oil separator and air desiccant material clean and dry the air.
- The cleaned and dried air is divided into two parts:
    - The largest part is sent to the MR (Main Reservoir) and is used to supply the Pneumatic System
    - The smallest part is sent to the top of the second Twin Tower and crosses the oil separator and air desiccant material to regenerate it. After that, through the Duplex Piston Valve, the oily and humid air is drained out

c) Starter Box Assembly

The Starter Box Assembly receives the LV and MV Power Supply and contains:

- a Terminal Board
- A Motor Contactor with Overload Relay
- A Pressure Switch, with the following thresholds:
    - 130psi for Motor Starter ON
    - 150psi for Motor Starter OFF



01. Drainage Port
02. Pre-control Valve
03. Raschig Rings (oil separation)
04. Desiccant
05. Raschig Rings (oil separation
06. Bracket
07. By-pass Valve
08. Air Outlet (to Main Reservoir)
09. Air Inlet (from Compressor)
10. Duplex Piston Valve

Figure 01-I-02.62 Drying Regenerating Towers

01-I-02.02.08.03 Air Reservoirs

There are three types of Air Reservoirs:

- The Main Reservoirs, a damper for the whole MR line
- The Supply Reservoirs, for the supply of the three BCUs
- The dampers for the Air Suspension System of the three Trucks (refer to Section 12 - Trucks and suspensions)

a) Main Reservoirs (MR)

The Main Reservoirs' capacity is 30.3 gals each.

The two reservoirs are connected in series to the output of the Air Supply Unit.

The pressure in the MR line varies from 130 psi and 150 psi (measured at the Air Pressure Gauge).

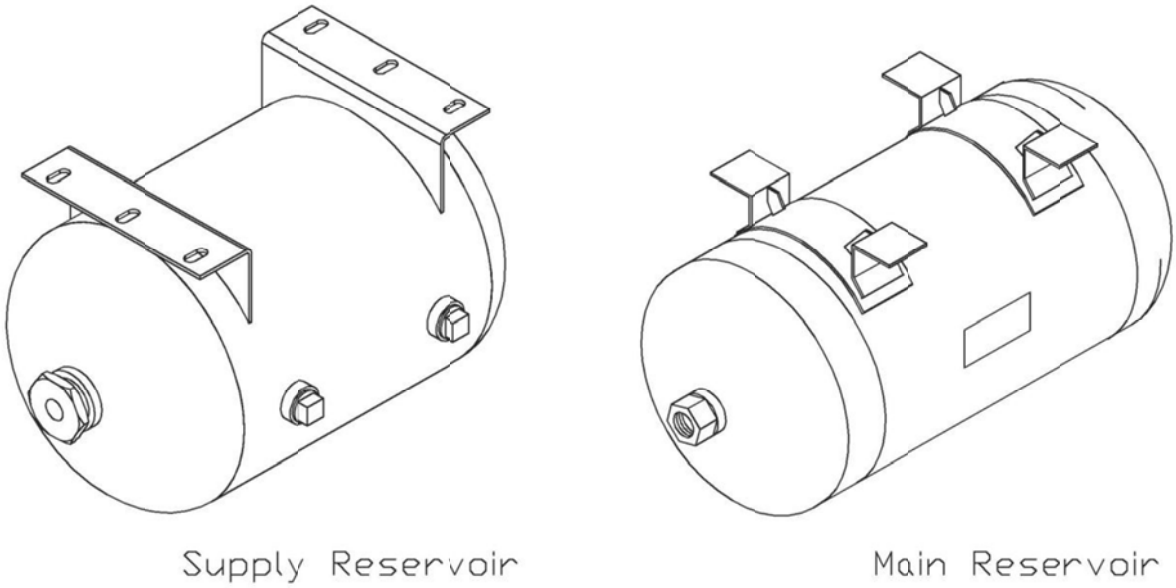


Figure 01-I-02.63 Supply Reservoir and Main Reservoir

b) Supply Reservoir (SR)

The Air Supply Reservoirs are three, one for each BCU/Truck.

In the event of a loss of main Air pressure, the Supply Reservoir provides the air capacity for five FSB applications and releases in AW4 conditions.

The capacity of each reservoir is 12.8 gals.

c) Duplex Air Pressure Gauge

Figure 01-I-02.64 Dual Pressure Gauge

Mounted on the Operator Console, the Dual Pressure Gauge shows the two most important parameters of the Pneumatic System:

- Red Needle: Brake Cylinder Air Pressure
- White Needle: Main Reservoir Air Pressure

01-I-02.02.08.04 Auxiliary Systems

a) Air Suspension

The Air Suspension system provides vehicle leveling on a per truck basis.

Air supply pressure for the leveling system comes from the main reservoir supply line through cutout cocks, an air filter, and a check valve.

Two leveling valves on each Motor Truck and one leveling valve on the Center Truck share the air supply.

On the Motor Truck, each leveling valve is used to adjust the air volume in the relevant air bag.

On the Center Truck, the leveling valve adjusts the air volume for both air bags.

The two air bags are on opposite sides of each Motor Truck and their pressure is compensated by means of a duplex check valve.

The duplex check valve allows air flowing from one air bag to the other, only when the pressure differential between air bags exceeds 22 psi.

A Leveling Valve, refer to Figure 01-I-02.65, has a V port at the top for the auxiliary reservoir, and an L port at both left and right side for connecting to the air bags.

The exhaust E port is on the opposite side of port V.

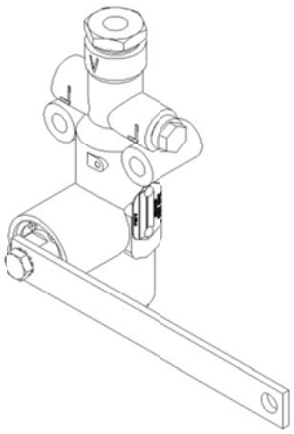


Figure 01-I-02.65 Leveling Valve

During a Leveling operation, the Actuating Lever can be lowered to increase the air volume in the air bag or can be raised to decrease the air volume in the air bag.

b) Electric Horn and Gong

The electric Horn & Gong is supplied by 37.5Vdc nominal (range 24-40 Vdc).

Its output sound has a frequency of 435Hz and amplitude greater than 105dB at 10 feet.

The Horn/Gong can be requested by the operator through the relevant pushbutton (refer to Figure 01-I-02.66).

Both the Horn and Gong Pushbuttons have a High and a Low Amplitude Level.

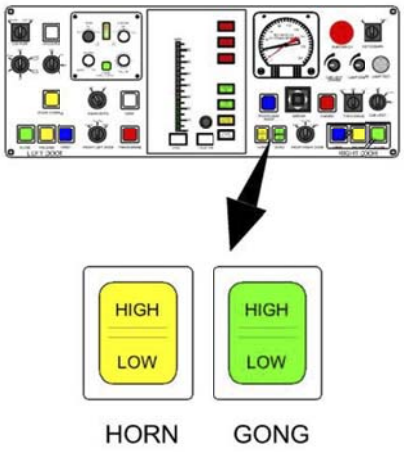


Figure 01-I-02.66 Horn and Gong Pushbuttons

The Horn and Gong are described in Section 17.

01-I-02.02.09 HVAC (Heating, Ventilation and Air Conditioning)

The Heating, Ventilation and Air Conditioning System regulates and monitors the internal vehicle air temperature.

The HVAC System is designed for cooling, heating and drying the air.

The functions of the HVAC Systems mounted on the roof of the two Body sections are carried out by two Climate Control Units (CCU).

The CCUs are fully interchangeable amongst the A and B sections of any car.
Each CCU weights 1,270lb (580 kg).

The LVDS (refer Section 10) supply the HVAC System with both MV and LV power:

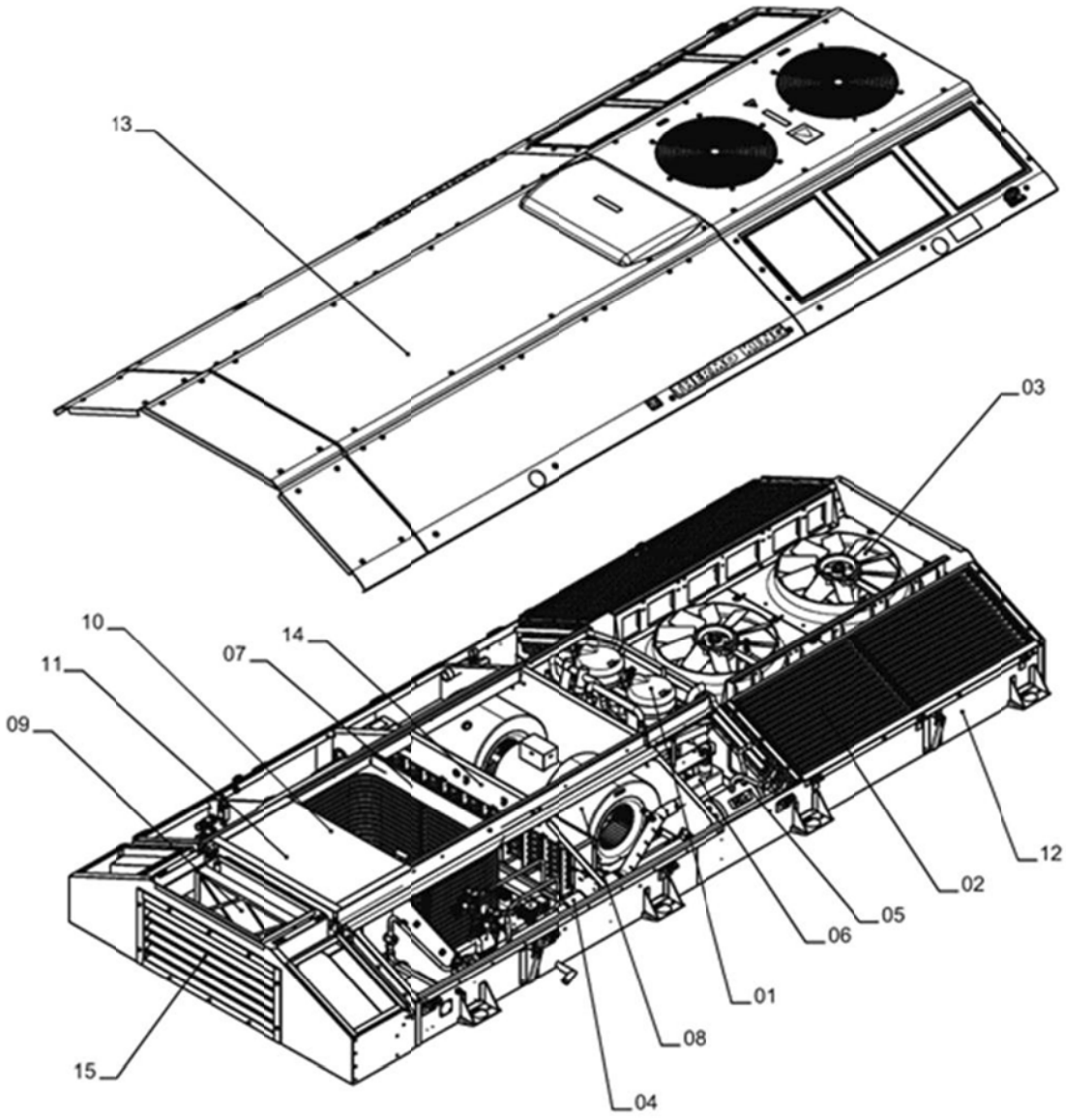
- 208 Vac, 60Hz, three-phase (MV): for the Evaporator Fan Motor, the Condenser Fan Motors, the Compressor Motors and the Heater Assembly
- 37.5Vdc (LV): for the two Control Boxes that manage the system

Figure 01-I-02.67 shows a CCU with its main components.

The Heating System is made up of a Heater Assembly located downstream of the Evaporator Blower.
The Heater Assembly is made up of two resistors that transform up to 9 kW of electric power into heat (Joule effect). It is provided with water barriers.

The air crosses these resistors after having been refrigerated and dehydrated; then it is blown into the vehicle air ducts and to the vehicle compartment.

The principles of operation of the HVAC system is shortly described in paragraph 01-I-02.02.09.01.
The HVAC Control Box electronic boards manage both Heating and Cooling Systems.



01. Scroll Compressor (2)
02. Condenser Coil (2)
03. Condenser Fan Motor (2)
04. Dehydrator
05. Liquid Receiver Tank
06. Vibration Eliminator (2)
07. Evaporator Coil
08. Evaporator Blower
09. Air Filter
10. Control Box
11. Microprocessor Controller
12. Structural Frame
13. Covers and Grilles
14. Heater Assembly
15. Water Eliminator

Figure 01-I-02.67 CCU Main Assembly

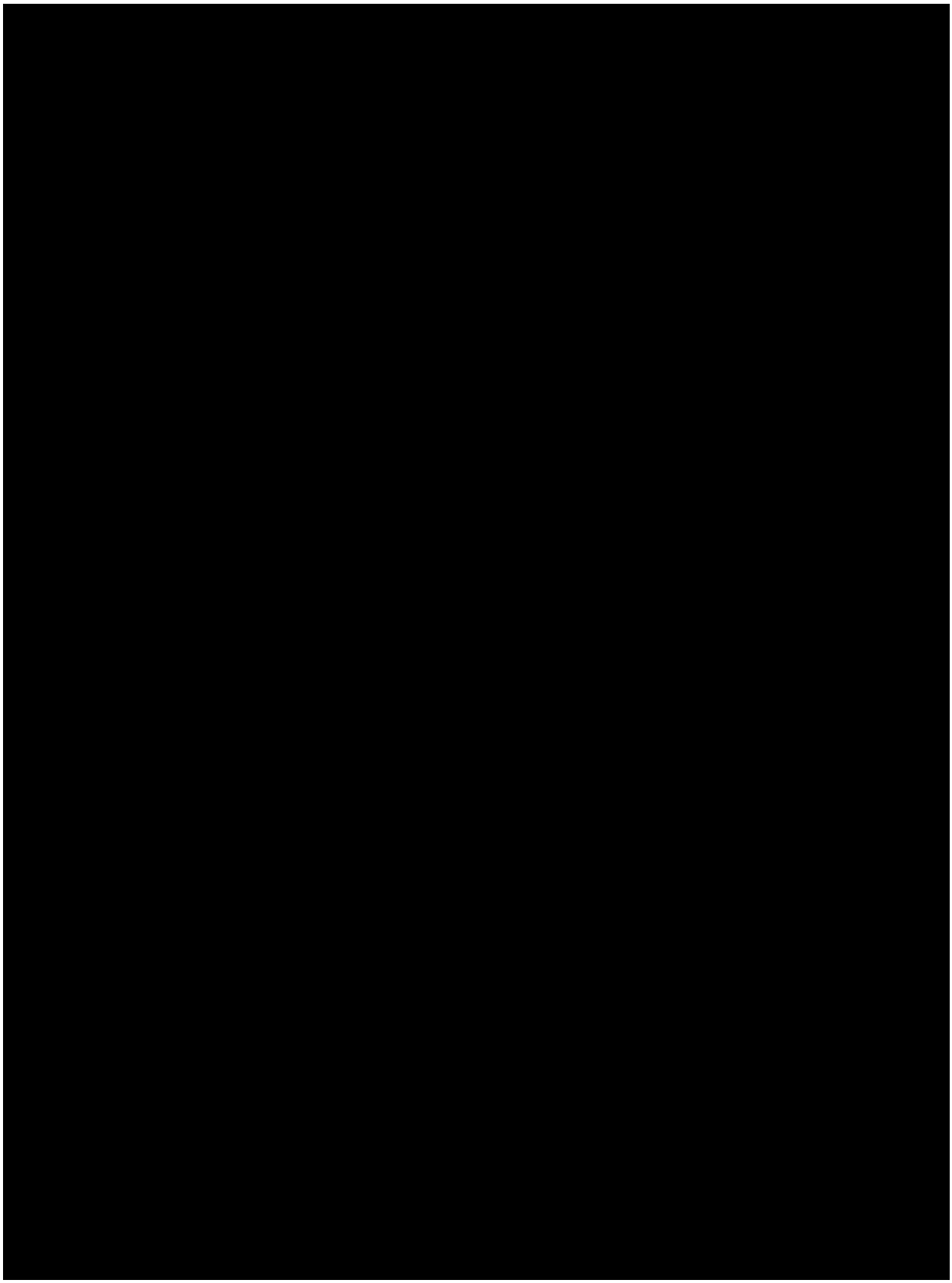


Figure 01-I-02.68 Air Conditioning System Diagram

The components of the HVAC System are connected in a closed, hermetically sealed system to form a refrigerant loop that responds to the commands of the microprocessor controller.

The cooling functions are implemented by means of the R-407C refrigerant which exchanges heat with the surrounding air.

The Evaporator Blower circulates heat-laden air across the evaporator coil. As the refrigerant changes its status from liquid to gas, the heat is transferred from the air to the refrigerant.

The conditioned air is then forced into the air ducts and distributed to the compartment through the air diffusers.

Now the refrigerant needs to release the heat accumulated.

Compressor sucks continuously and draws the heat-laden vapor from the evaporator. As the vapor is compressed, its pressure increases, and the vapor changes to high pressure, high temperature. This facilitates the heat transfer to the ambient air.

As the high-temperature vapor flows through the condenser coil, the heat is dispersed through the cooling fins and ambient air circulated by the condenser fan.

As the heat is removed, the vapor is condensed back into a liquid.

The high temperature liquid is maintained under pressure in the receiver, where it remains stored until needed.

The receiver serves as a reservoir for the variable demand of liquid refrigerant from the system.

Liquid refrigerant then flows from the receiver tank through the sub-cooler circuit to the bottom of the condenser coil.

The refrigerant continues to give off heat to the cooler ambient air circulating across the fins of the sub-cooling circuit, thus lowering the liquid temperature below saturation/condensing temperature.

This additional cooling ensures that the high pressure liquid remains in its liquid state until it reaches the thermal expansion valve(s).

From the sub-cooler circuit of the condenser coil, liquid refrigerant flows through the filter-drier (dehydrator), where impurities, solids and moistures are removed.

The filter-drier consists of a filter and a desiccant that traps and holds water molecules.

From the filter-drier, the high temperature, high pressure liquid flows through the liquid line solenoid valve to the expansion valves.

The expansion valves control the flow of the refrigerant liquid entering the evaporator coil, where it absorbs heat from the compartment.

When “Partial Cool” is required, the controller energizes the liquid line solenoid valve, one compressor and one condenser fan motor, circulating refrigerant through the evaporator coil.

When “Full Cool” is requested, the controller also energized the second compressor and the second condenser fan motor.

01-I-02.02.09.02 Control Box

The Control Box contains the HVAC electronic boards (the Microprocessor Controller) and all electric devices (relays, switches, circuit breakers, etc.) to manage the HVAC system.

The Control Box can be accessed from the roof or directly from the passengers' area by opening the return air grille.

Water barriers are provided inside the return air opening to prevent drain water from jumping into return air opening when the train is in motion or on a sloped track.

A Microprocessor Controller controls all unit functions to maintain the air temperature in the compartment at the proper temperature.

It also interfaces the HVAC system with the other train systems and monitors and records the system fault.

The Microprocessor Control is the brain of the whole system and can be set in three different operating modes through the "Auto-Off-Test Switch":

- AUTO position: the Unit operates according to the controller set-point temperature and the vehicle air temperature (Full Cool, Partial Cool, Reheat, Humidity Reheat, Ventilation, Heating1, Heating2)
- OFF position: the unit does not operate
- TEST position: the controller performs an automatic check of the system controls

Figure 01-I-02.69 Control Box

The Microprocessor Controller uses an advanced solid-state integrated circuit to monitor and control all unit functions. In particular, it manages:

- Compressor operation
- Condenser Fan operation
- Evaporator Blower Motor operation
- Liquid Line Solenoid Valves
- Fault Light
- Four Stages Heater

The Microprocessor Controller monitors inputs from:

- Return Air Sensor
- Duct air sensor
- Fresh (outside) air sensor
- Current transformer circuits (3) for compressor motors, condenser fan and evaporator blower motor

Each CCU is interfaced with the vehicle trough trainlined signals and through the MVB (Multifunction Vehicle Bus) of the TCN (Train Communication Network).

The HVAC trainlined signals are:

- HVAC Damper Position (Open/Closed)
- HVAC ON/OFF

These two signals can be selected through the two switches of the Indicator and Switch Panel located above the cab windshield.

All other HVAC signals flow through the MVB (and the WTB if part of a train consist). They are status signals and are sent from one CCU to the other and to the IDUs.

In this way, through the IDU, personnel (both operator and maintenance) can monitor the HVAC System status and can also turn the system on/off and set the Ventilation Only Mode.

The HVAC status can also be acquired by the PTU (refer to Section 5) through the RS232 connector on the Control Box or through the 12X01 connector located in the Data Download Panels of the two Electronic Lockers.

Fault Light Signals:

The Microprocessor Controller manages the Fault Light (mounted on the Control Box) for a quick CCU status overview.

The Controller generates Warning and Alarm signals for remote monitoring.

- Warning: the Fault Light flashes On and Off continuously. Warning signals indicate that corrective action should be taken before a problem becomes severe. The unit continues to operate, however, some unit functions may be inhibited.
- Alarm: the Fault Light stays On. Alarm signals indicate that a problem exists that affects the cooling system performance. On some alarms, the compressor and condenser fans are stopped to prevent damage to unit components while the unit continues to operate in ventilation mode.

01-I-02.02.10 Communications

The P2550 Communication System (Refer to Section 15) is capable of carrying out the following functions:

- Communications and Video Surveillance:
    1. Cab-to-cab communications
    2. Cab operator to passengers communications or automatic announcements via the P.A.S system
    3. Communication between passengers and operator, on demand of passengers
    4. Video surveillance, with image recording
- Signs:
    1. External message of Destination Station
    2. Internal messages of Next Station and Route
    3. Information Messages, manually edited by the operator
- Communications with way-side
- Radio-communications from/to the Control Center

The complete system is made up of the following components (refer to Figure 01-I-02.70):

- Two Communication Control Unit (CCU), one in each Electronic Locker
- Two Automatic Announcement and Display System (AADS), one in each cab
- Two Communication Control Head (CCH), one in each cab
- Two gooseneck microphones, one in each cab
- Four Passenger InterCom (PIC) units, two per car section

- Two TK-790 radios and related accessories, one in each cab
- Two radio power supplies, one per car section
- Two antennas. One per car section, on the roof
- Two radio loudspeakers, one per car section
- Four Announcement Signs, two per car section
- Two Side Destination Signs, one per car section
- Two End Destination Signs, one per car section
- Six Video Cameras, three per car section
- Twelve interior loudspeakers, six per car section
- Eight exterior loudspeakers, four per car section
- Two cab loudspeakers, one in each cab

Figure 01-I-02.70 System Block Diagram

01-I-02.02.1 .01 CCU

The CCU is made up of a standard 19" rack (U) fitted with the following boards:

- C/DC converter, supplying the main 24Vdc voltage, +15 and -15Vdc service voltages for the system
- PA (Public Announcement) final amplifier, with the audio signal amplification for the loudspeak rs

Each amplifi r has a volume control to adjust the PA p wer output separately between int rior and e×terior loudspeakers.

- Audio router, giving all combinatorial commutation ecoding for the communication managem nt, and routing to the train audio interface A and intercoms lines.
- CPU boar l (equipped with a 40 GBytes removable hard disk), which manages:
- Digital co mmunication to other units in the same vehicle by means of the main RS485 serial line and analog signals.
- Digital co mmunication to CCU of the other vehicle by means of an Ethernet line.
- Signal acquisition from the field: cab key switch, speed, coupled vehicle and doors status.
- igital com nunication to coupled vehicle by means o the coupler RS485 serial line.
- Digital co mmunication to TCU by means of the diagnostic RS485 serial line.
- Image acq isition and recording from security Video cameras.
- Audio synthesis for automatic announcements.
- Encoding and decoding of PA and Interc m audio signals for audio data exchange between v hicles.

01-I-02.02.10.02 AADS

The AADS (Automatic Announcement Display System) is interfaced with the CCU by means of the main RS485 serial line. It manages:

- Routes selection and initialization
- Station selection inside the current route
- Service and custom messages selection
- Train and operator ID input

These operations are performed by means of a keyboard and an alphanumeric display.

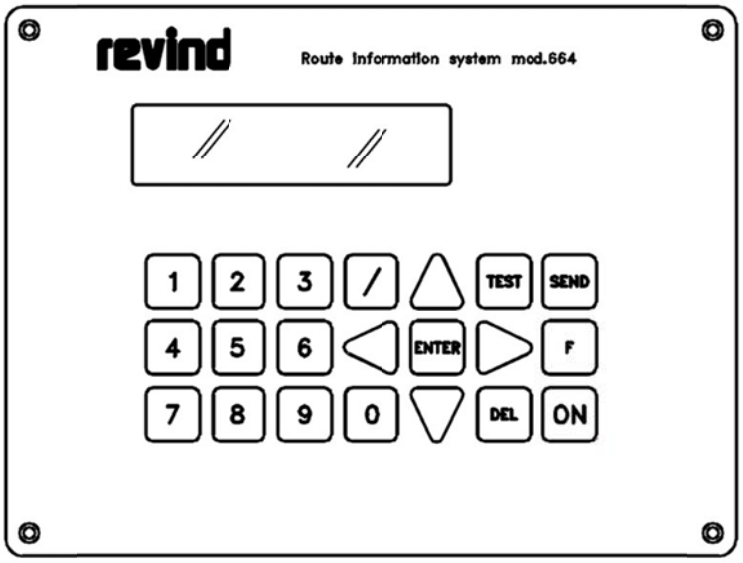


Figure 01-I-02.71 The AADS

01-I-02.02.1 .03 CCH

C CH is interfaced to the CCU by means of the main RS485 serial line and analog signals, to the microphone, to the radio, to the PTT s vitch and silent alarm switch. It m nages:

- Operation mode selection between PA, PIC and CCI
- PA source selection from radio and microp one
- PA routing between loudspeakers: interior, exterior and all
- Volume control for cab loudspeaker
- Forwardin to the radio of the silent alarm request
- Audio sign al exchange with the CCU
- PA level displayed by a VU audiometer
- PIC and CCI request alert by related lamp and an audible tone on the cab loudspeak er

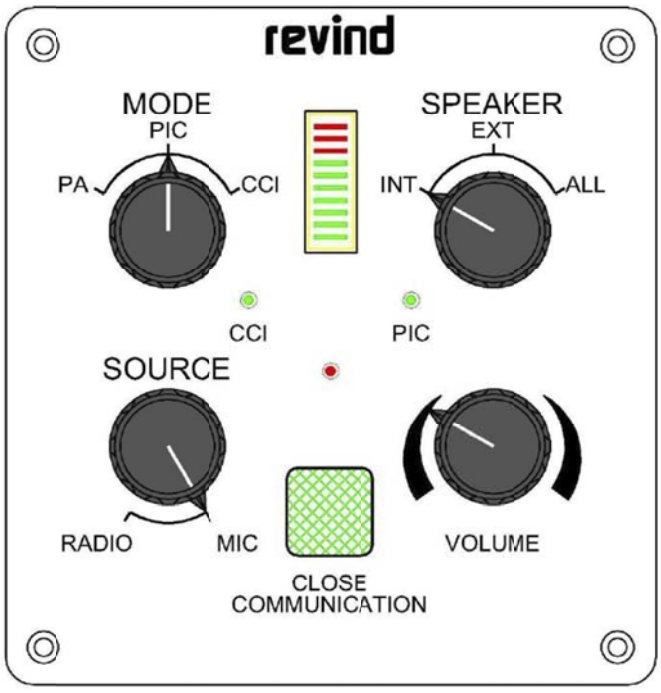


Figure 01-I-02.72 The CC H

01-I-02.02.10.04 PIC Unit

PIC unit is interfaced to the CCU by means of audio signals and control signals, it manages:

- Intercom communications between passengers and the operator

01-I-02.02.10.05 TK-790 radio

TK-790 radio is interfaced to the CCH by means of audio signal and control signals, it manages:

- Two-way communication between the operator and ROC
- One way communication from ROC to the passengers by means of the PA system
- Emergency calls activated by the silent alarm contact

01-I-02.02.10.06 Radio power supply

Radio power supply is a fully isolated DC/DC converter able to supply a nominal voltage of 13.6 VDC and a maximum current of 25 Amp to the TK-790 radio.

01-I-02.02.10.07 Signs

There are three types of signs:

- End destination sign
- Side destination sign
- Announcement sign

The messages displayed are:

The final destination of the selected route on the End and Side destination signs.

- Next station and Public services messages on the announcement signs.

01-I-02.02.10.08 Cameras

All cameras are interfaced to the CCU by means of the analog video out line. Cameras can operate with an environment light down to 0.5 lux @ f=2.

01-I-02.02.10.09 Loudspeakers

All loudspeakers (except for the ones in the cabs) are interfaced to the CCU by means of the isolated 100 V audio lines, cab loudspeakers are directly driven from audio router amplifier.

Interior loudspeakers have 4 taps for power adjustment: 0.25, 0.5, 1, 2 Watt.

Exterior loudspeakers have 3 taps for power adjustment: 1.5, 3, 6 Watt.

01-I-02.02.11 Coupler

The Dellner Automatic Coupler is designed to enable rail vehicles to couple automatically.

This coupling is accomplished at low speed without manual assistance and resulting in a rigid, slack free and fully latched connection.

In addition, with the designed pivot arrangement it allows for both horizontal and vertical track variations and, in addition, the designed pivot arrangement allows for both horizontal and vertical alignment.

Uncoupling of the mechanism head can be accomplished either remotely from driver's cab or at the coupler itself using manual release.

Once the rail vehicles have moved apart, the couplers are automatically reset and ready to be coupled again.

Each end of the vehicle is equipped with a self-centering, fully automatic coupler, such that the coupling can be accomplished with no manual assistance.

By moving one vehicle (leading the coupling operation) towards the other one (stopped, with no active cab) at low speed (Car Wash Mode), the couplers on both vehicles automatically couple mechanically, pneumatically and electrically without further action.

Uncoupling of the mechanism head can be accomplished (with service brakes fully applied) either remotely, from the operator's console of the active cab, or manually at the coupler's site.

Once the rail vehicles have been moved apart, the couplers reset automatically and are "ready to couple" again.

The coupler system is capable of withstanding coupling with another vehicle at a speed up to 4 mph (6.4 km/h) without automatic release or permanent deformation.

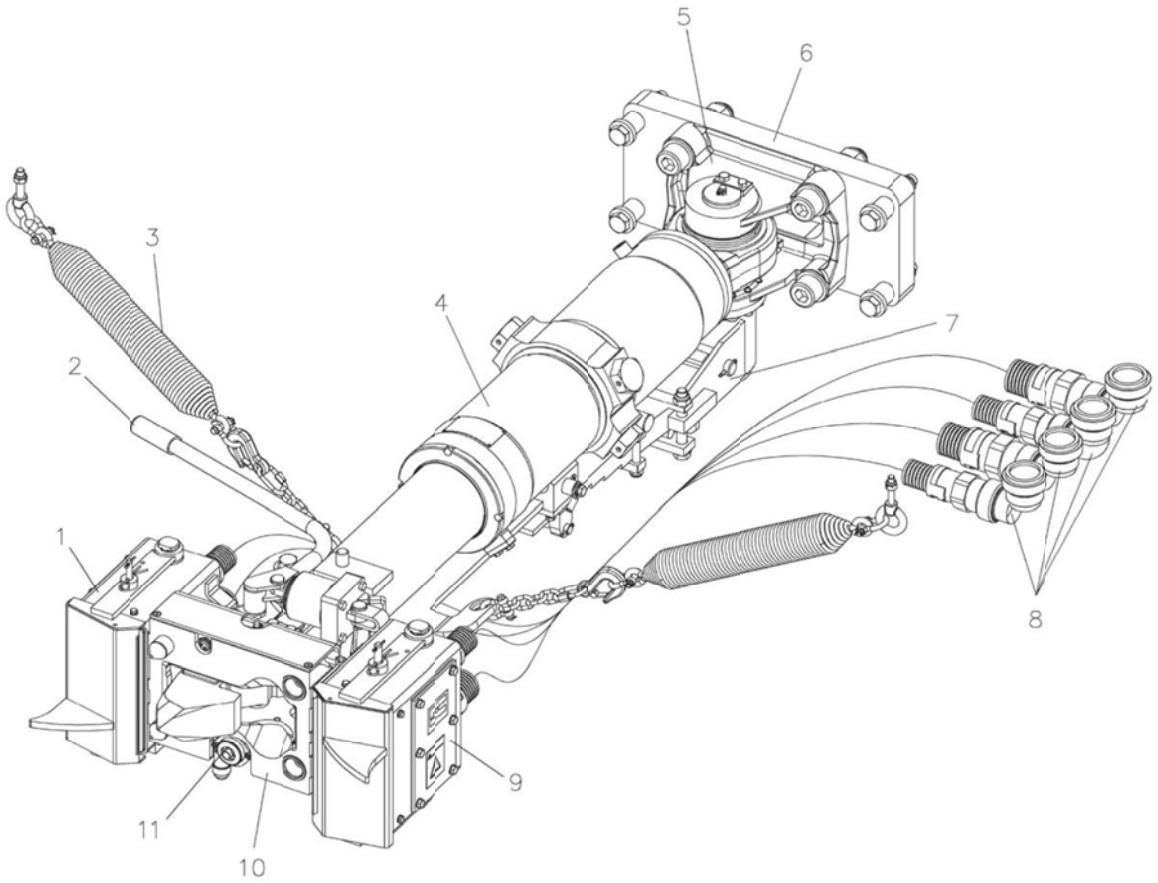
The draft gear and anchorage have sufficient strength to allow a train consist of three AW4-loaded cars to push or tow an AW4 loaded, inoperable train of three cars in an emergency over all grades and curves where the vehicle normally operates.

The electrical couplers are mounted on the left and right sides of the mechanical coupler and provide electrical train-line coupling between two coupled vehicles. The electrical couplers are connected to the Train Line Junction Box through the electrical head cables.

Each electrical coupler head (Refer to Figure 01-I-02.74) houses 86 spring contacts. The contacts are held in a non-conductive isolating block.

The contact attachment is mounted in a fixed contact housing.

A front seal, around the electrical head forms a seal between the coupled electrical heads. When the coupler is in uncoupled state, the contacts are protected by a cover.



01. Electric Coupler Right
02. Manual Uncoupling Handle
03. Centering Spring
04. Buffer
05. Bearing Brackets
06. Mounting Kit
07. Vertical Support
08. Electrical Head Cables
09. Electric Coupler Left
10. Mechanical Coupler
11. Pneumatic Coupler

Figure 01-I-02.73 Automatic Coupler

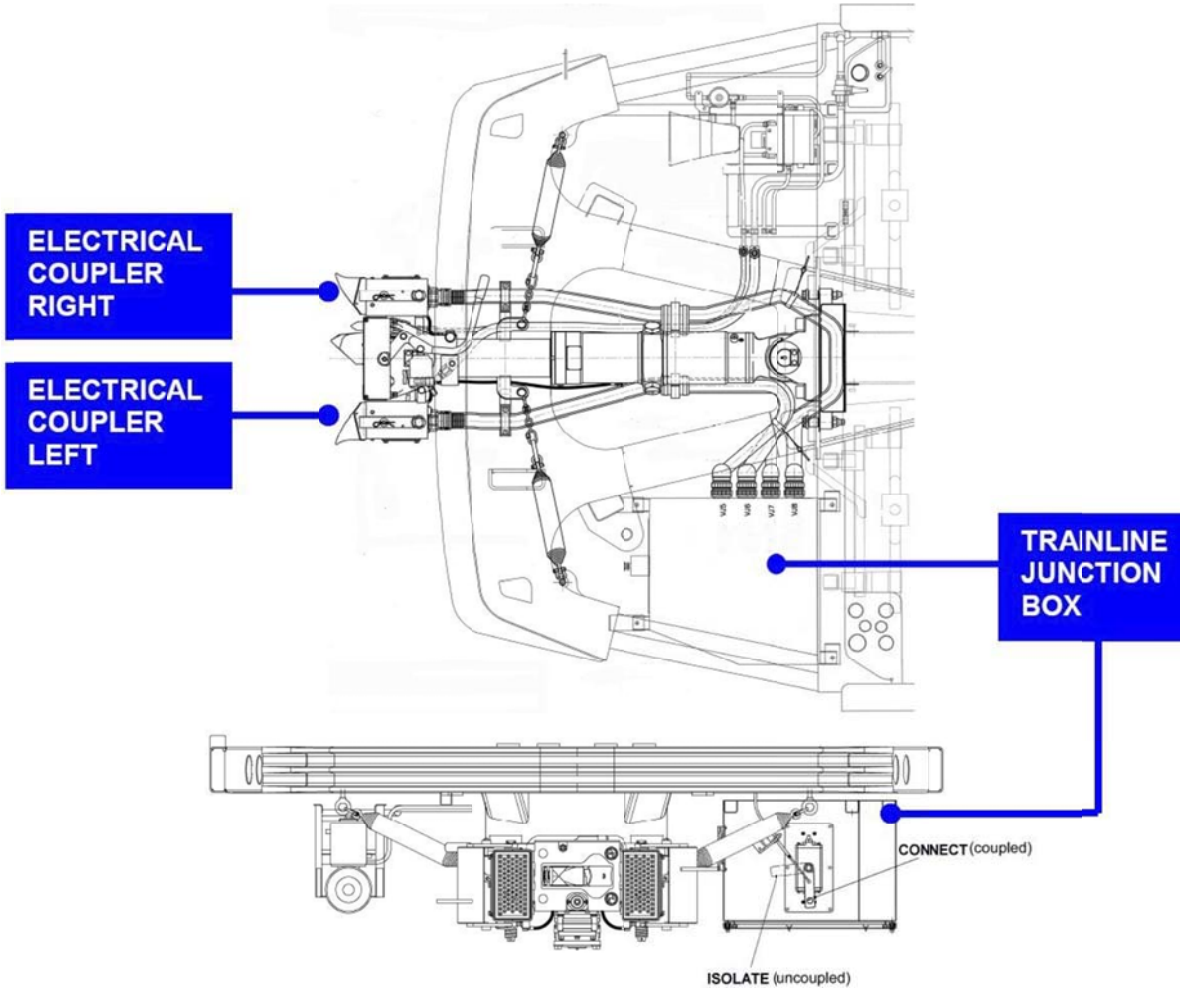


Figure 01-I-02.74 Electric Coupler and Junction Box

01-I-02.02.12 Lighting

The LACMTA P2550 Lighting System is made up of Interior and Exterior Lighting Subsystems. The Lighting System is described in Section 06.

01-I-02.02.12.01 Interior Lighting Subsystem

The Interior Lighting Subsystem is designed to provide internal lighting and requires low maintenance.

Refer to Figure 01-I-02.76 for LACMTA P2550 Interior Lighting Wiring Diagram.

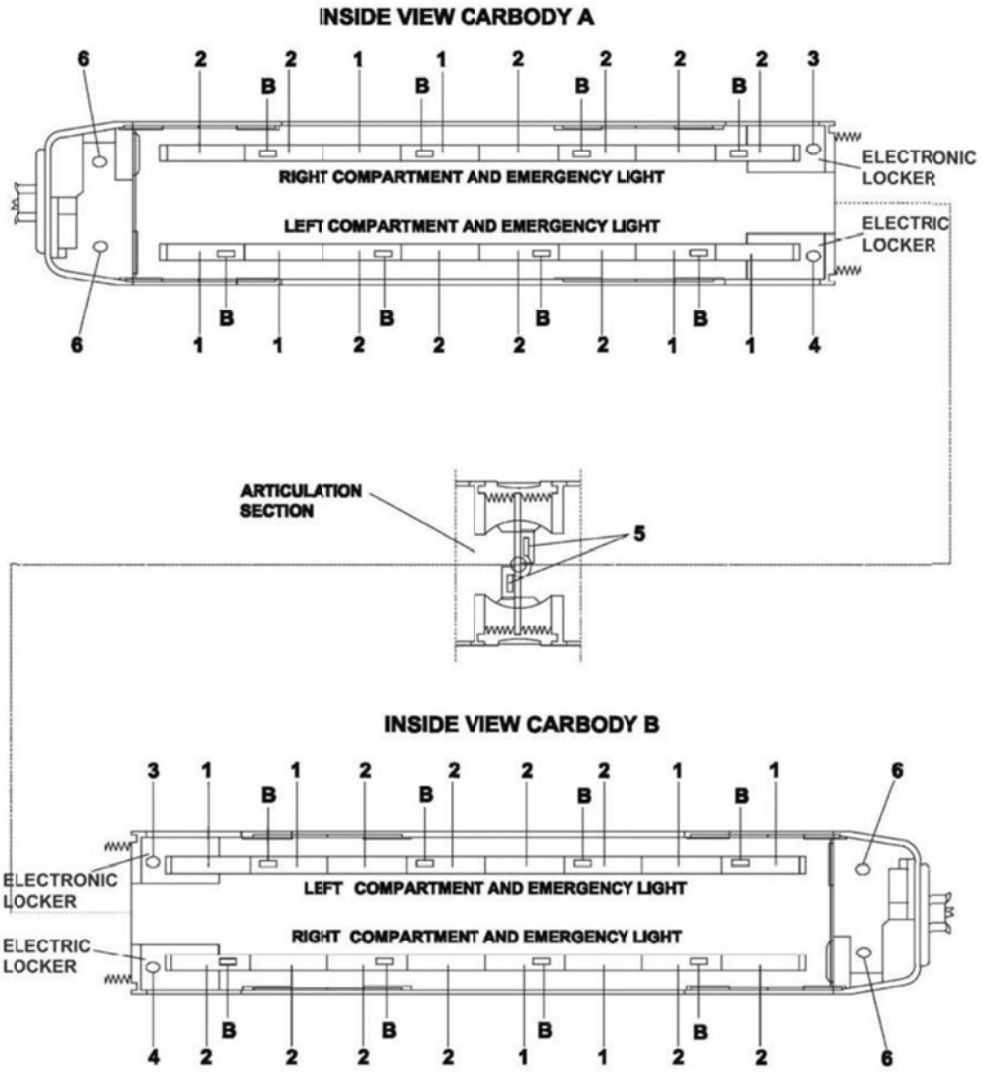
Designated Lights are turned into Emergency Lighting in the event of a vehicle power failure. Interior lighting includes:

- Compartment and Articulation Lights
- Locker Lights (Electronic and Low Voltage)
- Cab Lights

All Lighting Controls are powered by the LV Distribution System by means of the relevant Circuit Breakers and appropriate Relays and/or Logic Circuitry.

The Fixture Housing or Socket as a ground return is not used for the LACMTA P2550 Lighting System.

Both electrical feeds to the lamp(s) are isolated from ground and all Fixtures and their exposed metallic surfaces are grounded.



B. Ballast

01. Emergency Light	02. Compartment Light	03. Electronic Locker Light
04. Electric Locker Light	05. Articulation Light	06. Cab Light

Figure 01-I-02.75 Interior Lighting Layout

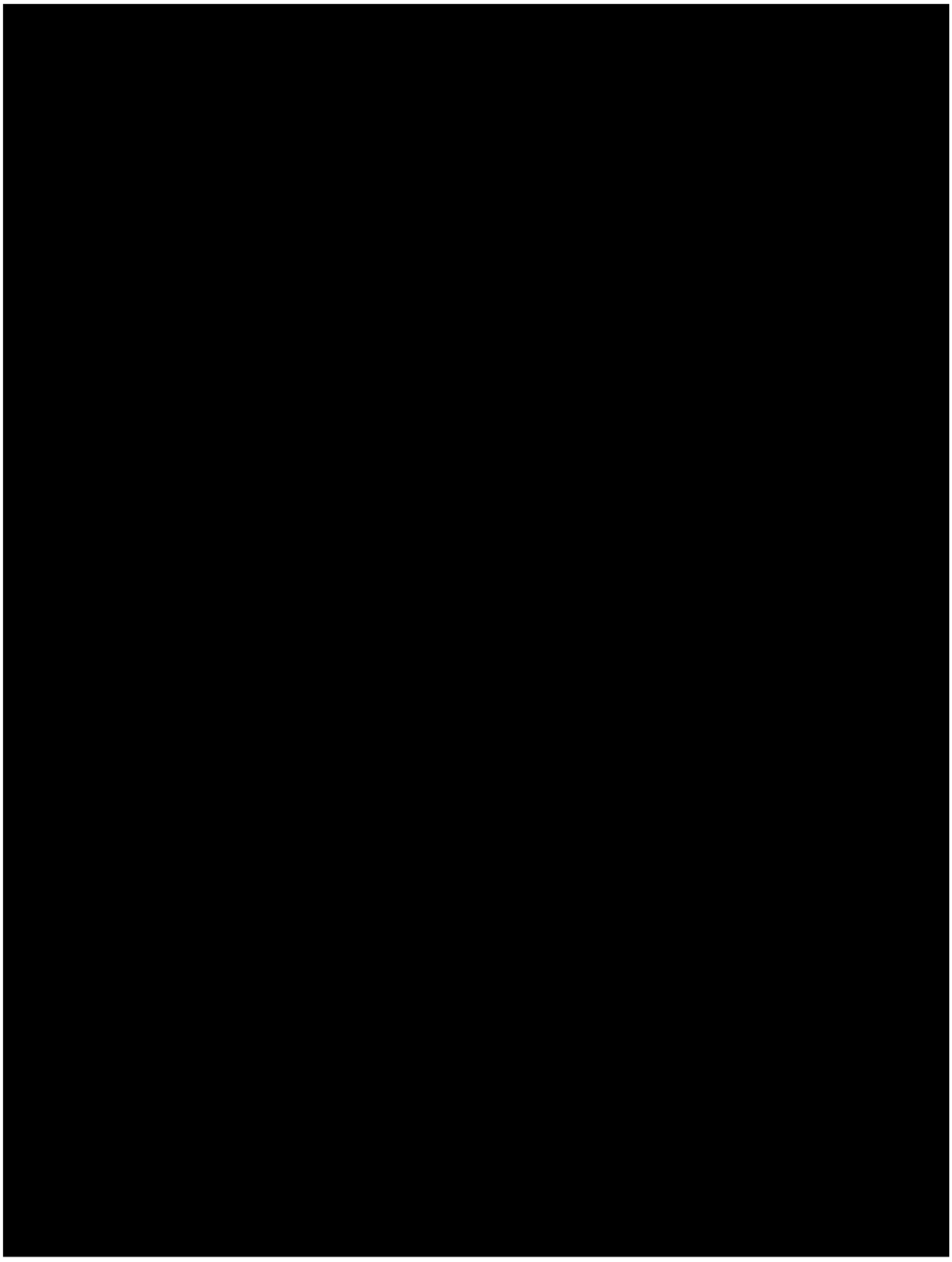


Figure 01-I-02.76 Interior Lighting Wi ing Diagram

a) Compartment and Articulation Lights

Each Passenger Compartment (A and B Sections) has eight (8) Light Fixtures that illuminate the passenger compartment.

The Light Fixtures in the passenger area also serve as Air Diffusers for the HVAC System.

Each Fixture is 100" long and consists of two 50" Reflectors Assemblies.

Each Reflector Assembly houses one cool white F32T8 (48") lamp. The Reflector Assembly can be with or without Ballast.

The Articulation Section has two (2) Articulation Fixtures (without air diffusers).

Each Fixture is 18" long and consists of one 18" Reflector Assembly. Each Reflector Assembly houses one cool white FB024T8 U-lamp each.

The Articulation Fixture located at the junction of the B-Section houses only one Ballast.

The Normal Lights of the Compartment Lighting Subsystem are controlled by the COMPARTMENT LIGHTING Circuit Breaker (CB 08F02 located on the B Cab Circuit Breaker Panel).

The Emergency Lights of the Compartment Lighting Subsystem are controlled by the EMERGENCY LIGHTING Circuit Breaker (CB 08F05 located on the B Cab Circuit Breaker Panel).

The Articulation Lights are controlled by the EMERGENCY LIGHTING Circuit Breaker (CB 08F05 located on the B Cab Circuit Breaker Panel).

b) Lockers Lights

Two (2) Electronic (E-E) Lockers and two (2) Electric (LV) Lockers are located at the center of the Vehicle, on both sides of the Articulation section entrances from each Car Body Section.

Each Locker is provided with one Internal Light Fixture housing Light Emitting Diode (LED) Lights controlled by a microswitch. LED Lights operate on 14 Vdc reduced from a 37.5 Vdc car power source applied to a receptacle on the back of each sealed LED module.

c) Cab Lights

Each cab area has two directionally adjustable Light Fixtures located on the ceiling of each cab.

Each Light Fixture houses one halogen lamp (10W) and is controlled by CAB LAMP Switch and relevant Dimmer both located on the Console.

When the Vehicle is not powered (i.e shop parking) and the Operator opens the Front Door by means of the Crew Switch, the Cab Lights are not activated.

The cab lights will be turned on when the crew key switch is used if the console switch is left in the AUTO position.

Cab Lights are powered with the Transfer Switch to ON or LOCAL and the CAB LAMP Switch (Console) to ON.

In an emergency situation, the Battery supplies only the Cab Lights.

Cab Lights still remain active even if the Vehicle is passing through an high voltage gap and/or in any other condition which may cause the Vehicle to lose the power supply.

01-I-02.02.12.02 Exterior Lighting Subsystem

The Exterior Lighting Subsystem is designed to take care of lighting needs on the Vehicle Exterior and requires low maintenance.

The Exterior Lighting components are listed below:

- "By Pass Active" Light
- Front Head Lights
- Marker Lights
- Roof Head Lights
- Silent Alarm Light
- Stop / Tail Lights
- Turn Indicators / Hazard Lights

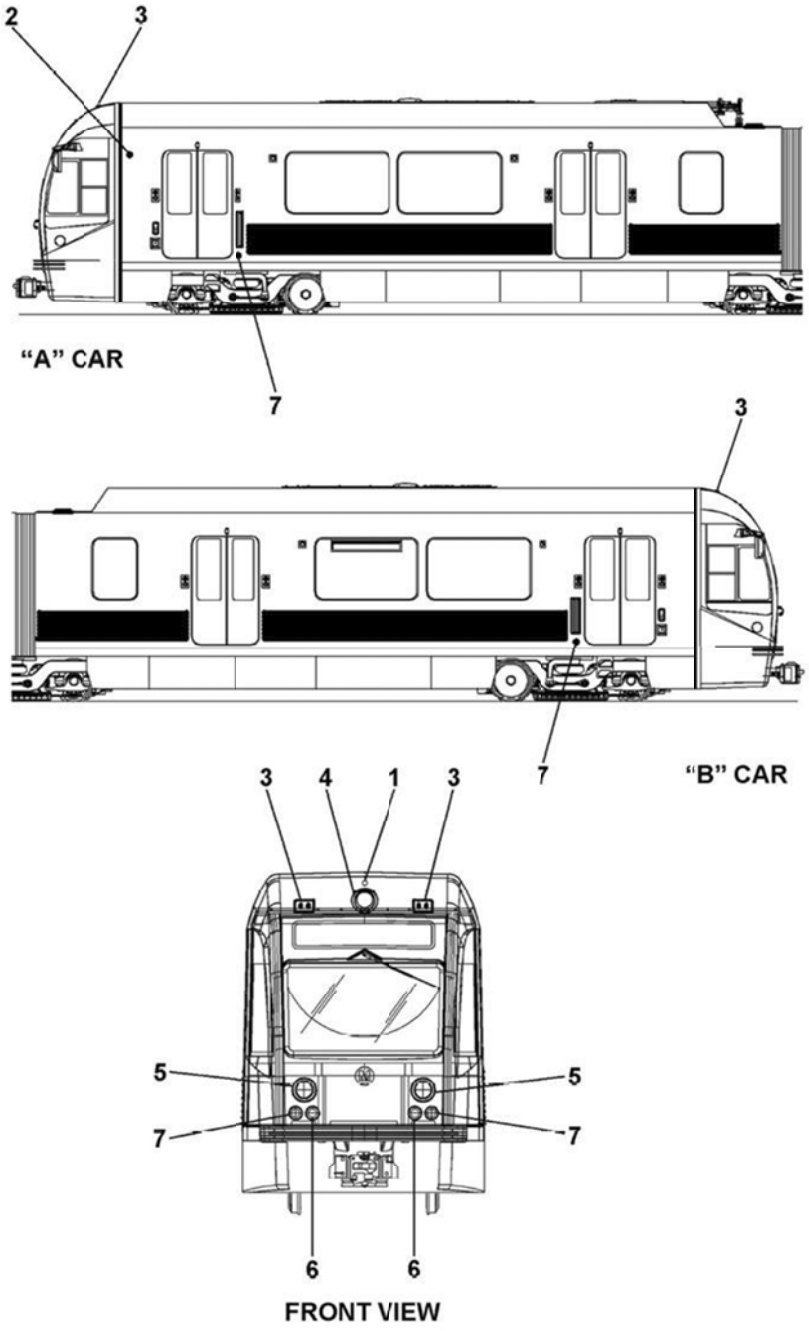
Refer to Figure 01-I-02.78 and Figure 01-I-02.79 for Exterior Lighting Wiring Diagram.

All Lighting Controls are powered by the LV System by means of the appropriate relay and/or logic circuitry.

Both electrical feeds to the lamp are isolated from ground and all Assemblies and their exposed metallic surfaces are grounded.

All Assemblies installed on the vehicle exterior and in doorways are waterproof. All Assemblies are designed and installed to provide easy, quick and safe maintenance.

For these reasons re-lamping of each Assemblies is performed from the outside with the exception of the Roof Head Light (for safety reasons due to its location on the roof close to the 750 Vdc catenary voltage).



01. Silent Alarm Light
02. By-Pass Active Light
03. Marker Light
04. Roof Headlight
05. Front Headlight
06. Stop/Tail Light
07. Turn Indicator/Hazard Light

Figure 01-I-02.77 Exterior Lighting Layout

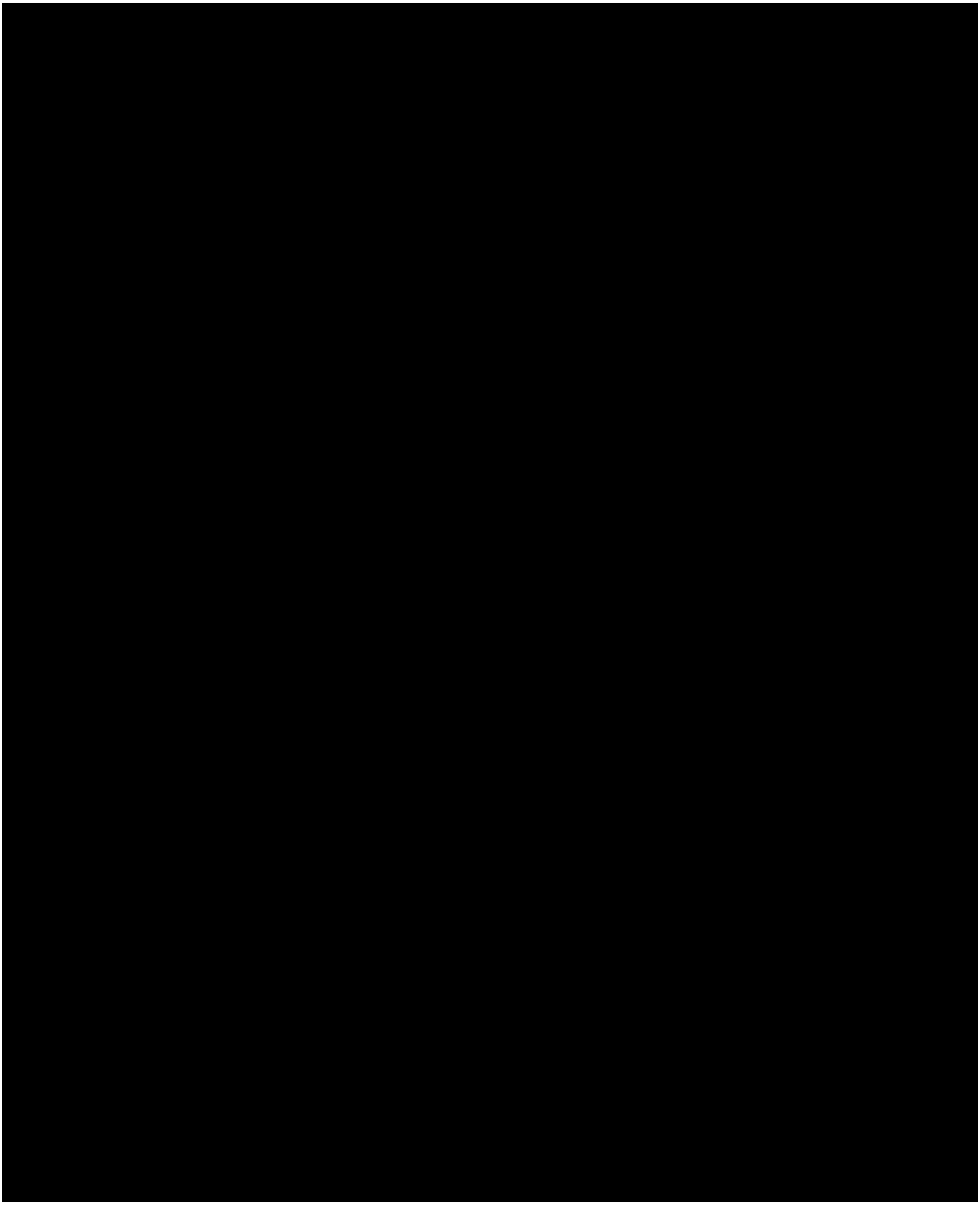


Figure 01-I-02.78 Car “A” Exterior Lighting Wiring Diagram

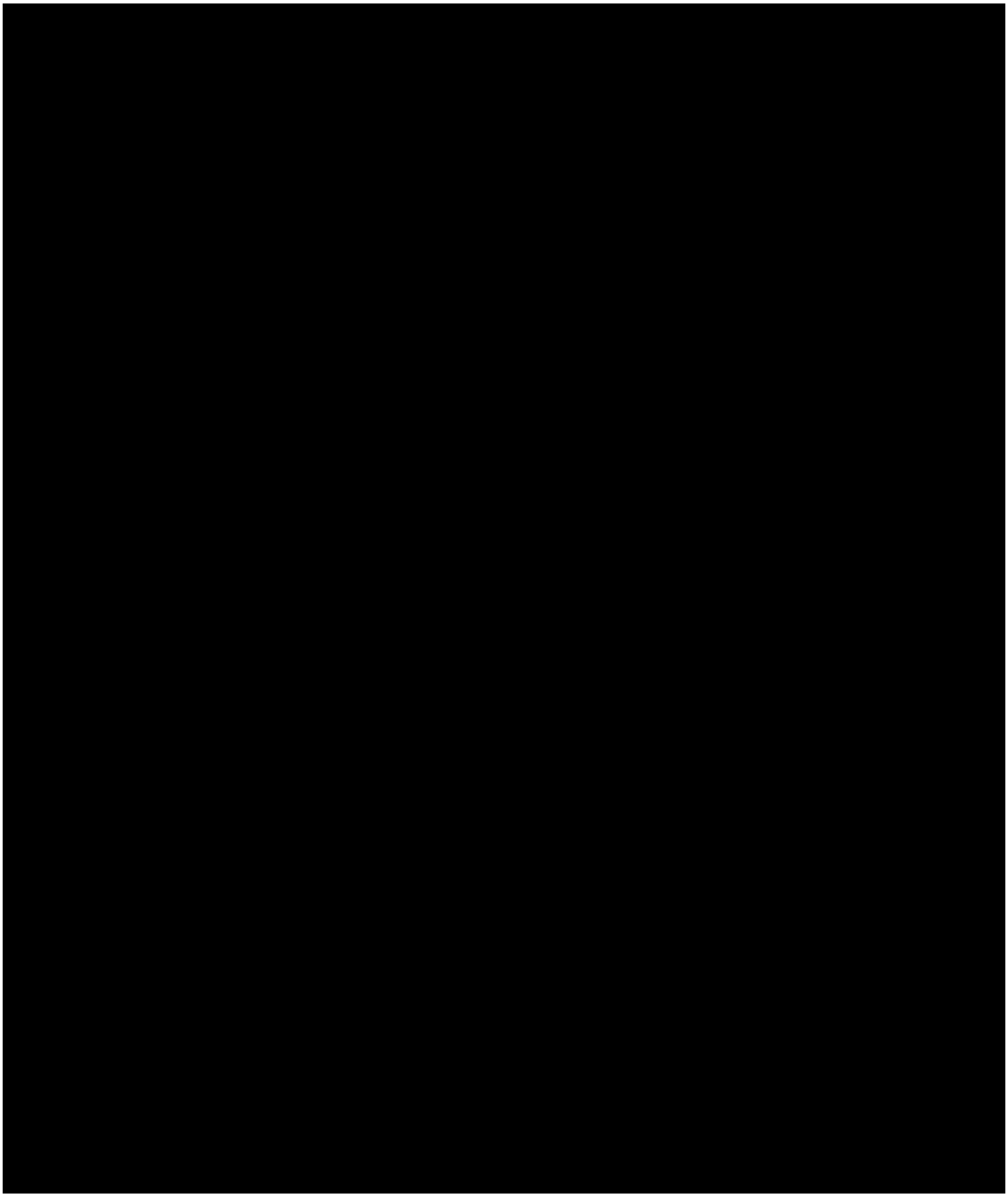


Figure 01-I-02.79 Car “B” Exterior Lighting Wiring Diagram

LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE

P2550

RUNNING MAINTENANCE
AND
SERVICE MANUAL

VOLUME M-01
PART II
TROUBLESHOOTING
SECTION 01 - VEHICLE SYSTEM

SECTION 01

VEHICLE SYSTEMS

PART II

TROUBLESHOOTING

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VEHICLE SYSTEMS

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LOS ANGELES COUNTY

METROPOLITAN TRANSPORTATION AUTHORITY

LIGHT RAIL VEHICLE
P2550

Metro

AnsaldoBreda

RUNNING MAINTENANCE AND SERVICE MANUAL

VOLUME M-01
PART III
MAINTENANCE
SECT 01 VEHICLE SYSTEMS

SECTION 01

VEHICLE SYSTEMS

PART III

MAINTENANCE

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SECTION 01

VEHICLE SYSTEMS

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SECTION 01

VEHICLE SYSTEMS

01-III-01 INTRODUCTION

The Vehicle Systems Part III - Maintenance provides Maintenance information for the Vehicle as a Whole.

It consists of:

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

01-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
ADU	Aspect Display Unit
A/H	Ampere Per Hour
APS	Auxiliary Power Supply
ASSY	Assembly
CCH	Communication Control Head
CCU	Communication Control Unit
DC	Direct Current
DCU	Door Control Unit
ECU	Electronic Control Unit
ELE	Electronic
EMI	Electro Magnetic Interference
H-CML	Heavy Consumable Material List
H-CMS	Heavy Corrective Maintenance Sheet
HV	High Voltage
IDU	Integrated Diagnostic Unit
IPC	Illustrated Parts Catalog
LRV	Light Railway Vehicle
LV	Low Voltage
LVDC	Low Voltage Direct Current
MC	Master Controller
PS	Power Supply
PTU	Portable Test Unit
R-CML	Running Consumable Material List
R-CMS	Running Corrective Maintenance Sheet
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 & Special Tools List
SCPM	Safety Critical Preventive Maintenance
SYS	System
TBD	To Be Defined
TBS	To Be Supplied
TOC	Table Of Content
TTEM	Tools & Test Equipment Manual
VAC	Voltage Alternate Current
VDC	Voltage Direct Current
W/	With
W/O	Without

01-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

01-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)
·	Ohm (Resistance)
°F	Fahrenheit (Temperature)
°C	Celsius (Temperature)
A	Amperes (Current)
Hz	Hertz (Frequency)
rpm	Revolution per Minute (Frequency)
N	Newton (Force)
Nm	Newton-Meter (Torque)
mphps	Mile Per Hour Per Second (Acceleration)

01-III-01.d References

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

01-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

01-III-03 RUNNING -PREVENTIVE MAINTENANCE

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

The Vehicle Systems -"Vehicle as a Whole" Running -Preventive Maintenance Matrix (R-PMM) provides the Preventive Maintenance Plan of the Vehicle Systems -"Vehicle as a Whole" up to 120,000 Miles.

The Vehicle as a Whole (R-PMM) is provided in two different arrangements as follows:

- **R-PMM Component Based**

It lists the Vehicle as a Whole 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:

- SUBSYSTEM /ASSEMBLY/UNIT/COMPONENT
- TASK
- SCPM
- INSPECTIONINTERVAL
- SHEET CODE

- **R-PMM Mileage Based**

It lists the Vehicle as a Whole 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 Maintainer 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.

01-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.

01-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.

01-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.

01-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 01-III-03.03.01 for Running- Preventive Maintenance Sheet (R-PMS) Form for detailed explanation.

01-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 01-III-03.1 for Running - Preventive Maintenance Matrix (R-PMM) (Component Based)
- Table 01-III-03.2 for Running - Preventive Maintenance Matrix (R-PMM) (Mileage Based)

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

Table 01-III-03.1 Running Preventive Maintenance Matrix (Component Based)

SYSTEM 01 VEHICLE SYSTEMS								
SUBSYSTEM ASSY/UNIT/COMPONENT	TASK	SCPM	INSPECTION INTERVAL MILES					SHEET CODE
			Daily	10K	30K	60K	120K	
01. VEHICLE SYSTEMS								
-VEHICLE AS A WHOLE	INSPECTION		●					R-P-01-01-00-00/I-00
-VEHICLE AS A WHOLE	INSPECTION		●					R-P-01-01-00-00/I-01

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

Table 01-III-03.2 Running Preventive Maintenance Matrix (Mileage Based)

SYSTEM 01 VEHICLE SYSTEMS

SUBSYSTEM	TASK	SCPM	PERSON HOURS	SHEET CODE
DAILY				
01. VEHICLE SYSTEMS				
-VEHICLE AS A WHOLE	INSPECTION		0.5	R-P-01-01-00-00/I-00
-VEHICLE AS A WHOLE	INSPECTION		0.5	R-P-01-01-00-00/I-01

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

This paragraph describes the contents of the Vehicle Systems- " Vehicle as a Whole" Running -Preventive Maintenance Reports (R-PMR/Job Cards) for the Running - Preventive Maintenance Tasks.

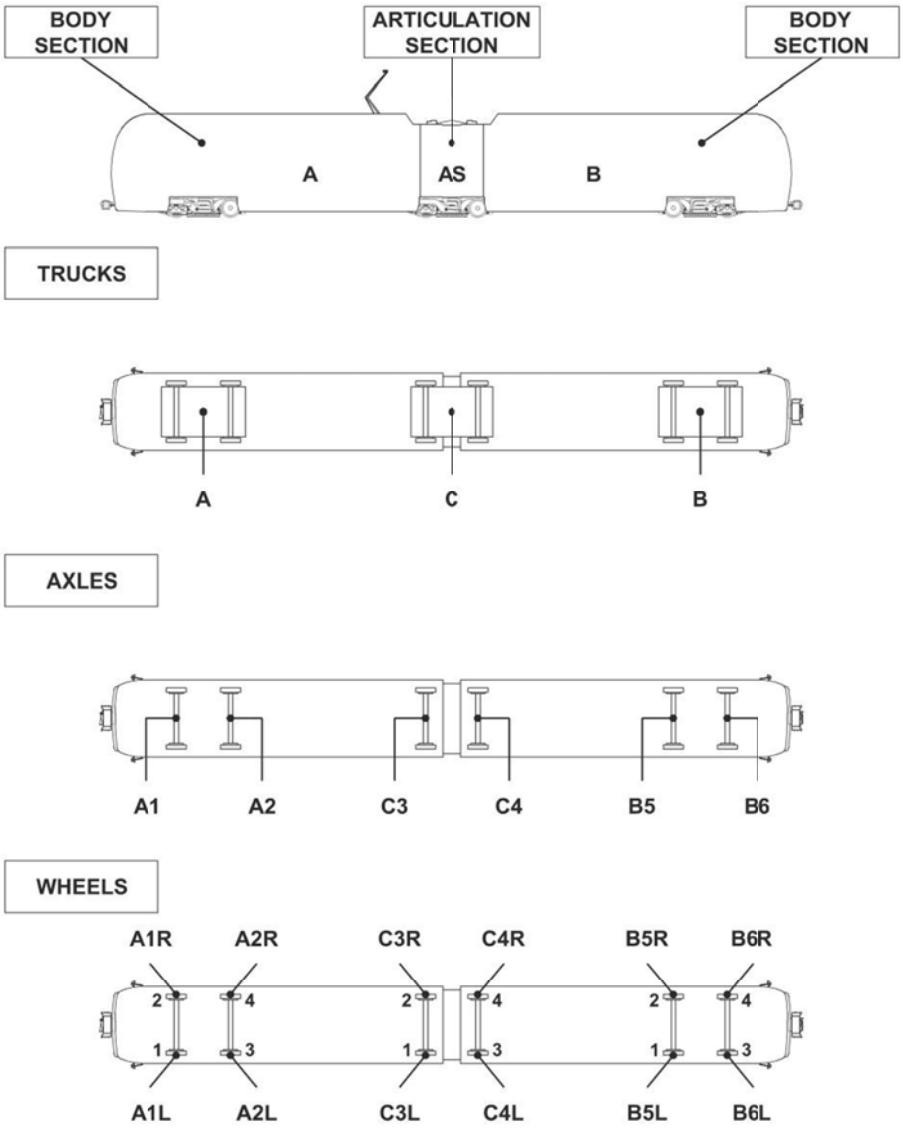
01-III-03.02.01 R-PMR/Job Card Form Content

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

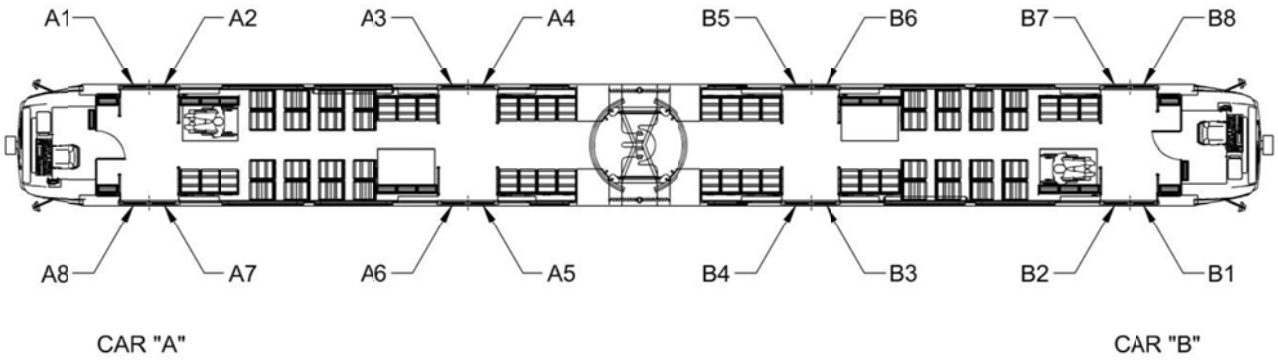
- Specific Data
- R-PM Data

Refer to Figure 01-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 Date on which the Vehicle entered the Maintenance Shop
3	**RUNNING HOURS**	This field indicates the Vehicle Running Hours at the above Date
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 k(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 PREVENTI 'E 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, Com ponent to be maintained
D	**TASK**	This column lists the R-PM tasks to be performed for each Assembly/Unit/Component (i.e., Cleaning, Inspection, Test) The R-PM Tasks are the following: Cleaning - Inspection -Lubrication - Replacement - Service- Test
E	**LOC .TION**	This column lists the On Board Vehicle L cation of all Equipment to be maintained ac cording to the following Location identification Code s 

RUNNING PREVENTIVE MAINTENANCE REPORTS (R-PMR/JOB CARDS) FORM (cont'd)	
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	**P I 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

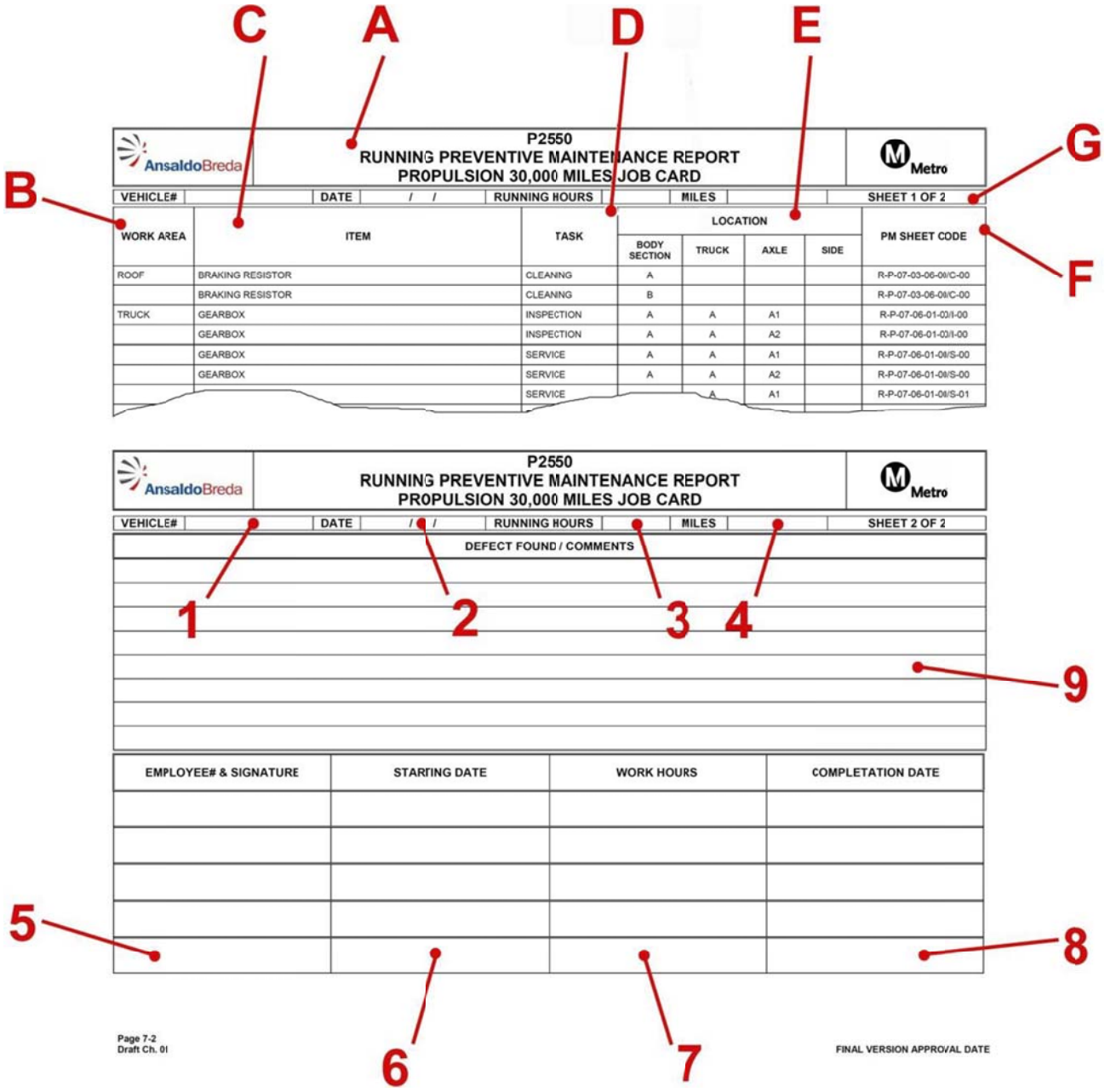


Figure 01-III-03.1 R-PMR/Job Card Form -Example

01-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

01-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

01-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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"VEHICLE SYSTEMS"

Running - Preventive Maintenance Reports

R-PMR/JOB CARDS

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" VEHICLE SYSTEMS"
RUNNING PREVENTIVE MAINTENANCE REPORT
DAILY 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	
EXTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-01
INTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

" VEHICLE SYSTEMS"
RUNNING PREVENTIVE MAINTENANCE REPORT
10,000 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	
EXTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-01
INTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

" VEHICLE SYSTEMS"
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	
EXTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-01
INTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

" VEHICLE SYSTEMS"
RUNNING PREVENTIVE MAINTEN ANCE REPORT
60,000 MILES JOB CA RD

VEHICLE #		DATE		RUNNING HOURS		MILES		SHEET 1 OF 1

WORK AREA	SYSTEM	ITEM	TASK	LOCATION				PM SHEET CODE
				BODY SECT	TRUCK	AXLE	SIDE	
EXTERIOR	VEHICLE SYS TEMS	VEHICLE AS A W HOLE	INSPECTION					R-P-01-01-00-00/I-01
INTERIOR	VEHICLE SYS TEMS	VEHICLE AS A W HOLE	INSPECTION					R-P-01-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYE E # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

" VEHICLE SYSTEMS"
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	
EXTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-01
INTERIOR	VEHICLE SYSTEMS	VEHICLE AS A WHOLE	INSPECTION					R-P-01-01-00-00/I-00

DEFECT FOUND / COMMENTS

EMPLOYEE # & SIGNATURE	STARTING DATE	WORK HOURS	COMPLETION DATE

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01-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 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

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

The R-PMS Form (refer to Figure 01-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 RPMSM Section Page number
16	**-#**	**Number**	This field indicates the RPMSM 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.

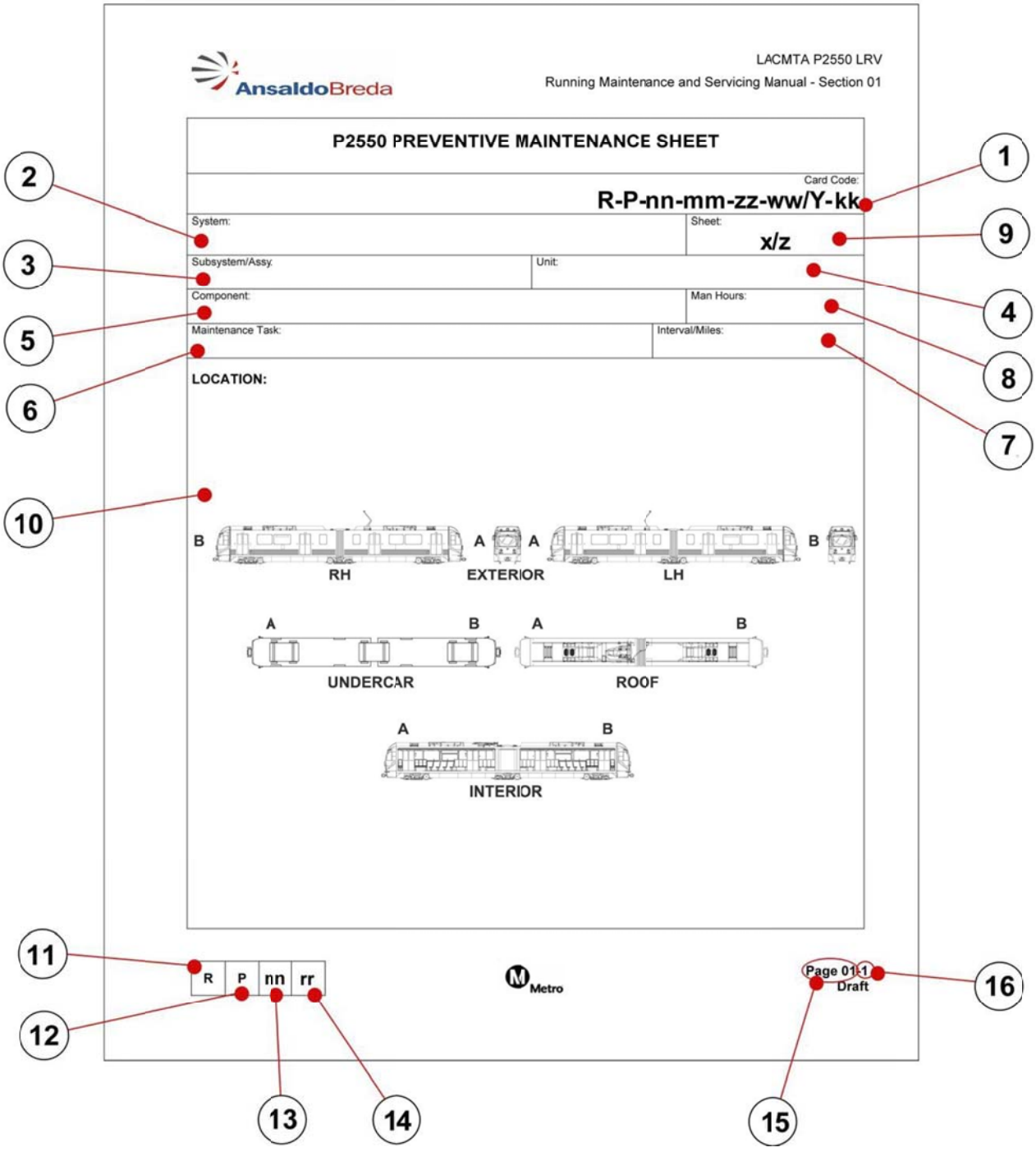


Figure 01-III-03.2 R-PMS Form
(Sheet 1 of 2)

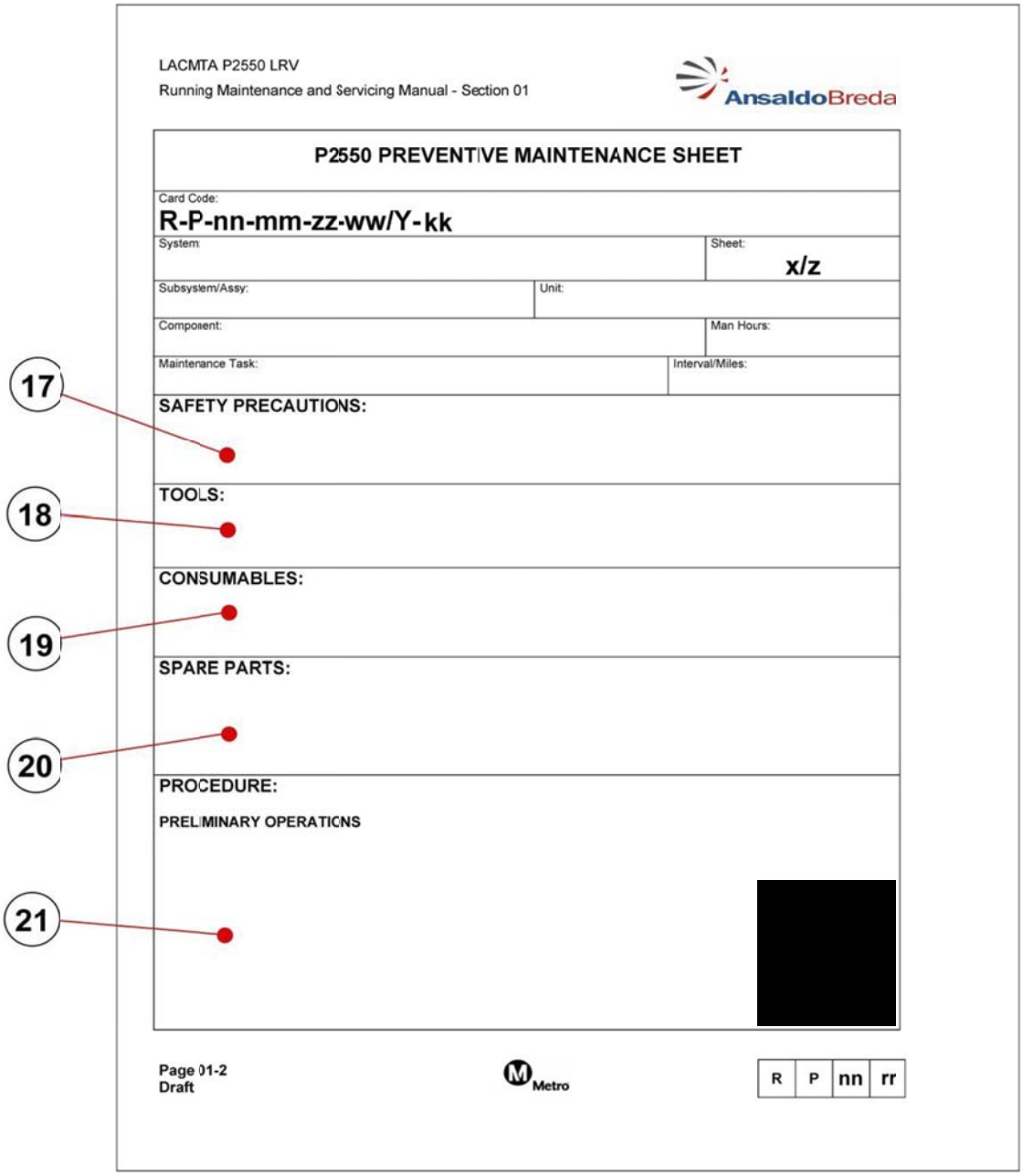


Figure 01-III-03.2 R-PMS Form
(Sheet 2 of 2)

01-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) Upon completing the Maintenance Task on 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 Signal 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)**

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

The Vehicle Systems - "Vehicle as a Whole" 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 01-III-03.3 Running Preventive Maintenance Sheets List

SYSTEM 01 VEHICLE SYSTEMS					
SUBSYSTEM/ ASSY	**ASSY /UNIT/ COMPONENT**	**SCPM**	**TASK**	**MAINTEN. INTERVAL (MILES)**	**SHEET CODE**
VEHICLE AS A WHOLE	VEHICLE AS A WHOLE		INSPECTION	DAILY	R-P-01-01-00-00/I-00
VEHICLE AS A WHOLE	VEHICLE AS A WHOLE		INSPECTION	DAILY	R-P-01-01-00-00/I-01

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

VEHICLE SYSTEMS

Running - Preventive Maintenance Sheets

R-PMS

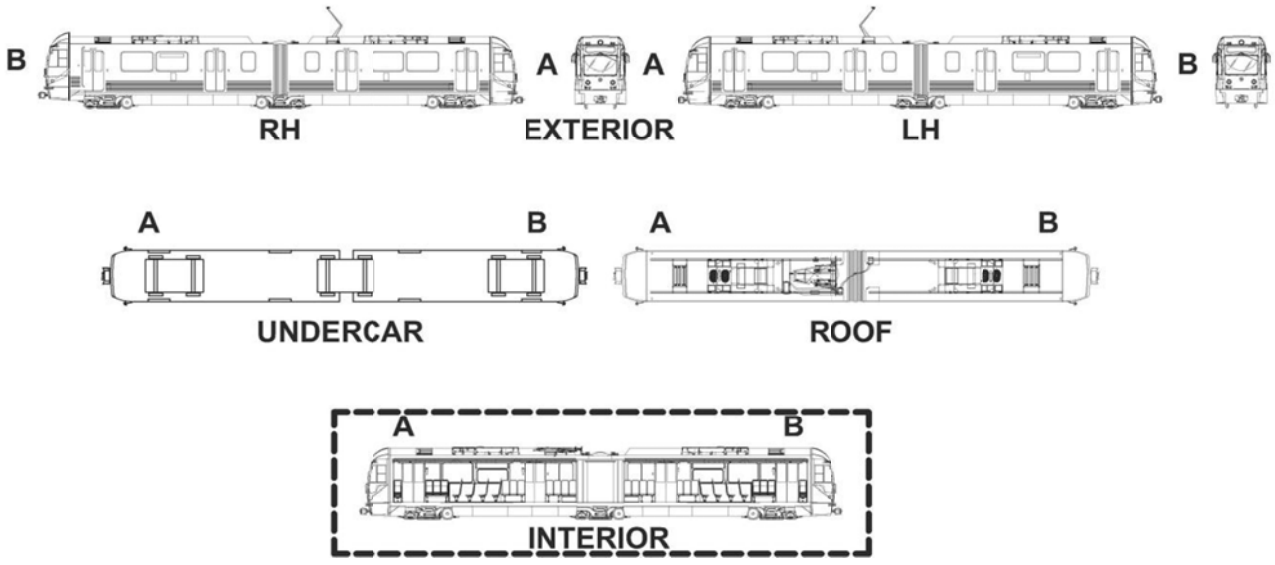
INTENTIONALLY LEFT BLANK

P2550 PREVENTIVE MAINTENANCE SHEET

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

System: **VEHICLE SYSTEMS**	Sheet: **1/12**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **INTERIOR**
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **Daily**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-01-01-00-00/I-00**		
System: **VEHICLE SYSTEMS**		Sheet: **2/12**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **INTERIOR**	
Component:		Man Hours: **0.5**
Maintenance Task: **INSPECTION**		Interval/Miles: **Daily**

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety regulations

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

N/A

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**3/12**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **INTERIOR**
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **Daily**

PROCEDURE:

PRELIMINARY OPERATIONS

1. It is assumed that the Vehicle is in safety condition in accordance with LACMTA Maintenance Shop regulations.
2. Pantograph raised
3. "A" and "B" Parking Brakes applied

INSPECTION

NOTE: The attached Interior Inspection procedure is provided by the Rail Fleet Services' Instruction department to ensure that P2550 vehicle receives maintenance necessary to provide our customers with safe and reliable transportation.
Examples of typical activities include visual inspections, lubrication, calibration, replacement of consumables, and testing.
Any discrepancies are logged and scheduled for repair, overhaul, or replacement.

NOTE: The Interior Inspection is relevant to one vehicle.
Repeat the procedure for all vehicles of train consist.

NOTE: it is advisable to perform the Interior Inspection starting from Non Operative Cab.

To perform Vehicle Interior Inspection, proceed as follows:

1. Perform checks according to the Check List provided in Table 1.
2. If you detect any fault / damage proceed as follows:
   - **a**. Report to Supervisor the type of fault / damage
   - **b**. Replace / Repair faulty component according to Supervisor instructions
3. Record Inspection Results on the Defect Report Card for administrative and maintenance planning

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
4/12

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:
INTERIOR

Component:

Man Hours:
0.5

Maintenance Task:
INSPECTION

Interval/Miles:
Daily

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
VEHICLE	ENTER THE VEHICLE	NON OPERATING CAB DOOR	CLOSED AND LOCKED		
NON OPERATING CAB	ENTER THE CAB	CAB	CLEAN /DIRTY		
		CAB WINDOWS	CLOSED		
		MIRRORS	PUSHED IN		
		SUN VISORS	UP AND SECURED		
		WINDSHIELD AIR DIFFUSER	FREE OF DIRTY		
		SIDE AIR DIFFUSER	FREE OF DIRTY		
		CEILING AIR DIFFUSER	PROPER INSTALLATION		
		VIDEOCAMERA	PROPER INSTALLATION / VISIBLE DAMAGE		
		TRACK BRAKE BUZZER	PROPER INSTALLATION		
		INDICATOR AND SWITCH PANEL	PROPER INSTALLATION / VISIBLE DAMAGE		
		OPERATOR SEAT	PROPER INSTALLATION AND OPERATION		
		REAR VIEW MIRROR	PROPER INSTALLATION AND CLEAN		
		ASSISTANT OPERATOR FLIP UP SEAT	PROPER INSTALLATION AND OPERATION		
		MASTER CONTROLLER PANEL	VISIBLE DAMAGE		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**5/12**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **INTERIOR**
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **Daily**

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
NON OPERATING CAB		CONSOLE PUSHBUTTONS	VISIBLE DAMAGE		
		CONSOLE KNOBS	ALL IN NORMAL POSITION (NEUTRAL / OFF)		
		PTT FOOT PB	PROPER INSTALLATION / VISIBLE DAMAGE		
		SILENT ALARM PB	PROPER INSTALLATION / VISIBLE DAMAGE		
		TWC CONTROL PANEL	PROPER INSTALLATION / VISIBLE DAMAGE		
		GOOSENECK MICROPHONE	PROPER INSTALLATION / VISIBLE DAMAGE		
		LOUD SPEAKER	PROPER INSTALLATION / VISIBLE DAMAGE		
		RADIO AND AAD EQUIPMENT	PROPER INSTALLATION / VISIBLE DAMAGE		
		MONITOR IDU	PROPER INSTALLATION / VISIBLE DAMAGE		
		FIRE EXTINGUISHER	PROPER INSTALLATION		
			EXPIRATION DATE		
			CHARGE STATUS (NEEDLE IN GREEN AREA OF DIAL)		
		BY PASSES SWITCH	ALL IN NORMAL POSITION AND SEALED		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**6/12**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**INTERIOR**

Component:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INSPECTION	**Daily**

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
NON OPERATING CAB		CUT OUT SWITCH	ALL IN NORMAL POSITION AND SEALED		
		DESTINATION SIGN	PROPER INSTALLATION / VISIBLE DAMAGE		
		CBs	ALL IN ON POSITION		
		EMERGENCY MUSHROOM	VISIBLE DAMAGE		
		PANTOGRAPH MANUAL CRANK	PROPER INSTALLATION / DAMAGE (A CAB ONLY)		
	EXIT THE CAB, CLOSE AND LOCK THE DOOR				
PASSENGER COMPARTMENT	ENTER THE COMPARTMENT	EMERGENCY INTERCOM	PROPER INSTALLATION / DAMAGE		
		ANNOUNCEMENT DEST SIGN	PROPER INSTALLATION / DAMAGE		
		VIDEOCAMERA	PROPER INSTALLATION / VISIBLE DAMAGE		
		CEILING AND LINERS	PROPER INSTALLATION		
			DAMAGE		
			GRAFFITI		
		AIR DIFFUSER / LIGHT FIXTURES	PROPER INSTALLATION		
			DAMAGE/		

P2550 PREVENTIVE MA INTENA ICE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**7/12**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**I NTERIO R**

Compo ient:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INS PECTION	**Daily**

PRO CEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST (cont'd)

LO CATION	ACTION	ITEM	CHE K FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
PAS ENGER COM PARTMENT		DOORS	D MAGE		
			G AFFITI		
		DOORS INDICATOR LIGHTS	D MAGE		
		EMERGENCY RELEASE HANDLE	D MAGE		
			IN NORMAL POSITION		
		DOOR POCKETS	P OPER INSTA LATION / D MAGE		
		PASSENGER SEAT	P OPER INSTA LATION / D MAGE		
			CLEAN /DIRTY		
		SAND BOX	SAND LEVEL A ID REFILL IF SAND IS NOT VISIBLE		
		UNDERSEAT BOX	CLOSED AND L OCKED		
		STACHIONS AND HANRAILS	P OPER INSTA LATION / D MAGE		
		FLOOR	R BBER DAMA GE		
			CLEAN / DIRTY		
		FLOOR TRAPS	PROPER INSTA LATION D MAGE/ LOOSE / MISSING HARDWARE		
		ELE AND LV LOCKERS DOORS	D MAGE		
			CLOSED AND L OCKED		
	OPEN ELE LOCKER DOOR	EQUIPMENT INSTALLED IN THE LOCKER	P OPER INSTA LATION		
			SI GNS OF OVERHEATING		
			D MAGE		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
8/12

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:
INTERIOR

Component:

Man Hours:
0.5

Maintenance Task:
INSPECTION

Interval/Miles:
Daily

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST (cont'd)

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
PASSENGER COMPARTMENT	CLOSE AND LOCK ELEC LOCKER DOOR				
	OPEN LV LOCKER DOOR	EQUIPMENT INSTALLED IN THE LOCKER	PROPER INSTALLATION		
			SIGNS OF OVERHEATING		
			DAMAGE		
	CLOSE AND LOCK LV LOCKER DOOR				
		GANGWAY LIGHT FIXTURES	PROPER INSTALLATION		
			DAMAGE		
		ANNOUNCEMENT DEST SIGN	PROPER INSTALLATION /VISIBLE DAMAGE		
		VIDEOCAMERA	PROPER INSTALLATION / VISIBLE DAMAGE		
		ART SECT FLOOR	DAMAGE		
		GANGWAY PANELS	PROPER INSTALLATION /VISIBLE DAMAGE		
LEAD CAB		CAB DOOR	CLOSE AND LOCKED		
	ENTER THE CAB	CAB	CLEAN / DIRTY		
		CAB WINDOWS	CLOSED		
		SUN VISORS	UP AND SECURED		
		WINDSHIELD AIR DIFFUSER	FREE OF DIRTY		
		SIDE AIR DIFFUSER	FREE OF DIRTY		
		CEILING AIR DIFFUSER	PROPER INSTALLATION		
		VIDEOCAMERA	PROPER INSTALLATION / VISIBLE DAMAGE		
		TRACK BRAKE BUZZER	PROPER INSTALLATION		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**9/12**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **INTERIOR**
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **Daily**

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST (cont'd)

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
LEAD CAB		INDICATOR AND SWITCH PANEL	PROPER INSTALLATION / VISIBLE DAMAGE		
		OPERATOR SEAT	PROPER INSTALLATION AND OPERATION		
		REAR VIEW MIRROR	PROPER INSTALLATION AND CLEAN		
		ASSISTANT OPERATOR FLIP UP SEAT	PROPER INSTALLATION AND OPERATION		
		MASTER CONTROLLER PANEL	VISIBLE DAMAGE		
		CONSOLE PUSHBUTTONS	VISIBLE DAMAGE		
		CONSOLE KNOBS	ALL IN NORMAL POSITION (NEUTRAL / OFF)		
		PTT FOOT PB	PROPER INSTALLATION / VISIBLE DAMAGE		
		SILENT ALARM PB	PROPER INSTALLATION / VISIBLE DAMAGE		
		TWC CONTROL PANEL	PROPER INSTALLATION / VISIBLE DAMAGE		
		GOOSENECK MICROPHONE	PROPER INSTALLATION / VISIBLE DAMAGE		
		LOUD SPEAKER	PROPER INSTALLATION / VISIBLE DAMAGE		
		RADIO AND AAD EQUIPMENT	PROPER INSTALLATION / VISIBLE DAMAGE		
		MONITOR IDU	PROPER INSTALLATION / VISIBLE DAMAGE		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**10/12**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**INTERIOR**

Component:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INSPECTION	**Daily**

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST (cont'd)

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
LEAD CAB		FIRE EXTINGUISHER	PROPER INSTALLATION		
			EXPIRATION DATE		
			CHARGE STATUS (NEEDLE IN GREEN AREA OF DIAL)		
		BY PASSES SWITCH	ALL IN NORMAL POSITION AND SEALED		
		CUT OUT SWITCH	ALL IN NORMAL POSITION AND SEALED		
		DESTINATION SIGN	PROPER INSTALLATION / VISIBLE DAMAGE		
		CBs	ALL IN ON POSITION		
		EMERGENCY MUSHROOM	VISIBLE DAMAGE		
		PANTOGRAPH MANUAL CRANK	PROPER INSTALLATION / DAMAGE (A CAB ONLY)		
		PANTOGRAPH	RAISED		
	KEY VEHICLE UP (TS TO ON)	CONTROLS AND INDICATORS	ON		
		MONITOR IDU	ON		
		HVAC	ON		
		INTERIOR LIGHTS	ON		
		HEADLIGHT	ON		
		MARKER LIGHTS	ON		
		MONITOR IDU	LINE VOLTAGE about 750V		
			BATTERY VOLTAGE about 37.5 V		

P2550 PREVENTIVE MAINTENA ICE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**11/12**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **INTERIOR**
Compo ient:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **Daily**

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST (cont'd)

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
LEAD CAB		MONITOR IDU	PARKING BRAKE A NOT RELEASED		
			PARKING BRAKE B NOT RELEASED		
			ALL DOORS CLOSED		
			NO FAULT IS ON		
			"MAIN RESERVOIR AIR LOW" INDICATION (RED) NOT ACTIVE		
		AIR PRESSURE GAUGE	PRESSURE START BUILDING UP		
		FRONTLIGHTS	PROPER OPERATION		
		TURNSIGNAL LIGHTS	PROPER OPERATION		
		HAZARD	PROPER OPERATION		
		WIPERWASHER AND FLUID	PROPER OPERATION		
		DEFROSTER / HEATER / FAN	PROPER OPERATION		
		HORN /GONG	PROPER OPERATION		
		AADS	PROPER OPERATION (SET ROUTE INFORMATION)		
		TWC	PROPER OPERATION (SET ROUTE IDENTIFICATION)		
		RADIO	PROPER OPERATION (TURN ON)		
		PASSENGER COMPT LIGHTS	ON (IF OFF CHECK CB 8F02 -CAB LV PANEL AND CB 8F03 LV LOCKER CB PANEL 8F04 LV LOCKER CB PANEL)		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
12/12

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:
INTERIOR

Component:

Man Hours:
0.5

Maintenance Task:
INSPECTION

Interval/Miles:
Daily

PROCEDURE (CONT'D):

TABLE 1 INTERIOR INSPECTION CHECKS LIST (cont'd)

LOCATION	ACTION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
LEAD CAB		CAB LAMPS	PROPER OPERATION (TEST USING LAMP TEST)		
		MIRRORS	PUSHED OUT (ADJUST)		
		PA SYSTEM	PROPER OPERATION (TEST)		
		DOORS	LH/RH SIDE PROPER OPERATION (USING DOOR OPEN PB)		
			LH/RH SIDE PROPER OPERATION (USING RELEASE AND DOORWAY PB)		
		DOORS INDICATOR LIGHTS	PROPER OPERATION (TEST)		
		MASTER CONTROLLER	PROPER OPERATION LOCKING FUNCTIONS		
		REVERSER SWITCH	PROPER OPERATION LOCKING FUNCTIONS		
		DEAD MAN	PROPER OPERATION (TEST)		
		EMERGENCY MUSHROOM	PROPER OPERATION (TEST)		
		HVAC	CAB / PASSENGER COMPT COMFORTABLE TEMPERATURE		

P2550 PREVENTIVE MAINTENANCE SHEET

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

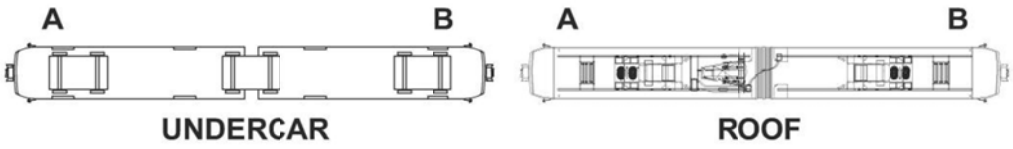
System:	Sheet:
VEHICLE SYSTEMS	**1/10**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**EXTERIOR**

Component:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INSPECTION	**Daily**

LOCATION:



P2550 PREVENTIVE MAINTENANCE SHEET

Card Code: **R-P-01-01-00-00/I-01**		
System: **VEHICLE SYSTEMS**		Sheet: **2/10**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **EXTERIOR**	
Component:		Man Hours: **0.5**
Maintenance Task: **INSPECTION**		Interval/Miles: **Daily**

SAFETY PRECAUTIONS:

LACMTA Maintenance Shop Safety regulations

TOOLS:

LACMTA Maintenance Shop Standard Tools Kit

CONSUMABLES:

N/A

SPARE PARTS:

N/A

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**3/10**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **EXTERIOR**
Component:	Man Hours: **0.5**
Maintenance Task: **INSPECTION**	Interval/Miles: **Daily**

PROCEDURE:

PRELIMINARY OPERATIONS

1. Set the Vehicle in safety condition in accordance with LACMT Maintenance Shop regulations.
2. Set the Transfer Switch (located on the Operator's Console) to "ON" or "LOCAL" Position.

INSPECTION

NOTE: It is assumed that Interior Inspection including Vehicle Set Up For Revenue Service have been previously performed.

NOTE: It is advisable to proceed around the Vehicle in counterclockwise direction starting from A End while performing Exterior Inspection.

NOTE: The attached Exterior Inspection procedure is provided by the Rail Fleet Services' Instruction department to ensure that P2550 vehicle receives maintenance necessary to provide our customers with safe and reliable transportation
Examples of typical activities include visual inspections, lubrication, calibration, replacement of consumables, and testing.
Any discrepancies are logged and scheduled for repair, overhaul, or replacement.

NOTE: The Exterior Inspection is relevant to one vehicle.

Repeat the procedure for all vehicles of train consist.

To perform Vehicle Exterior Inspection, proceed as follows:

1. Perform checks according to the Check List provided in Table 1.
2. If you detect any fault / damage proceed as follows
   - **a**. Report to Supervisor the type of fault / damage.
   - **b**. Replace / Repair faulty component according to Supervisor instructions.
3. Record Inspection Results on the Defect Report Card for administrative and maintenance planning

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**4/10**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**EXTERIOR**

Component:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INSPECTION	**Daily**

PROCEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS LIST

LOCATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
VEHICLE	EXTERIOR	CLEANING CONDITIONS		
FRONT END	STRUCTURE	DAMAGE		
		PAINT DEGRADATION		
		SCRATCHES		
	SILENT ALARM LIGHT	PROPER INSTALLATION		
		PROPER OPERATION		
	HEAD LIGHT	PROPER INSTALLATION		
		PROPER OPERATION		
		DAMAGE		
	MARKER LIGHTS	PROPER INSTALLATION		
		PROPER OPERATION		
		DAMAGE		
	DESTINATION SIGN	DESTINATION AND RUN NUMBER DISPLAY.		
	WINDSHIELD WIPER	PROPER INSTALLATION		
		WIPER ARM DAMAGE / WEAR		
	WINDSHIELD	DAMAGE		
		SCRATCHES		
		LOOSE OR MISSING PARTS		
	FRONT LIGHTS	PROPER INSTALLATION		
		PROPER OPERATION		
		DAMAGE		
	TURN SIGNAL LIGHTS	PROPER INSTALLATION		
		PROPER OPERATION		
		DAMAGE		

P2550 PREVENTIVE MA INTENA ICE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**5/10**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **EXTERIOR**
Compo ıent:	Man Hours: **0.5**
Maintenance Task: **INS PECTION**	Interval/Miles: **Daily**

PRO CEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS .IST (CONT'D)

LO CATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
FRO NT END	COUPLER	DAMAGE		
		LUBRICATION AS NEE ED		
		LOOSE OR MISSING P ARTS		
		SIGNS OF DEFORMATION		
		PAINT DEGRADATION /RUST		
		CLAMP BOLTS SECURITY		
		UNCOUPLING HANDLE PROPER OP ERATION (PULL IT)		
		UNCOUPLING HANDLE SIGNS OF S .ACK OR JAMMING		
		OIL LEAKAGE		
		BUFFER ASSY SIGNS OF SLACK OR MOVEMENT		
		SPRINGS DAMAGE, DEFORMATION		
		CENTERING SPRINGS (PUSH THE COUPLER UT OF CENTER AND VERIFY THAT THE COUPLER RETURNS TO ITS PREVIOUS POSITION.)		
		OVERALL CONDITION F ELECTRICAL COUPLER INCLUDING SEALS, CONNECTORS, COVER SPRINGS, MOVEMENT OF COVERS		
		ELECTRICAL CONTAC S.MISSING, IRTY OR DAMAGED		
		PNEUMATIC COUPLER AIR LEAKAG E		
		HOSE CONNECTIONS		
FRO NT END	DRUM SWITCH	PROPER INSTALLATIO N		
		DAMAGE		
		LOOSE OR MISSING P ARTS		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**6/10**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**EXTERIOR**

Component:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INSPECTION	**Daily**

PROCEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS LIST (CONT'D)

LOCATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
FRONT END	ATP/TWC ANTENNAS	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING PARTS		
	HORN/GONG	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING PARTS		
	FRONT SKIRTS	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING PARTS		
SIDE	ROOF FAIRINGS	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING PARTS		
	MIRRORS	PROPER INSTALLATION		
		DAMAGE		
	SIDEWALLS	DAMAGE		
		PAINT DEGRADATION		
		SCRATCHES		
		GRAFFITI		
	BY PASS LIGHT	PROPER INSTALLATION		
		DAMAGE		
	LOUD SPEAKER	PROPER INSTALLATION		
		DAMAGE		
	DOORS PB / LIGHTS	PROPER INSTALLATION		
		PROPER OPERATION		
		DAMAGE		

P2550 PREVENTIVE MA INTENA ICE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**7/10**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **EXTERIOR**
Compo ient:	Man Hours: **0.5**
Maintenance Task: **INS ECTION**	Interval/Miles: **Daily**

PRO CEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS IST (CONT'D)

LO CATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
SIDE	CREW SWITCH	PROPER INSTALLATION		
		PROPER OPERATION		
		DAMAGE		
	GRAB HANDLE	PROPER INSTALLATION		
		DAMAGE		
	EMERGENCY HANDLE	PROPER INSTALLATION		
		DAMAGE		
		PROPER POSITION		
	DOORS (FRONT AND CENTER)	LEAFS DAMAGE		
		LEAF WINDOWS DAMAGE /STRESS CRACKS /SCRATCHES		
		SEAL ANCHORAGE PROPERLY EN AGED		
		NO CLEARANCE BET EEN THE DO OR LEAVES WHEN THE DOOR IS CLOSED.		
		SEAL DRY ROT		
		LOOSE OR MISSING HARDWARE		
	INDOWS	DAMAGE		
		STRESS CRACKS /SC ATCHES		
		SEAL DRY ROT		
		LOOSE OR MISSING HARDWARE		
	DESTINATION SIGN	DESTINATION AND RU N NUMBER DISPLAY.		
	SKIRTS	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING HARDWARE		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**8/10**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	**EXTERIOR**

Component:	Man Hours:
	0.5

Maintenance Task:	Interval/Miles:
INSPECTION	**Daily**

PROCEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS LIST (CONT'D)

LOCATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
SIDE	SKIRTS	DIRTY /DAMAGE / SIGNS OF OVERHEATING OF THE EQUIPMENT INSTALLED BEHIND SKIRTS		
		LATCHED AND SECURE.		
	CREW LADDER	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING HARDWARE		
	WIPER WASHER FLUID TANK	FILL UP DOOR PROPER INSTALLATION AND OPERATION		
		FILL UP TANK CAP PROPER INSTALLATION		
		FILL UP TANK CAP SEALING		
		WASHER FUID LEVEL (FILL UP AS NEEDED)		
	BATTERY BOX BATTERY RACK	PROPER INSTALLATION		
		DAMAGE		
		LOOSE OR MISSING HARDWARE		
	BATTERY	COMPONENT PROPER INSTALLATION		
		COMPONENT DAMAGE/LOOSE/MISSING HARDWARE		
		SIGNS OF OVERHEATING		
		CONNECTIONS CLEANING AND TIGHTENING		
		CABLES CHAFING		
		TEMPERATURE SENSORS DAMAGE		
	OUTER BELLOW	PROPER INSTALLATION		
		TEARS AND DAMAGE		
		LOOSE OR MISSING HARDWARE		
		TIE ROD STRETCHING AND SECURITY		
		MOUNTING HARDWARE SECURELY FASTNED		
		GROUND RETURN WIRE PROPER INSTALLATION		

P2550 PREVENTIVE MAINTENA ICE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**9/10**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit: **EXTERIOR**
Compo ient:	Man Hours: **0.5**
Maintenance Task: **INS PECTION**	Interval/Miles: **Daily**

PRO CEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS IST (CONT'D)

LO CATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
SIDE	MOTOR TRUCK	TRUCK OVERALL CONDITIONS		
		FRAME SIGNS OF RUST		
		FRAME PAINT DEGRA ATION		
		LOOSE OR MISSING HARDWARE		
		AIR LEACKAGE		
		OIL LEACKAGE		
		LEVELING VALVE PROPER INSTALLATION LOOSE / MISSING HARDWARE		
		FRICTION BRAKE CUT OUT COCK PROPER OPERATION		
		TRACK BRAKE PROPER INSTALLATION		
		TRACK BRAKE SIGNS OF OVERHEA TING/WEAR		
		WHEEL RETURN CURRENT SHUNTS PROPER INSTALLATION / SIGNS OF OVERHEATING		
		WHEEL TIRES SIGNS OF DEFORMA TION /FLATING		
		AXLE COVERS PROPER INSTALLATION		
		AXLE COVERS LOOSE OR MISSING HARDWARE		
		AIR SPRING DAMAGE		
		GROUND RETURN WIRES		
		SHOCK ABSORBERS DAMAGE		
		HOSES CONNECTIONS PROPER IN TALLATION		
		PILOT BAR PROPER IN STALLATION LOOSE / MISSING HARDWARE		
		FLANGE LUBRICATOR PROPER INS TALLATION /LOOSE / MISSING HARDWARE		

P2550 PREVENTIVE MAINTENANCE SHEET

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

System: **VEHICLE SYSTEMS** | Sheet: **10/10**

Subsystem/Assy: **VEHICLE AS A WHOLE** | Unit: **EXTERIOR**

Component: | Man Hours: **0.5**

Maintenance Task: **INSPECTION** | Interval/Miles: **Daily**

PROCEDURE (CONT'D):

TABLE 1 EXTERIOR INSPECTION CHECKS LIST (CONT'D)

LOCATION	ITEM	CHECK FOR	CHECK BOX A SECT.	CHECK BOX B SECT.
SIDE	MOTOR TRUCK	SANDING NOZZLES PROPER INSTALLATION / LOOSE / MISSING HARDWARE		
		LABELS PROPER INSTALLATION		
		LABELS LOOSE OR MISSING HARDWARE		
	TRAILER TRUCK	TRUCK OVERALL CONDITIONS		
		FRAME SIGNS OF RUST		
		FRAME PAINT DEGRADATION		
		LOOSE OR MISSING HARDWARE		
		AIR LEACKAGE		
		LEVELING VALVE PROPER INSTALLATION LOOSE / MISSING HARDWARE		
		FRICTION BRAKE CUT OUT COCK PROPER OPERATION		
		TRACK BRAKE PROPER INSTALLATION		
		TRACK BRAKE SIGNS OF OVERHEATING/WEAR		
		WHEEL RETURN CURRENT SHUNTS PROPER INSTALLATION/SIGNS OF OVERHEATING		
		WHEEL TIRES SIGNS OF DEFORMATION /FLATTING		
		AXLE COVERS PROPER INSTALLATION		
		AXLE COVERS LOOSE OR MISSING HARDWARE		
		AIR SPRING DAMAGE		
		GROUND RETURN WIRES		
		SHOCK ABSORBERS DAMAGE		
		HOSES CONNECTIONS PROPER INSTALLATION		
		LABELS PROPER INSTALLATION		
		LABELS LOOSE OR MISSING HARDWARE		

01-III-04 RUNNING -CORRECTIVE MAINTENANCE

01-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.

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

The R-CMS Form (refer to Figure 01-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-CMS 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 = 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 **L** =**L**eveling **R** = **R**eplacement **R** = **R**e-**P**rofiling **RR** = **R**epair **S** = **S**ervice **SP** = **S**afety / **P**recaution **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 SHEE ˙ (R-CMS) Form (cont'd)			
ITE I #	TITLE	CONTENT	EXPLANATORY N ›TES
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 mai ıtained The follo ving Graphic Symbols are used for: Assembly/Unit/Co nponent for System/Subsystem/Vehicle as a Whole
10	R	Letter	This field indicates tha: the Sheet pertains to Running Maintena ıce
11	C	Letter	This field indicates tha: the Sheet pertains to Corrective Maintena ıce
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 # ǂ	Page ##	This field indicates the RMSM Section Page number
15	-#	Number	This field indicates the RMSM Section Revision number
16	SAFETY PREC UTIONS	Text	This field presents the General and/or specific Safety Precautio ıs to be follo ved to accomplish safely the relevant Maintena ıce 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 t ıe TTE Manual for the TE and Special Tools detailed descriptions and tools maintenance.
18	CONS IMABLES	Text	This field lists the Con ;umables 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 Des ;ription and PN of Spare Parts (consiste ıt with Illustrated Parts Catalog) needed to accomplish the Maintenance Task.
20	PROC DURE	Text	The Proc ;dure field pr ɔvides Preliminary Operations and Procedur ıl step by step Instructions to be followed while performin g the Mainte ıance Task. Illustratio ıs and Pictur ;s are inserted in the text to facilitate the under ;tanding of t ıe topics and/or to explain step-by-step proc ;dure.

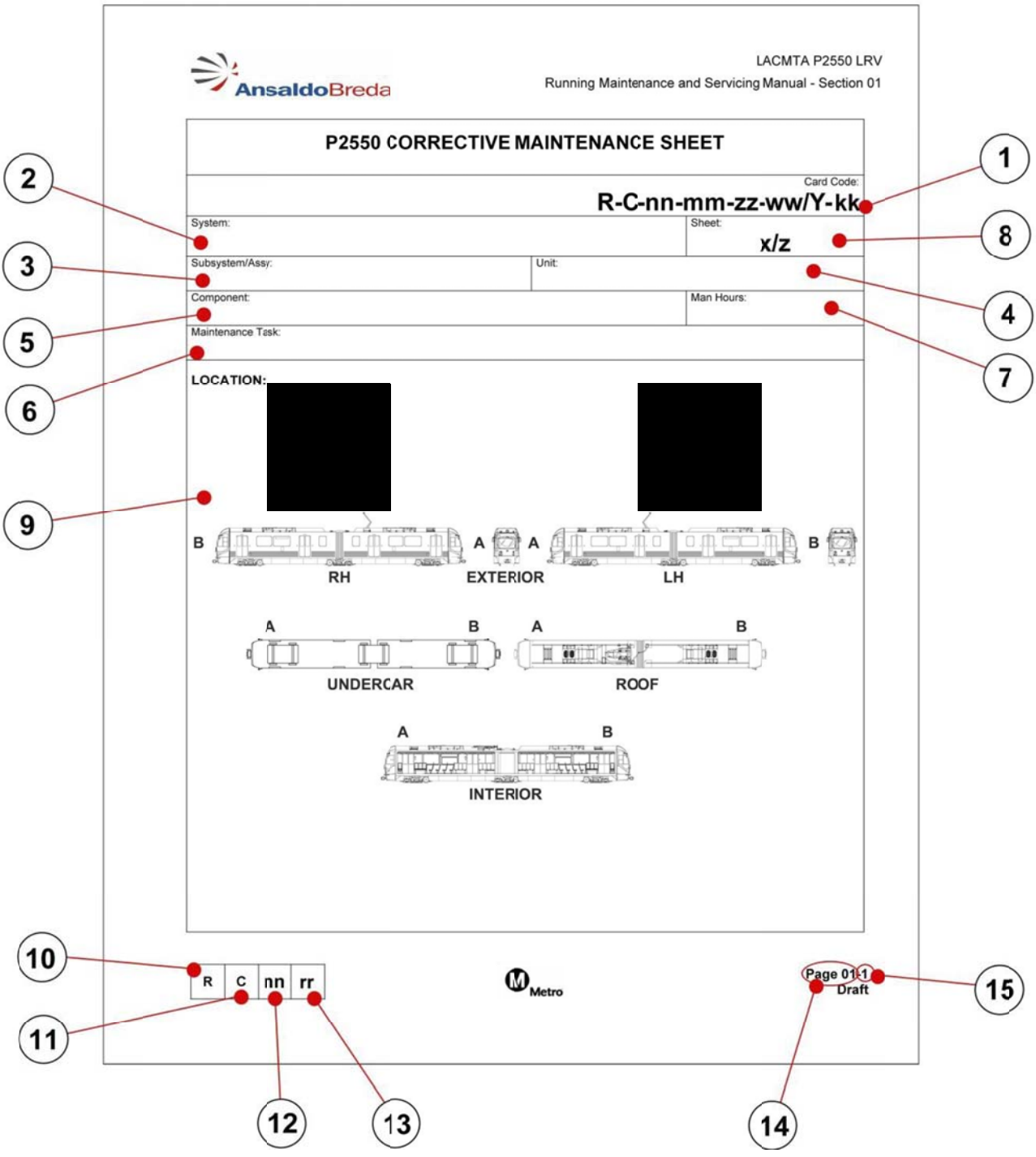


Figure 01-III-04.1 R-CMS Form
(Sheet 1 of 2)

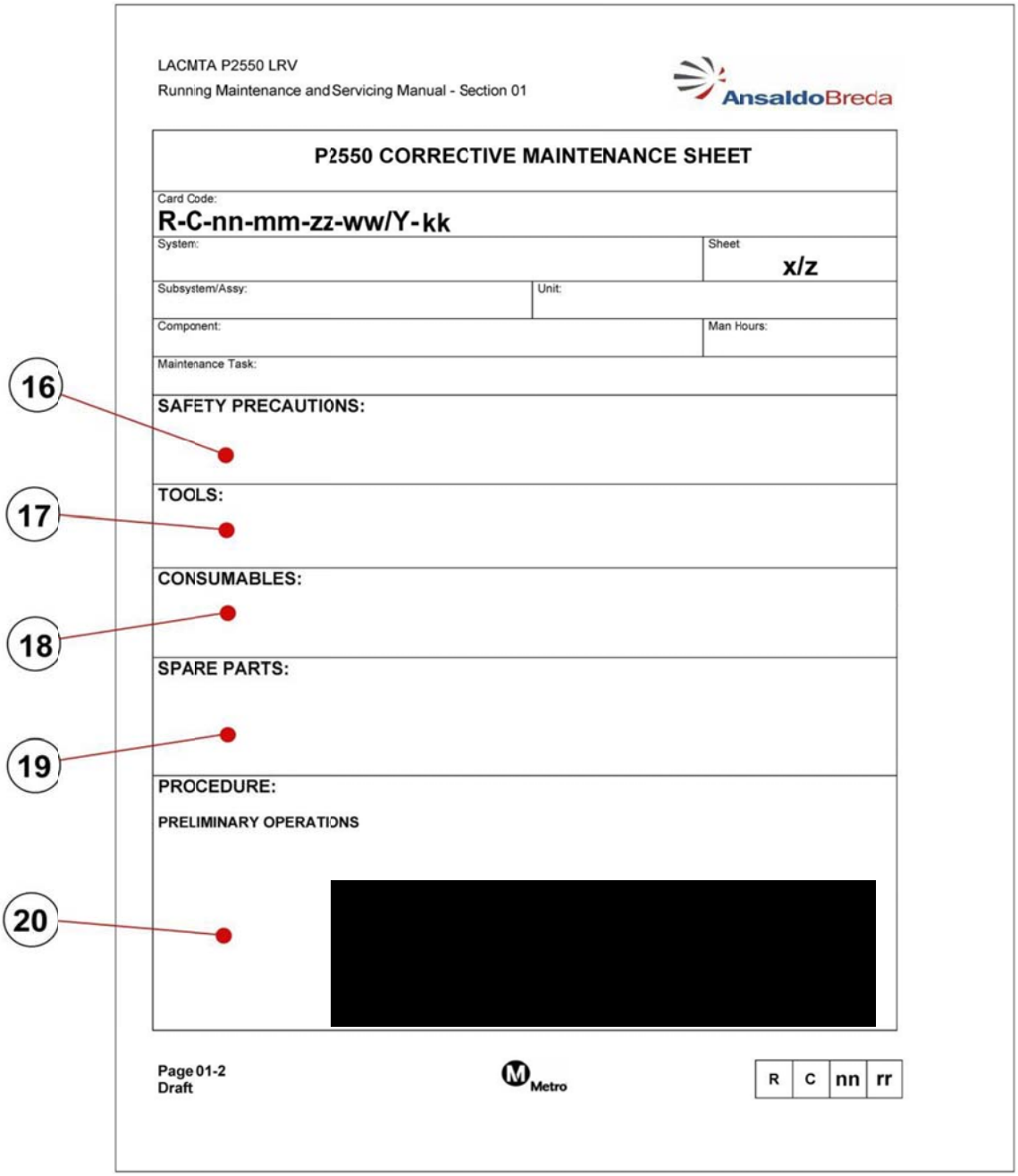


Figure 01-III-04.1 R-CMS Form
(Sheet 2 of 2)

01-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)**

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

The Vehicle Systems - "Vehicle as a Whole" Running- Corrective Maintenance Sheets (R-CMS) List is provided in the following Table 01-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 01-III-04.1 Running Corrective Maintenance Sheets List

SYSTEM 01 VEHICLE SYSTEMS				
SUBSYSTEM / ASSY	**UNIT**	**COMPONENT**	**TASK**	**SHEET CODE**
VEHICLE AS A WHOLE			LEVELING VALVE ADJUSTMENT & TRUCKS SHIMMING	R-C-01-01-00-00/LL-00
			LEVELING	

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

VEHICLE SYSTEMS

Running - Corrective Maintenance Sheets

R-CMS

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P2550 CORRECTIVE MAINTENANCE SHEET

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

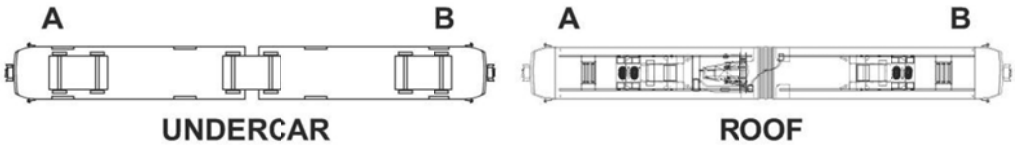
System:	Sheet:
VEHICLE SYSTEMS	**1/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

LOCATION:



P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**2/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

SAFETY PRECAUTIONS:

WARNING: **SAFETY CLOTHES HAVE TO BE USED IN ACCORDANCE WITH SAFETY RULES.**

WARNING: **MAKE SURE THAT 2 WHEEL CHOCKS (1 PER AXLE) ARE APPLIED IN BOTH RUNNING DIRECTIONS TO EACH TRUCK.**

WARNING: **WORKING AREAS HAVE TO BE WELL VENTILATED, LIGHTED AND CLEAR.**

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

WARNING: **(CAR HOIST SYSTEM) BODY STANDS MUST BE CORRECTLY POSITIONED AND INSTALLED AT THE PROPER LOCATIONS BEFORE SUPPORTING THE VEHICLE ON THE CAR BODY JACKING PADS.**

WARNING: **HIGH VOLTAGE ON BOARD VEHICLE.**

CAUTION SINCE THE AIR SPRINGS ARE NOT PRESSURIZED, PAY ATTENTION TO NOT RAISE THE VEHICLE MORE THAN 1.8 " TO AVOID THE DISENGAGEMENT OF THE AIR SPRING PINS FROM THE BOLSTER BEAM OF THE TRUCK.

CAUTION: VERIFY THAT THERE IS NO EQUIPMENT OR ANY MATERIAL ON BOARD THAT COULD

TOOLS:

Flexible Steel Meter
Straight Edges minimum length: 118 inches, QTY=5
Double Calipers (for Interior and Exterior dimensions measurements)
Air Gauges (with adapter for Test Fitting L8), scale 0÷200 PSI, interval 1 PSI, QTY=5

CONSUMABLES:

N/A

SPARE PARTS:

Air Spring Adjusting Shim	P/N AA0464U
Vertical Bump Stop Shim	P/N AA0464Z (0.24 in thickness)
Vertical Bump Stop Shim	P/N AA04VJY (0.08 in thickness)

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**3/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE:

This Task consists of the following procedures:

1-LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING.
2-VEHICLE LEVELING.

1- LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING.

The Task must be performed when one of the following conditions occurs:

- Truck Wheels Diameter Average Value **≤ 26.75 inch**, resulting from Preventive Maintenance Inspection.
- Level difference from Vehicle Floor (at Doors Opening) and the Station Platform Floor **≥ 5/8 inch**. in accordance with ADA Regulations and with the basic assumption that all the components of the Vehicle Leveling System are properly working.

The Task must be performed at the same time for all Trucks.
Each Truck must be adjusted according to the relevant Wheels Diameter Average Value / Level difference from Vehicle Floor (at Doors Opening) and the Station Platform Floor.

PRELIMINARY OPERATIONS

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

1. Place the Vehicle over the Car Hoist and Support System.
2. Check that the Trucks are correctly positioned on the Stand up Rail.
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. Turn the Transfer Switch to LOCAL.
6. Apply wheel chocks to prevent Vehicle from moving (both running directions).

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**4/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

LEVELING VALVES ADJUSTMENT &TRUCKS SHIMMING

SPECIFIC OPERATIONS FOR MOTOR TRUCKS

EXPLANATORY NOTES

1 The aim of this Task is to adjust both the Leveling valves and/or to shim both the Air Springs of each Motor Truck in order to restore the Design Value of Vehicle Floor from Top of Rail as indicated in the following Table and shown in Figure 1.

"A" MOTOR TRUCK				**"B" MOTOR TRUCK**			
DOOR A1/A2		DOOR A7/ A8		DOOR B1/B2		DOOR B7/B8	
Dimension "**L**"		Dimension "**L**"		Dimension "**L**"		Dimension "**L**"	
38.98 inch	+0.51 -0.25	38.98 inch	+0.51 -0.25	38.98 inch	+0.51 -0.25	38.98 inch	+0.51 -0.25

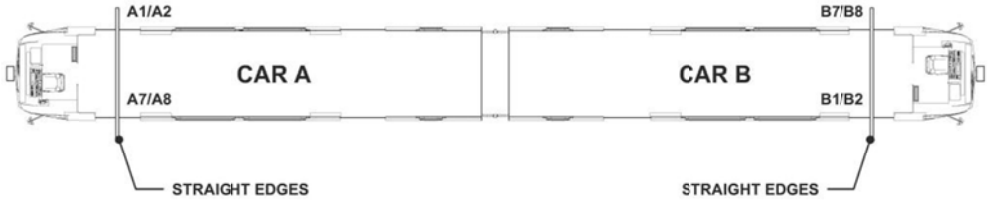
P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**5/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**
Maintenance Task: **LEVELING**	

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)



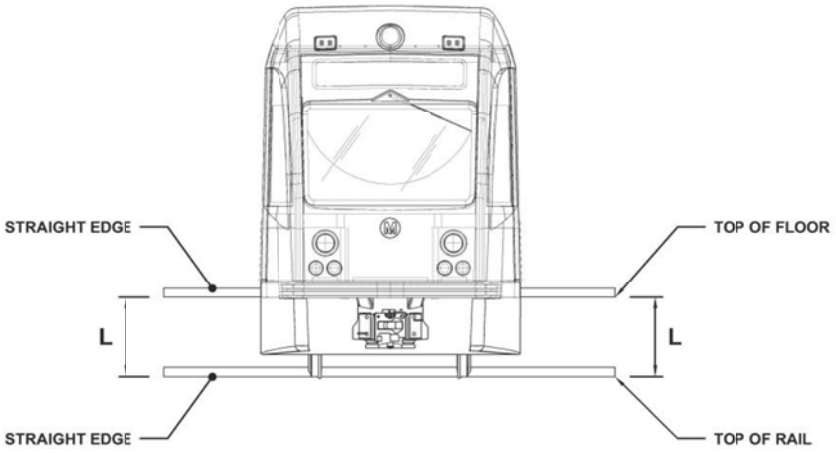


Figure 1 - DESIGN VALUE OF DIMENSION " L "

2 The Components of each Motor Truck involved in the Task are:

a) The two (2) Leveling Valves with relevant Adjusting Plates each one connected to the relevant Operating Lever through the relevant Adjusting Rod.

b) The two (2) Air Springs with relevant Adjusting Shim(s).

c) The two (2) Vertical Bump Stops with relevant Shim(s).

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**6/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

3 The Design Value of Dimension "L" must be reached complying the following Nominal Design Data Limits:

- Air Supply Pressure Nominal Value: **140 ± 10 PSI** - (at "A" / "B" Cab -Double Air Pressure Gauge - White Pointer).
- Air Spring Nominal Height (Dimension "**e**"): **6.93 + 0.12 inch** Max.
- Air Spring Adjusting Shims Thickness: **0.79 inch** Max.
- Clearance between Vertical Bump Stop and Frame Stopper (Dimension "**f**"):**1.38 ± 0.4** Min.

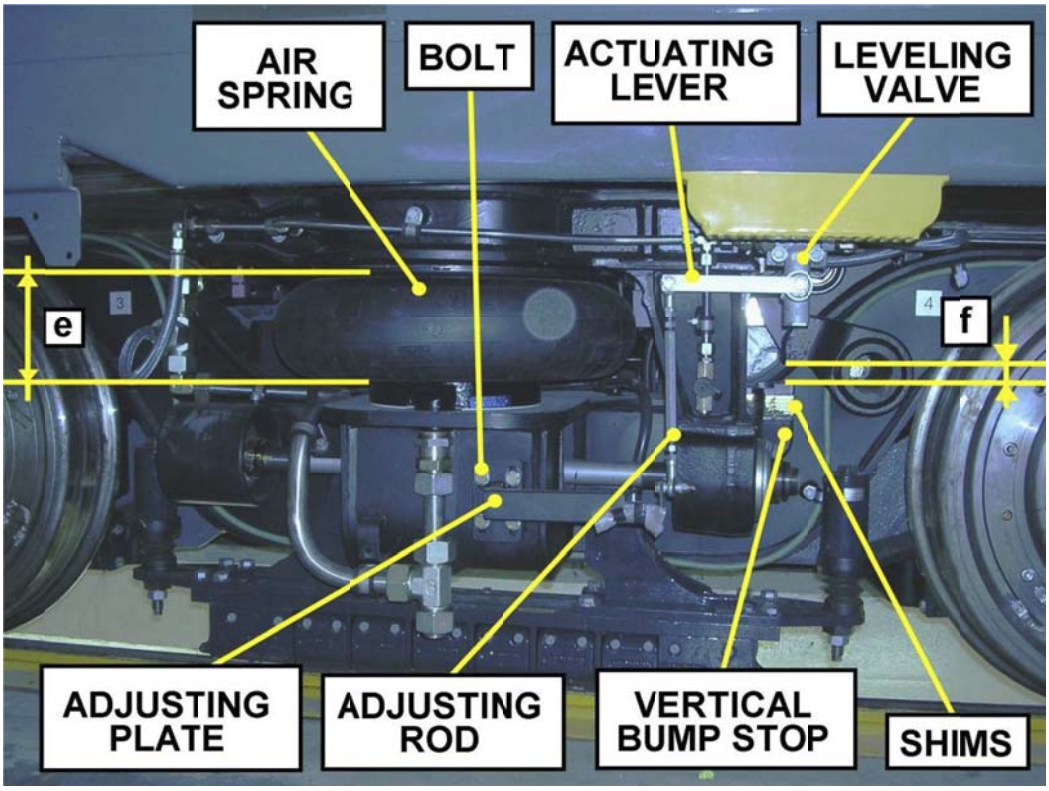


Figure 2 - MOTOR TRUCK SECONDARY SUSPENSION COMPONENTS & DESIGN DATA LIMITS

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**7/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

Figure 3 - AIR SUPPLY PRESSURE NOMINAL -DESIGN DATA

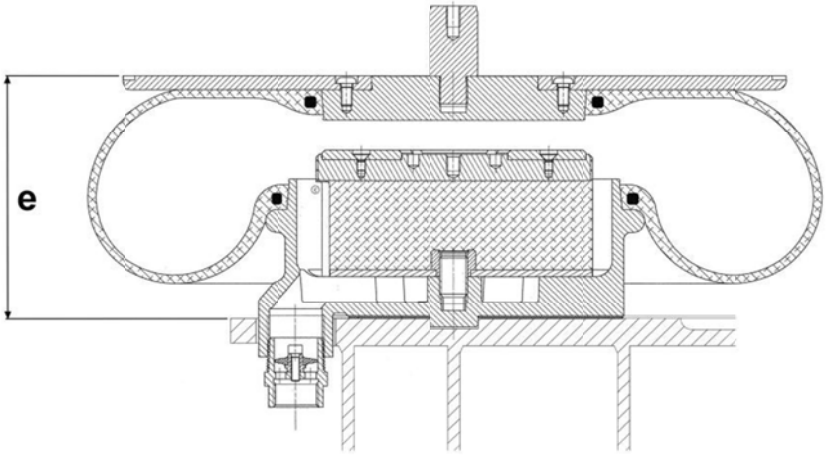


Figure 4 - AIR SPRING -DESIGN DATA LIMIT

P2550 CORRECTIVE MAINTENANCE S HEET

Card Code:
R-C-01-01-00-0)/LL-00

System:	Sheet:
VEHICL : SYSTEMS	**8/56**

Subsystem/Assy:	Unit:
VEHICLE S A WH LE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIM MING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDUR : LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (co nt'd)

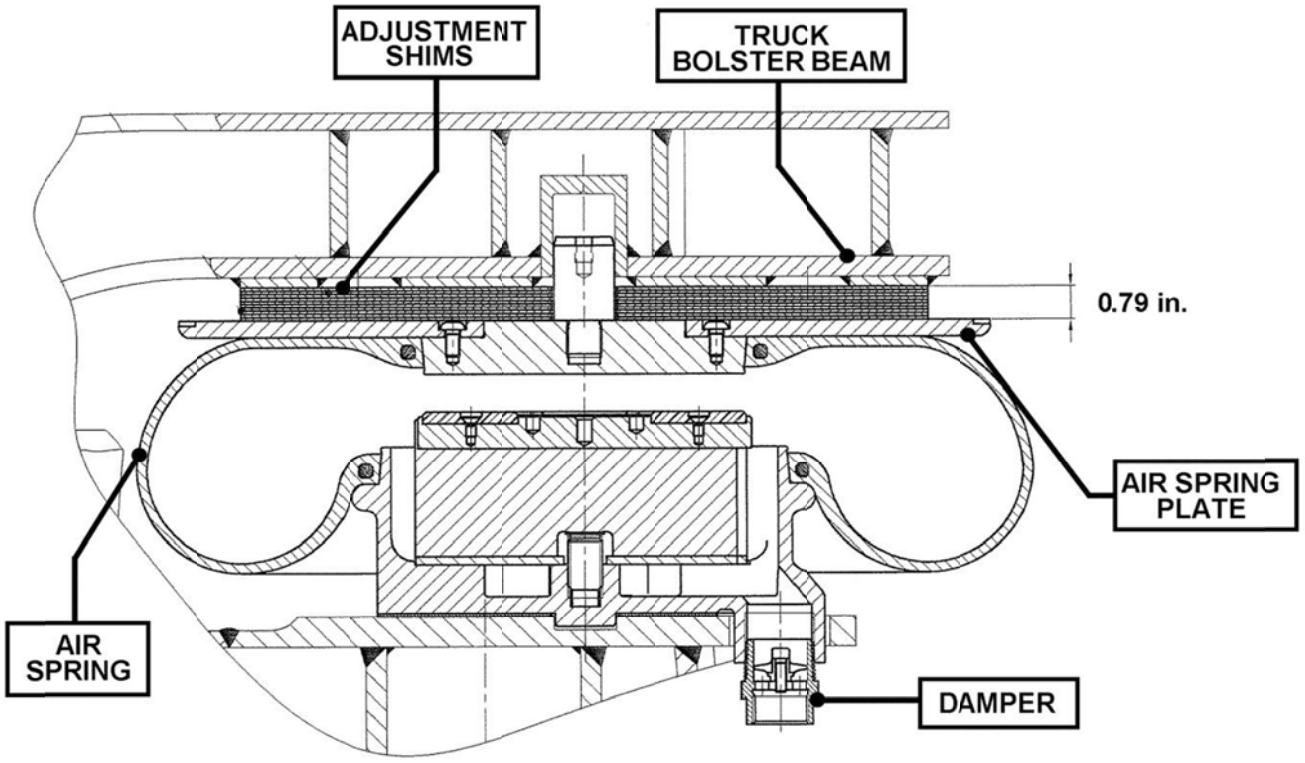


Figure 5 - AIR SPRING -ADJUSTING SHIMS -THICK NESS -DESI GN DATA LIMIT

P2550 CORRECTIVE MAINTENA ICE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**9/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMI IG	**1**	**VE HICLE LEVE LING**	**2**

Maintenance Task:
LEVELING

PRO CEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

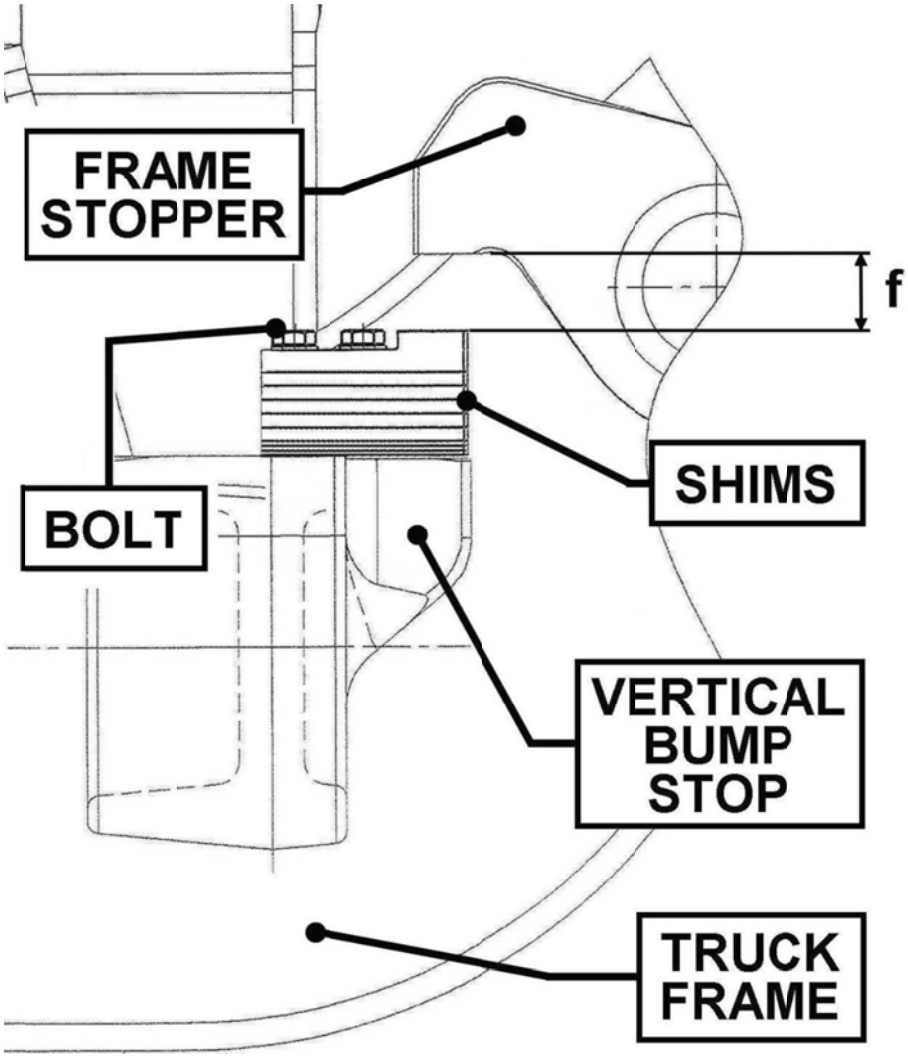


Figure 6 - VERTICAL BUMP ST OP -DESIGN DATA LIMIT

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**10/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

4 The Leveling Valve Adjusting Plate, connected to the Adjusting Rod, is installed through 4 Bolts on its Base Plate which is provided with 4 slots in order to allow the Adjusting Plate up & down sliding. The matching areas between the Adjusting Plate and Base Plate is toothed to firmly fix the Adjusting Plate once slid and to easily allow the adjustment by pre-determined positions. The Adjusting Plate max sliding from the lower to the upper position is 0.96 inch, corresponding to 4 positions (teeth) since the tooth pitch is **0.24 inch.**

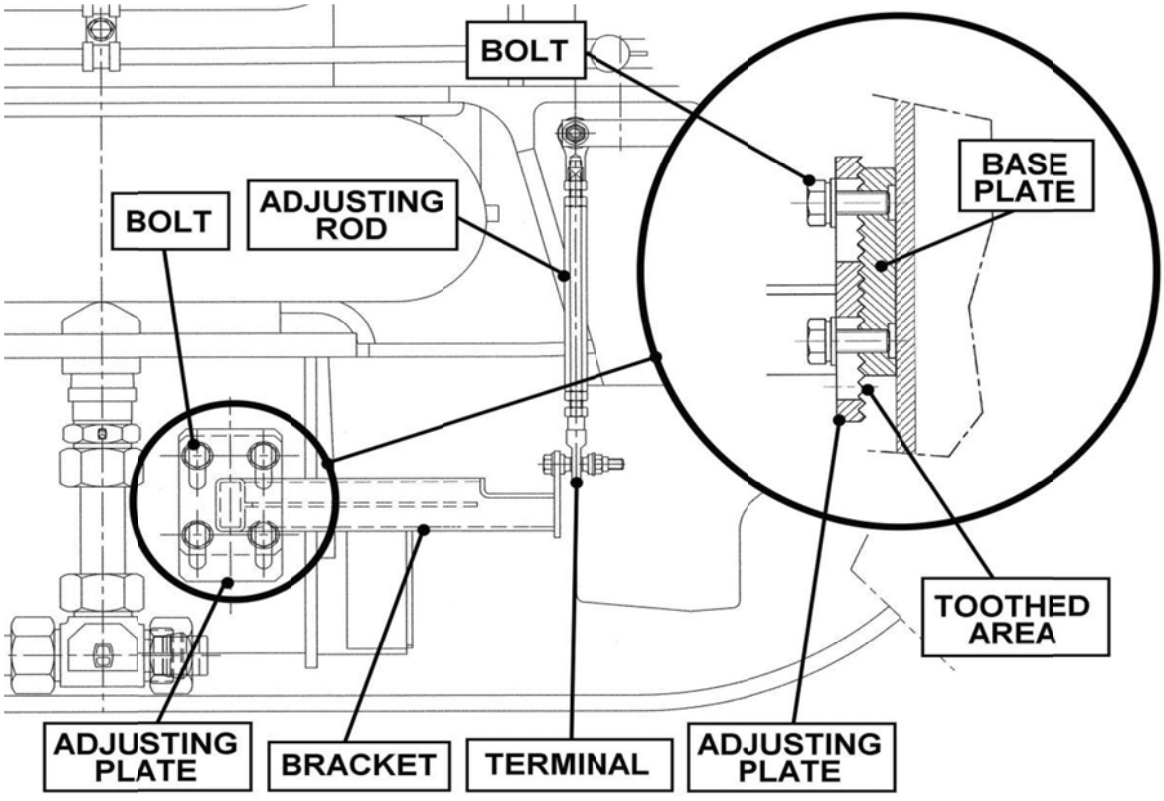


Figure 7 - LEVELING VALVE -ADJUSTING & BASE PLATES

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**11/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

5 The thickness of each Air Spring Adjusting Shim to be used is **0.08 inch.**
The shims is shaped with an open slot to ease the installation.

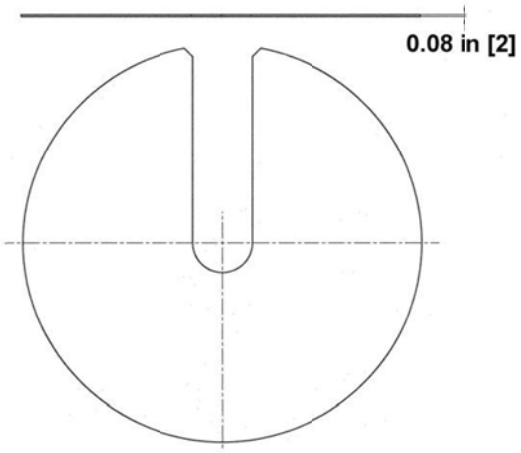


Figure 8 - AIR SPRING - ADJUSTING SHIM

6 The Vertical Bump Stop Shims to be used are of two thicknesses: **0.08** inch and **0.24 inch.**

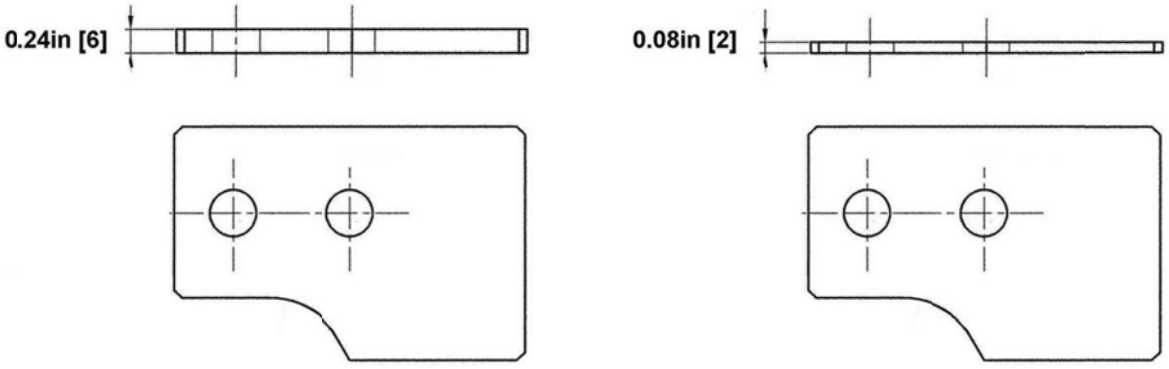


Figure 9 - VERTICAL BUMP STOP - SHIMS

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-01-01-00-00/LL-00**		
System: **VEHICLE SYSTEMS**		Sheet: **12/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:	
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**	
Maintenance Task: **LEVELING**		

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

7 To restore the Design Value of the Vehicle Floor from Top of Rail it is necessary to work on both the Leveling Valves Adjusting Plates and / or to shim both the Air Springs in such a way that the summation
of the adjustment reaches the goal.

PROCEDURE FOR MOTOR TRUCKS

To perform the Task for each Motor Truck proceeding as follows:

NOTE: It is assumed that is / are known:

a) The Truck Wheels Average Value.
b) The Level difference from Vehicle Floor (at Doors Opening) and the Station Platform Floor.

1 Determine, according to the known Wheel Average Value of the each Truck and the Nominal Design Limits to be complying:

a) How many positions both the Leveling Valves Adjusting Plates should be moved up.
b) How many Air Springs Adjusting Shims are needed to be installed on each Air Springs.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**13/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

2 Raise the (Car Hoist System) Body Stands until they put under stress the Car Body Jacking Pads (YELLOW) (refer to Fig 10).

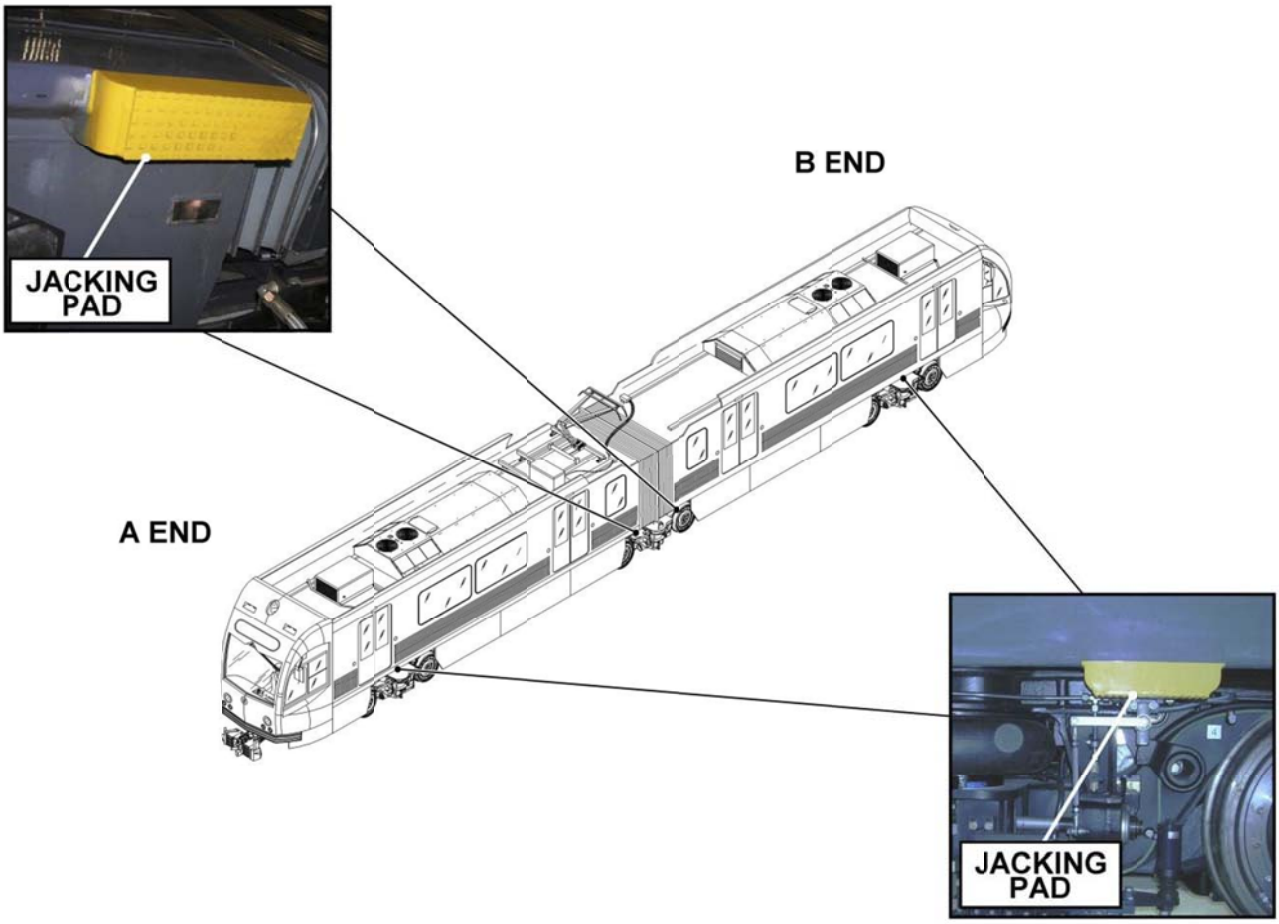


Figure 10 - CARBODY JACKING PADS LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**14/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

3 Close Air Suspension System (Vented) Cut-Out Cock to release Pneumatic Pressure from Air Suspension System (refer to Fig 11).

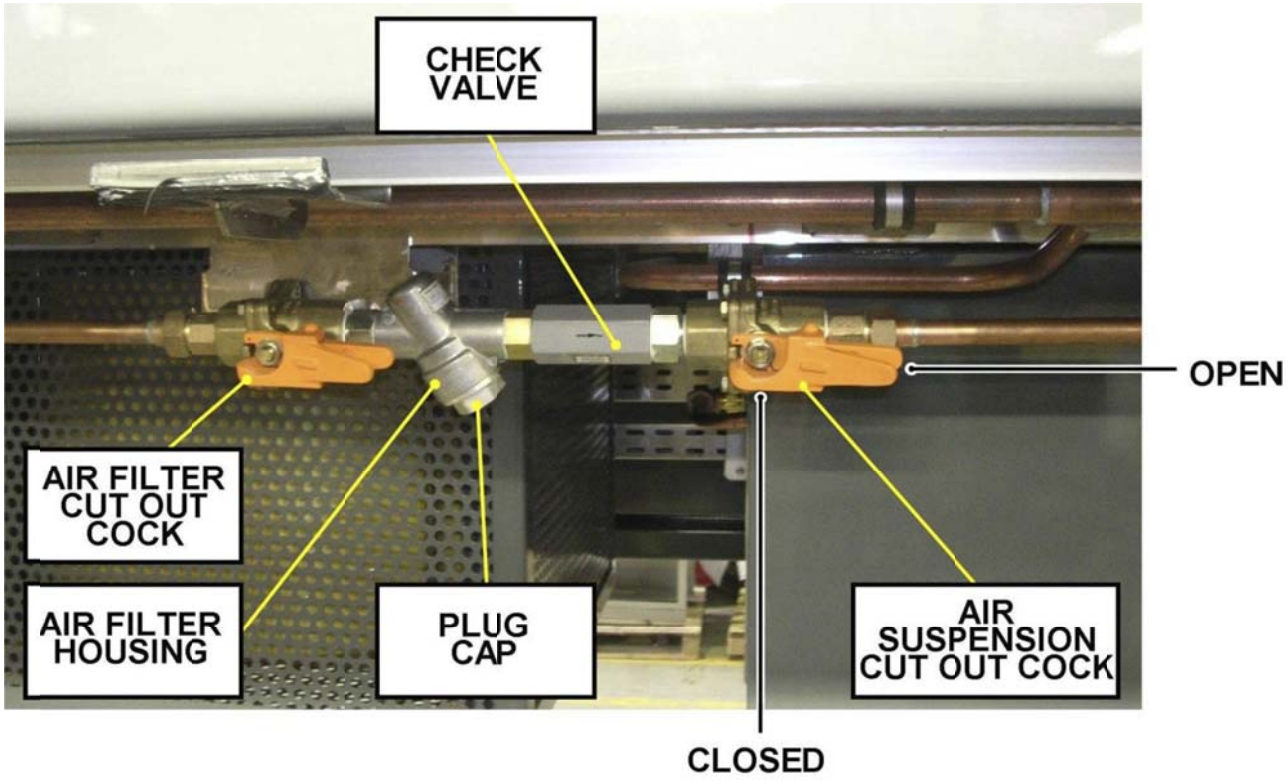


Figure 11 - AIR SUSPENSION (VENTED) CUTOUT COCK

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**15/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

4 Operate the (Car Hoist System) Body Stands in ALL BODY STANDS mode to raise the Vehicle not less of **0.03** inch more than the Total Thickness Value of the Air Spring Adjusting Shims previously determined.

WARNING: **(CAR HOIST SYSTEM) BODY STANDS MUST BE CORRECTLY POSITIONED AND INSTALLED AT THE PROPER LOCATIONS BEFORE SUPPORTING THE VEHICLE ON THE CAR BODY JACKING PADS.**

CAUTION SINCE THE AIR SPRINGS ARE NOT PRESSURIZED, PAY ATTENTION TO NOT RAISE THE VEHICLE MORE THAN 1.8" TO AVOID THE DISENGAGEMENT OF THE AIR SPRING PINS FROM THE BOLSTER BEAM OF THE TRUCK.

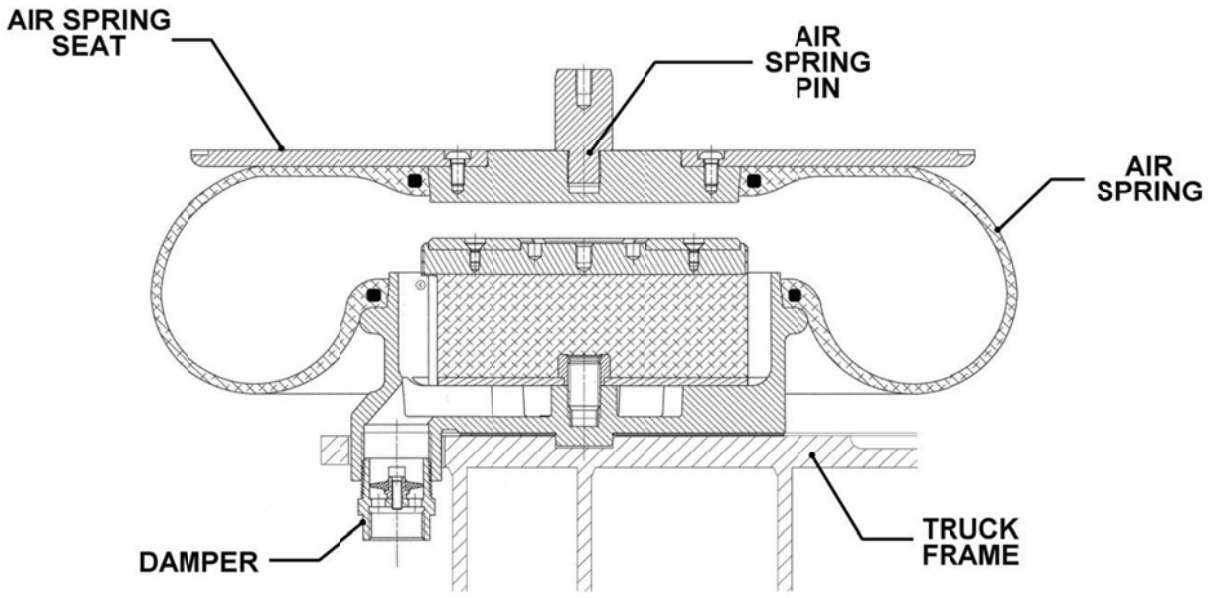


Figure 12 - MOTOR TRUCK AIR SPRING PIN

P2550 CORRECTIVE MAINTENANCE SHEET

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

System: **VEHICLE SYSTEMS** | Sheet: **16/56**

Subsystem/Assy: **VEHICLE AS A WHOLE** | Unit:

Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**

Man Hours: **VEHICLE LEVELING** **2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

5 Install on each Air Spring the Adjusting Shims between the Air Spring Plate and the Truck Bolster Beam (refer to Fig 5).

6 Note, on the Report Form provided at the end of this section, the **Qty of Shims and the relevant Shims Total Thickness** installed.

7 Loose the four (4) bolts attaching each Leveling Valve Adjusting Plate to the Truck Frame.

8 Slide up the Adjusting Plate according to the previous determined position(s) (refer to Fig 5).

9 Note, on the Report Form provided at the end of this section, **the # of the positions Up**.

10 Torque the Adjusting Plate Bolts to **30 ft-lb.**

11 Unscrews and remove the Bolts, Washers and Nuts retaining the Vertical Bump Stop Shims. Retain hardware for later use.

12 Remove the Vertical Bump Stop Shims, in order to comply the Nominal Design Data Limit of the dimension "**f**" according to:

- how many positions each Leveling Valve Adjusting Plate has been moved up.
- the Total Thickness value of the Air Spring Adjusting Shims previously installed on each Air Spring.

The following Table provides detailed instructions.

ADJUSTING PLATE				AIR SPRING			
Direction: **UP**		Vertical Bump Stop		Adjusting Shims		Vertical Bump Stop	
# of Positions	Dimension reached (inch)	Shims to be removed Thickness (inch)	Qty	Qty installed	Dimension reached (inch)	Shims to be removed Thickness (inch)	Qty
1	0.24	0.24	1	1	0.08	0.08	1
2	0.48	0.24	2	2	0.16	0.08	2
3	0.72	0.24	3	3	0.24	0.24	1
4	0.96	0.24	4	4	0.32	0.24 0.08	1 1
				5	0.40	0.24	1
				6	0.48	0.08 0.24	2 2

13 Note, on the Report Form provided at the end of this section, the **Qty of Shims and the relevant Shims Total Thickness removed.**

14 Install the Bolts, Washers and Nuts to retain the Vertical Bump Stop Shims in working position.

15 Torque the Vertical Bump Stop Shims Bolts to **25 ft -lb.**

16 Perform the Task on the Trailer Truck according to the Specific Procedure provided in the next pages.

P2550 CORRECTIVE MAINTENA ıCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**17/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMI IG	**1**	**VE HICLE LEVE LING**	**2**

Maintenance Task:
LEVELING

PRO CEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

"A" MOTOR TRUCK
LEVELING VALVES ADJUSTMENT & TRUCK S IMMING REPORT

P2550 LRV	Vehicle #		Date / / /	Running Miles	

Air Spring Rh	Air Spring Lh	Adjusting Plate Rh	Adjusting Plate Lh	Vertical Bump Stop Rh	Vertical Bump Stop Lh
Design Value Dimension"**e**"	Design Value Dimension"**e**"	# of Positions **Up**	# of Positions **Up**	Design Value Dimension"**f**"	Design Value Dimension"**f**"
6.9 + 0.12 in	**6.93 + 0.12 in**			**1.38 ± 0.4 in**	**1.38 ± 0.4 in**
Measured Value Dimension"**e**"	Measured Value Dimension"**e**"			Measured Value Dimension"**f**"	Measured Value Dimension"**f**"
Qty of Shims added	Qty of Shims added			Qty of Shims removed	Qty of Shims removed
Shims Total T ickness	Shims Total Thickness			Shims Total Thickness	Shims Total Thickness

"A " MOTOR TRUCK				"A " MOTOR TRUCK			
DOOR A1/ 2		DOOR A7/ A8		DOOR A1/A2		DOOR A7/ A8	
Dimension " . "		Dimension "L "		Dimension "L "		Dimension "L "	
Design Value		Design Value		Measured Value		Measured Value	
38.9 3 inch	**+0.51**	**38.98 inch**	**+0.51**				
	-0.25		**-0.25**				
				Restored to Design Value	Y / N	Restored to Design Value	Y / N
				Complying with ADA Regulations	Y / N	Complying with ADA Regulations	Y / N

P2550 CORRECTIVE MAINTENANCE S HEET

Card Code:
R-C-01-)1-00-0 0/LL-00

System:
VEHICL E SYS 'EMS

Sheet:
18/56

Subsystem/Assy:
VEHICLE AS A WH OLE

Unit:

Man Hours::
LEVELING VA .VES ADJU TMENT & TRUCKS SHIM MING **1**

Man Hours:
VEHICLE LEVELING **2**

Maintenance Task:
LEVELING

PROCEDURE LEVELIN VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

"B" MOTOR TRUCK

LEVELIN 3 VALVES ADJUSTMENT & TRUCK SHIMMING REPORT

P2550 LRV	Vehicle		Date / / /	Running Miles	

Air Spring R	Air Spring Lh	Adjusting Plate Rh	Adjusting Plate L	Verti cal Bump Stop Rh	Vertical Bump Stop Lh
Design Value Dimension"e"	Design /alue Dimensi on"e"	# of Position **Up**	# of Position **Up**	Design Value Dim ension"f"	Design Value Dimension"f"
6.93 + 0.12 in	**6.93 + 0.12 in**			**1.3 ± 0.4 in**	**1.38 ± 0.4 in**
Measured Value Dimension"e"	Measured Value Dimensi on"e"			Measured /alue Dim ension"f"	Measured Value Dimension"f"
Qty of Shims added	Qty of Shims added			Qty of Shims removed	Qty of Shims removed
Shims Total Thickness	Shims otal Thickness			Shims Total Th ickness	Shims Total Thickness

"B " MOTO R TRUCK				"B " MO TOR TRUCK			
DOOR B1/B2		**DOOR B7/ B8**		**DOO R B1/B2**		**DOOR B7/ B8**	
Dimension "L "		Dimension "L "		Dimension "L "		Dimension "L "	
Design alue		Design Value		Measu ed Value		Measured Value	
38.98 inch	**+0.51 -0.25**	**38.98 inch**	**+0.51 -0.25**				
				Restored to Design Value	Y / N	Restored to Design Value	Y / N
				Complying with ADA Regulation	Y / N	Complying with ADA Regulations	Y / N

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**19/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

SPECIFIC OPERATIONS FOR TRAILER TRUCK

EXPLANATORY NOTES

1 The aim of this Task is to adjust the Leveling valve and/or to shim both the Air Springs of the Trailer Truck in order to restore the Nominal Design Value of Vehicle Floor from Top of Rail as indicated in the following Table and shown in Figure 13.

TRAILER TRUCK							
DOOR A3/A4		DOOR A5/ A6		DOOR B3/B4		DOOR B5/B6	
Dimension "L"		Dimension "L"		Dimension "L"		Dimension "L"	
38.98 inch	**+0.51**	**38.98 inch**	**+0.51**	**38.98 inch**	**+0.51**	**38.98 inch**	**+0.51**
	-0.25		**-0.25**		**-0.25**		**-0.25**

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**20/56**

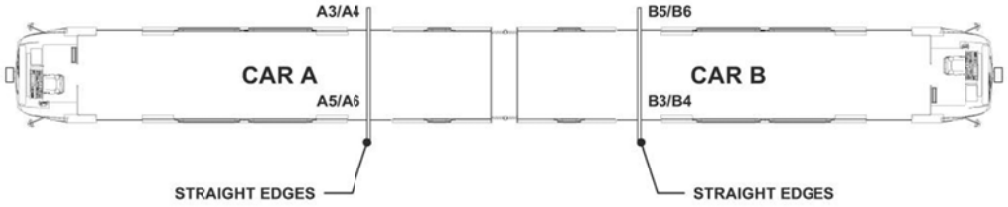
Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)



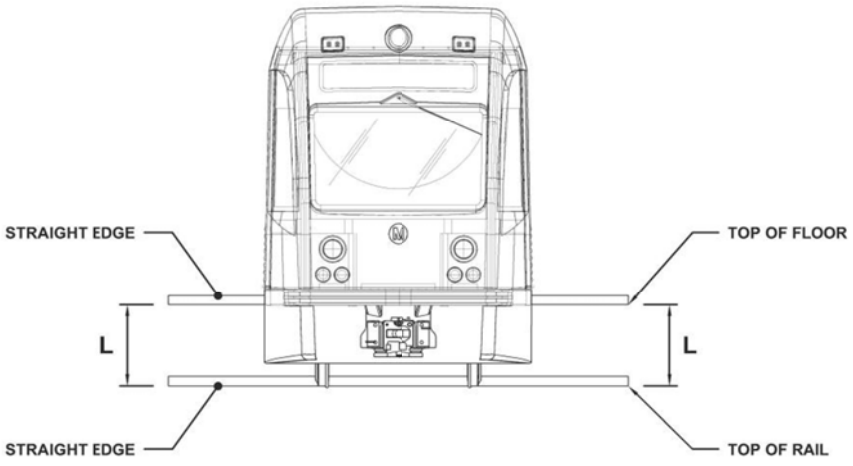


Figure 13 - DESIGN VALUE OF DIMENSION " L "

2 The Components of the Trailer Truck involved in the Task are:

a) The Leveling Valve with relevant Adjusting Plate connected to the Operating Lever through the Adjusting Rod.
b) The two (2) Air Springs with relevant Adjusting Shim(s).
c) The two (2) Vertical Bump Stops with relevant Shim(s).

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**21/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

3 The Design Value of Dimension "L" must be reached respecting the following Nominal Design Data Limits.

- Air Spring Supply Pressure Nominal Value: **140 ± 10** PSI - (at "A" / "B" Cab - Double Air Pressure Gauge - White Pointer).
- Air Spring Nominal Height (Dimension "**e**"): **6.93 + 0.12** inch Max.
- Air Spring Adjusting Shims Thickness: **0.79** inch Max.
- Clearance between Vertical Bump Stop and Frame Stopper (Dimension "**f**"):**1.38 ± 0.4** Min.

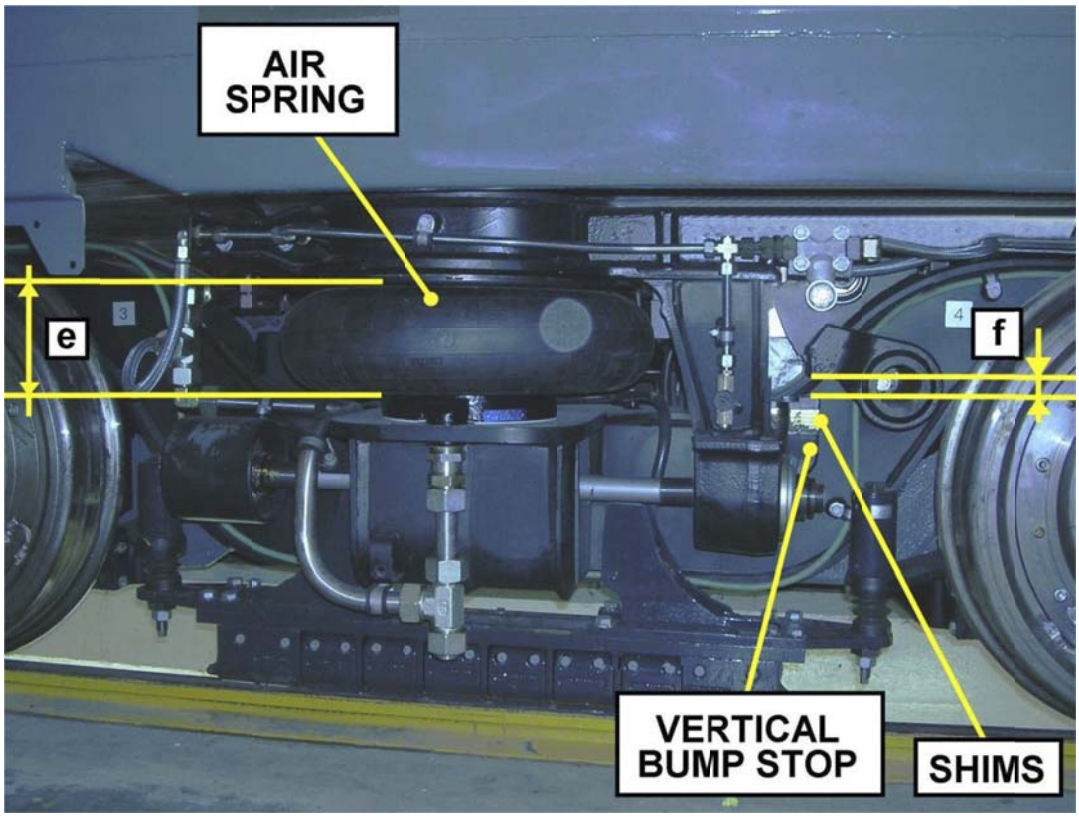


Figure 14 - TRAILER TRUCK SECONDARY SUSPENSION COMPONENTS & DESIGN DATA LIMITS

P2550 CORRECTIVE MAINTENANCE SHEET			
Card Code: R-C-01-01-00-00/LL-00			
System: VEHICLE SYSTEMS		Sheet: 22/56	
Subsystem/Assy: VEHICLE AS A WHOLE		Unit:	
Man Hours:: LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	1	Man Hours: VEHICLE LEVELING	2
Maintenance Task: LEVELING			

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

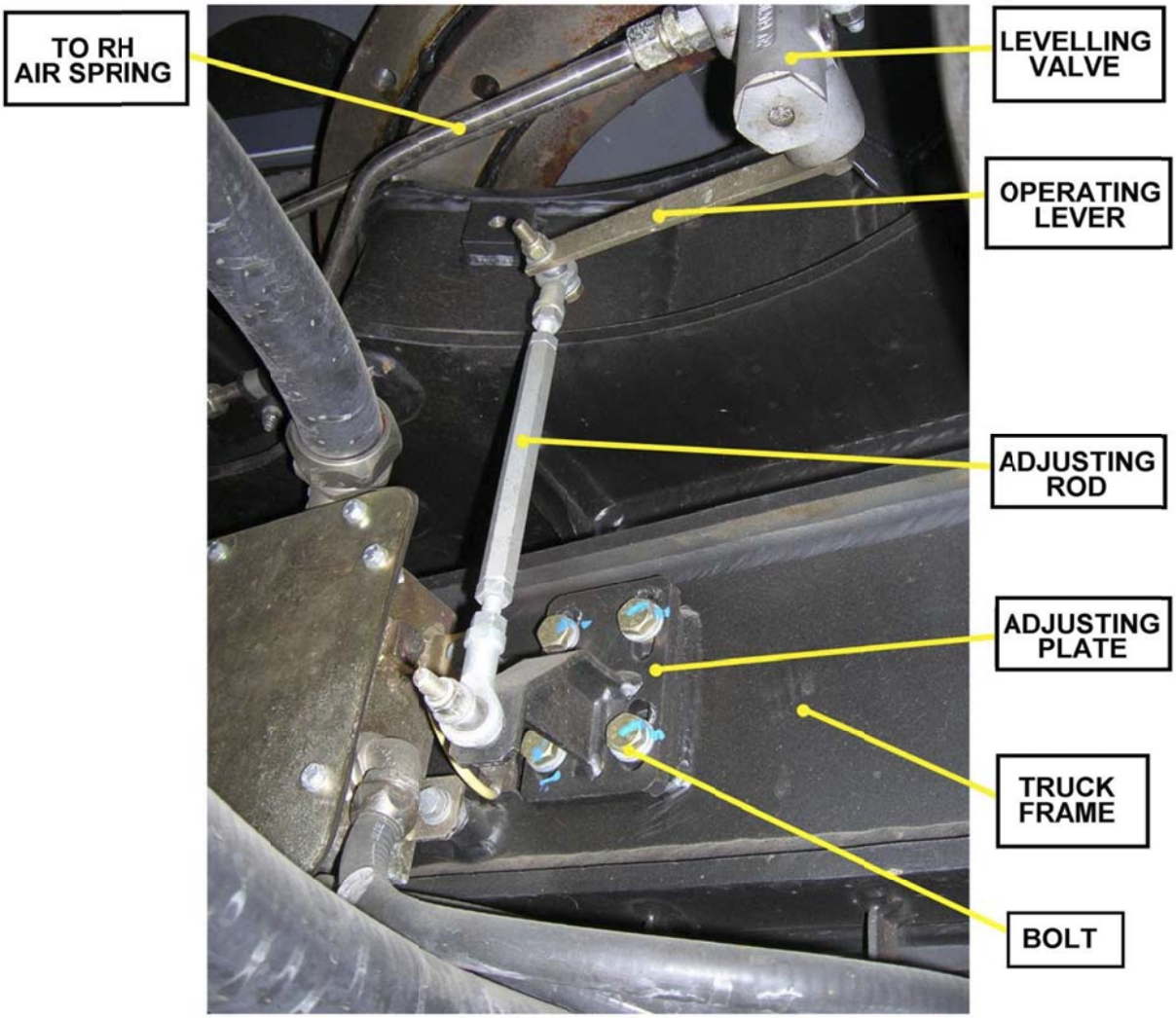


Figure 15 - TRAILER TRUCK LEVELING VALVE

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**23/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

Figure 16 - AIR SUPPLY PRESSURE NOMINAL -DESIGN DATA

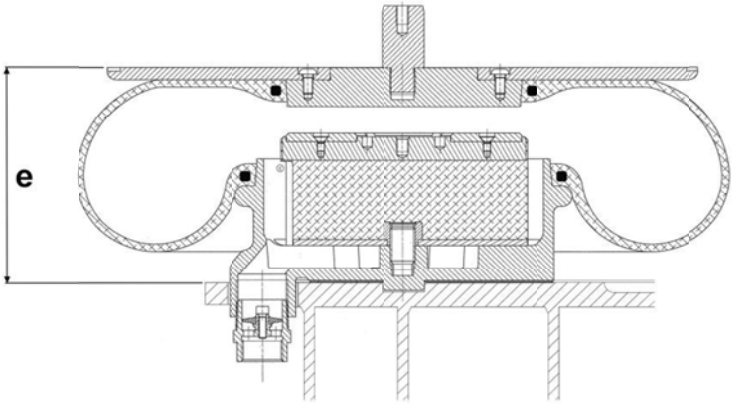


Figure 17 - AIR SPRING DESIGN DATA LIMIT

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**24/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

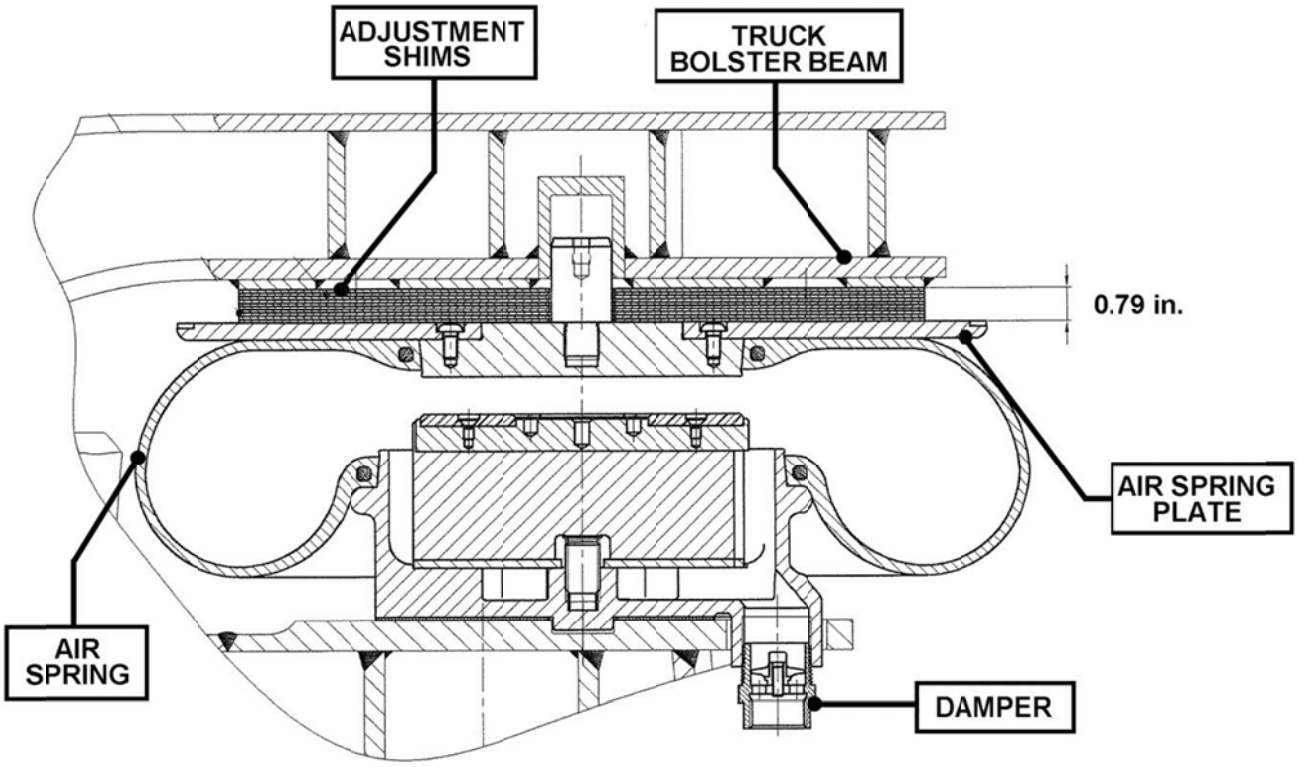


Figure 18 AIR SPRING ADJUSTING SHIMS THICKNESS DESIGN DATA LIMIT

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**25/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

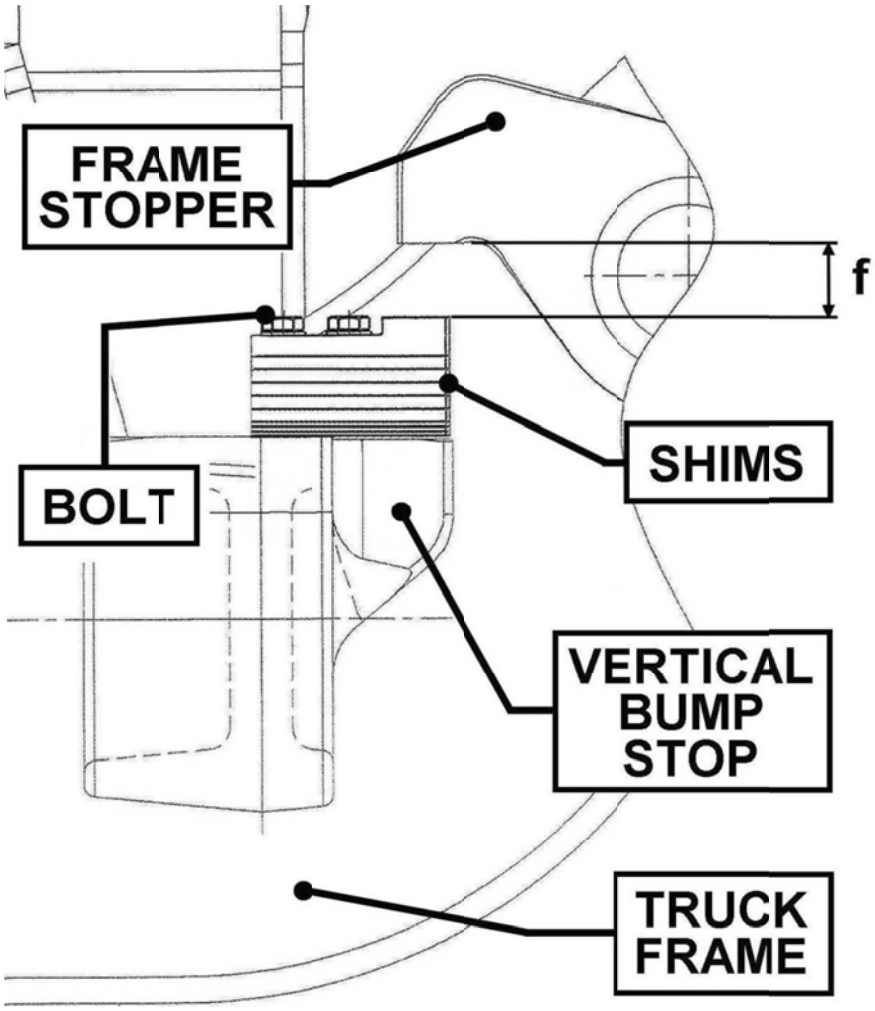


Figure 19 - VERTICAL BUMP STOP DESIGN DATA LIMIT

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**26/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE: LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

4 The Leveling Valve Adjusting Plate, connected to the Adjusting Rod, is installed through 4 Bolts on its Base Plate which is provided with 4 slots in order to allow the Adjusting Plate up & down sliding.
The matching areas between the Adjusting Plate and Base Plate is toothed to firmly fix the Adjusting Plate once slid and to easily allow the adjustment by pre-determined positions.
The Adjusting Plate max sliding from the lower to the upper position is **0.96 inch**, corresponding to 4 positions (teeth) since the tooth pitch is **0.24 inch**.

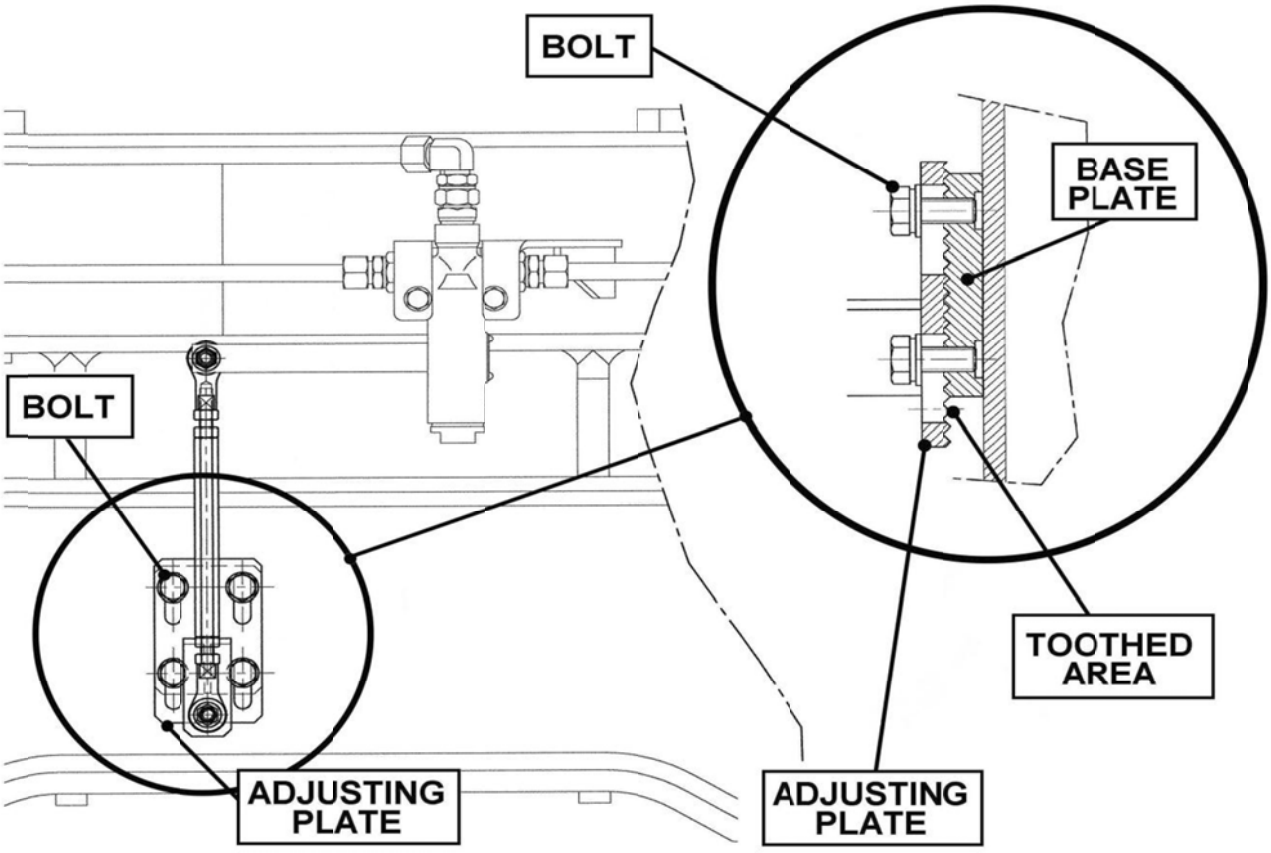


Figure 20 - LEVELING VALVE ADJUSTING & BASE PLATES

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**27/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**
Maintenance Task: **LEVELING**	

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

5 The thickness of each Air Spring Adjusting Shim to be used is 0.08 inch. The shims is shaped with an open slot to ease the installation.

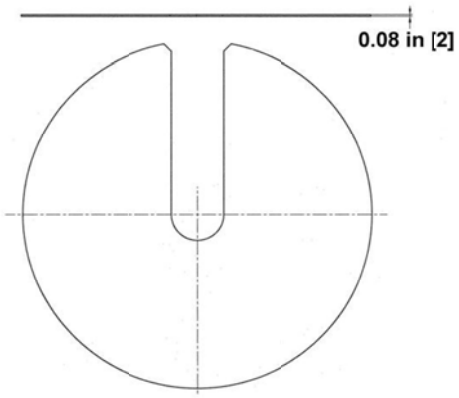


Figure 21 - AIR SPRING ADJUSTING SHIM

6 The Vertical Bump Stop Shims to be used are of two thickness: 0.08 inch and 0.24 inch.

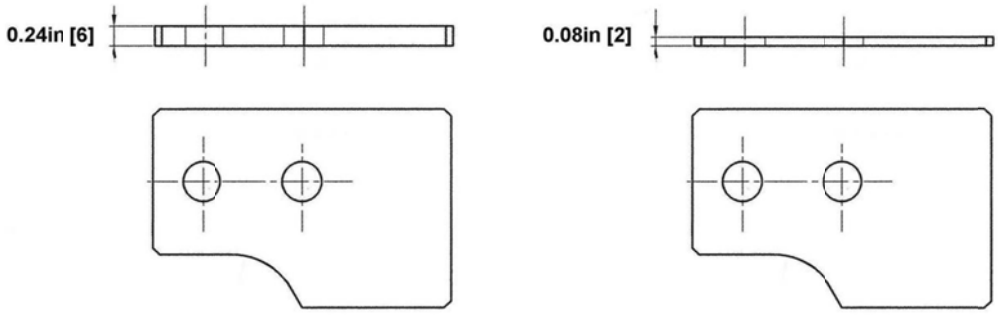


Figure 22 - VERTICAL BUMP STOP - SHIMS

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**28/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

EXPLANATORY NOTES (cont'd)

7 To restore the Design Value of the Vehicle Floor from Top of Rail of the Trailer truck it is necessary to work on the Leveling Valve Adjusting Plate and / or to shim both the Air Springs in such a way that the summation of the adjustment reaches the goal.

PROCEDURE FOR TRAILER TRUCK

To perform the Task proceed as follows :

NOTE: It is assumed that is / are known:
- The Truck Wheels Average Value.
- The Level difference from Vehicle Floor (at Doors Opening) and the Station Platform Floor.

1 Determine, according to the known Wheel Average Value of the Truck and the Nominal Design Data Limits to be complying:
   a) How many positions the Leveling Valve Adjusting Plate should be moved up.
   b) How many Air Springs Adjusting Shims are needed to be installed on each Air Springs.

2 Close Air Suspension System (Vented) Cut-Out Cock to release Pneumatic Pressure from Air Suspension System (refer to Fig 23).

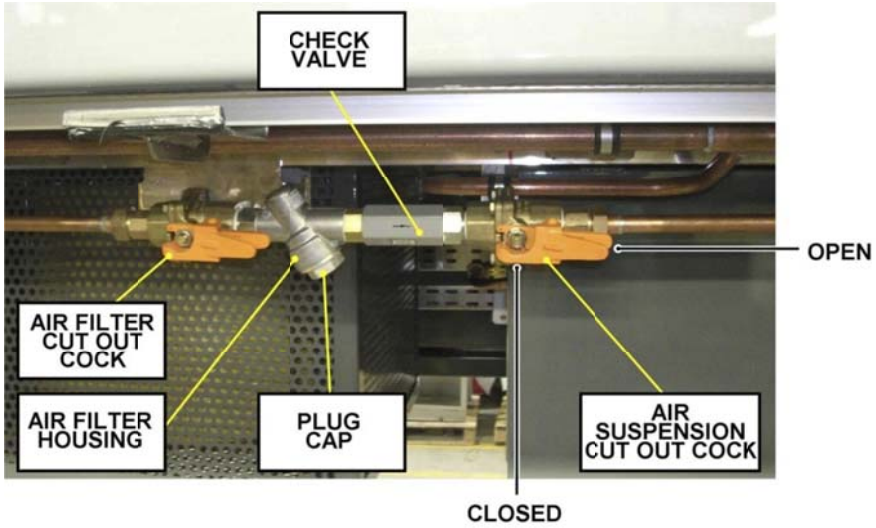


Figure 23 - AIR SUSPENSION (VENTED) CUTOUT COCK

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**29/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**
Maintenance Task: **LEVELING**	

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

3 Check that the Vehicle (previously raised to accomplish Motor Trucks Specific Operations) is raised not less of **0.08** inch more that the Total Thickness Value of the Air Spring Adjusting Shims previously determined.

4 As per check result proceed to complete the Task operate the (Car Hoist System) Body Stands in RAISE ALL BODY STANDS mode, accordingly as above indicated, to meet the Trailer Truck required value.

WARNING: **(CAR HOIST SYSTEM) BODY STANDS MUST BE CORRECTLY POSITIONED AND INSTALLED AT THE PROPER LOCATIONS BEFORE SUPPORTING THE VEHICLE ON THE CAR BODY JACKING PADS.**

CAUTION: SINCE THE AIR SPRINGS ARE NOT PRESSURIZED, PAY ATTENTION TO NOT RAISE THE VEHICLE MORE THAN 1.80" TO AVOID THE DISENGAGEMENT OF THE AIR SPRING PINS FROM THE BOLSTER BEAM OF THE TRUCK.

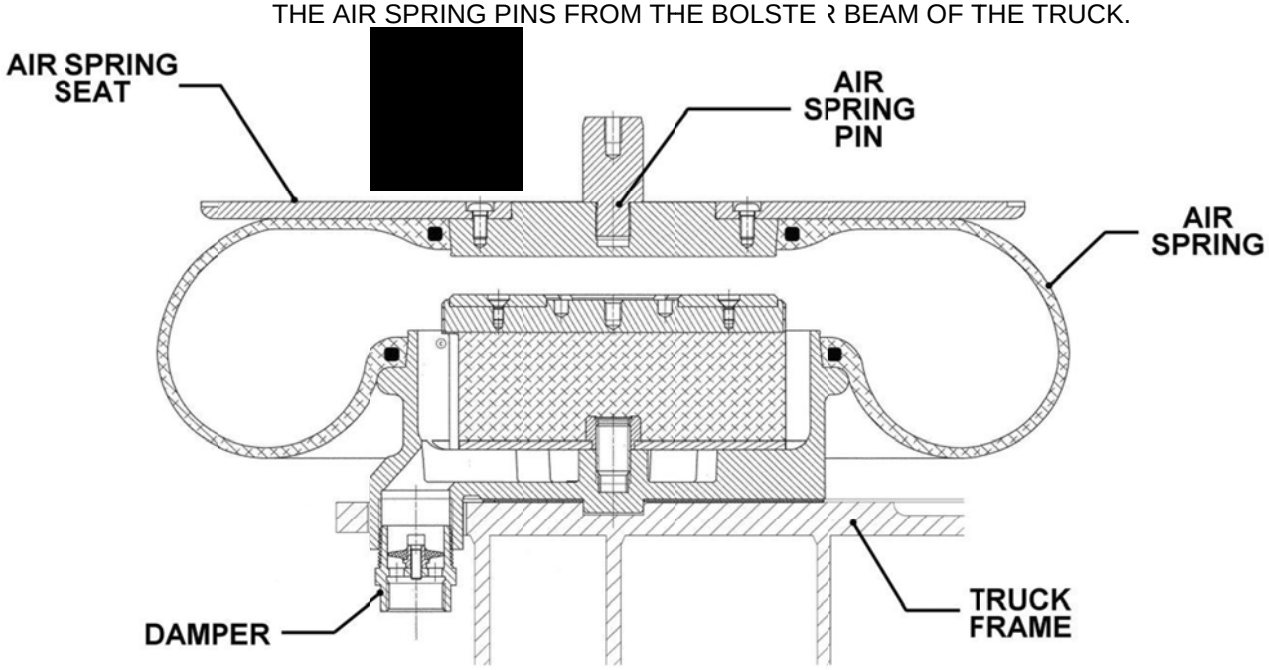


Figure 24 TRAILER TRUCK AIR SPRING PIN

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
30/56

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:

Man Hours::
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING **1**

Man Hours:
VEHICLE LEVELING **2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

5 Install on each Air Spring the Adjusting Shims between the Air Spring Plate and the Truck Bolster Beam (refer to Fig 18).

6 Note on the Report Form, provided at the end of this section, **the Qty of Shims and the relevant Total Thickness** installed.

7 Loose the four (4) Bolts attaching the Leveling Valve Adjusting Plate to the Truck frame.

8 Slide up the Adjusting Plate according to the previous determined position(s)

9 Note, on the Report Form provided at the end of this section, the **# of positions Up.**

10 Torque the Adjusting Plate Bolts to **30 ft-lb.**

11 Unscrews and remove the Bolts, Washers and Nuts retaining the Vertical Bump Stop Shims. Retain hardware for later use.

12 Remove the Vertical Bump Stop Shims, in order to comply the Nominal Design Data Limit of the dimension "**f**" according to:

- How many positions the Leveling Valve Adjusting Plate has been moved up.
- The Total Thickness Value of the Air Spring Adjusting Shims previously installed on each Air Spring.

The following Table provides detailed instructions.

ADJUSTING PLATE				AIR SPRING			
Direction: **UP**		Vertical Bump Stop		Adjusting Shims		Vertical Bump Stop	
Position	Dimension reached (inch)	Shims to be removed		Qty installed	Dimension reached (inch)	Shims to be removed	
		Thickness (inch)	Qty			Thickness (inch)	Qty
1	0.24	0.24	1	1	0.08	0.08	1
2	0.48	0.24	2	2	0.16	0.08	2
3	0.72	0.24	3	3	0.24	0.24	1
4	0.96	0.24	4	4	0.32	0.24 0.08	1 1
				5	0.40	0.24 0.08	1 2
				6	0.48	0.24	2

13 Note, on the Report Form provided at the end of this section, **the Qty of Shims and the relevant Total Thickness removed**.

14 Install the Bolts, Washers and Nuts to retain the Vertical Bump Stop Shims in working position.

15 Torque the Vertical Bump Stop Shims to **25 ft -lb**.

P2550 CORRECTIVE MAINTENA NCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
31/56

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:

Man Hours::
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMI IG **1**

Man Hours:
VE HICLE LEVE LING **2**

Maintenance Task:
LEVELING

PRO CEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

TRAILER T RUCK					
LEVELING VALVE ADJUSTMENT TRUCK SHIMMING REPORT					
P2550 LRV	**Vehicle #**		**D ate / / /**	**Miles**	
Air Spring Rh	**Air Spring Lh**	**Adjusting Plate**		**Vertical Bump Stop Rh**	**Vertical Bump Stop Lh**
Design Value Dimension"**e**"	Design Value Dimension"**e**"	# of Positio ns **Up**		Design Value Dimension"**f**"	Design Value Dimension"**f**"
6.93 + 0.12 in	**6.93 + 0.12 in**			**1.38 ± 0.4 in**	**1.38 ± 0.4 in**
M easured Value Dimension"**e**"	Measured Value Dimension"**e**"			Measured Value Dimension"**f**"	Measured Value Dimension"**f**"
Qty of Shims added	Qty of Shims added			Qty of Shims removed	Qty of Shims removed
Shims Total T ickness	Shims Total Thickness			Shims Total Thickness	Shims Total Thickness

'RAILER TRUCK				TRAILER TRUCK			
Dime ision "**L** "Design Value				Dim ension "**L** "Measured Value			
DOOR A3/A4		DOOR A5/ A6		DOOR A3/A4		DOOR A5/ A6	
38.9 3 inch	**+0.51 -).25**	**38.98 inch**	**+0.51 -0.25**				
				Restored to Design Value	Y / N	Restored to Design Value	Y / N
				Complying with ADA Regulations	Y / N	Complying with ADA Regulations	Y / N
DOOR B3/B4		DOOR B5/ B6		DOOR B 3/B4		DOOR B5/ B6	
38.9 3 inch	**+0.51 -).25**	**38.98 inch**	**+0.51 -0.25**				
				Restored to Design Value	Y / N	Restored to Design Value	Y / N
				Complying with ADA Regulations	Y / N	Complying with ADA Regulations	Y / N

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**32/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING (CONT'D):

FINAL OPERATIONS

1 Open Air Suspension System (Vented) Cut-Out Cock of each Truck. to restore Pneumatic Pressure to Air Suspension System (refer to previous Fig 2 for Motor Trucks and Fig 23 for Trailer Truck).
2 Verify that Pneumatic Pressure build up to Nominal Value of 140±10 PSI (at "A" / "B" Cab -Double Air Pressure Gauge -White Pointer).
3 Lower the Vehicle by operating the (Car Hoist System) Body Stands in LOWER ALL BODY STANDS mode.
4 Wait that the Leveling Valves of all Trucks reach a **steady** working position.
5 Open all the Vehicle Doors.
6 Position at each Doors Opening,as indicated in the previous Fig 1 and Fig 13 one (1) Straight Edge on the Vehicle Floor in the center of the Door Opening, (Total Qty of Straight Edges to be positioned = 4).
7 Position at A1/A2-A7/A8 Doors Opening, a Straight Edge, transversally at the track, on the Top of Rail, under and aligned with the relevant Straight Edge previous positioned.
8 Verify the correct execution of the Task by checking, on A1/A2-A7/A8 Door Opening, using recommended Calipers, the value of dimension.
   - "**L**" (refer to previous Figures 1 and 13).
   - "**e**" (refer to previous Figures 4 and 17).
9 Note each Measured Values on the Report Form provided at the end of Motor Trucks section:
10 Note, on the same Report Form, if:
   - The Nominal Design Value of Vehicle Floor from Top of Rail has been restored.
   - The Measured Value of Vehicle Floor from Top of Rail complies with the ADA Regulations.
11 Repeat previous steps 7 through 10 for B1/B2-B7/B8 Doors Opening.
12 Repeat previous steps 7 and 8 for A3/A4- A5/A6 and B3/B4- B5/B6 Doors Openings.
13 Note each Measured Values on the Report Form provided at the end of Trailer Truck section:
14 Note, on the same Report Form, if:
   - The Design Value of Vehicle Floor from Top of Rail has been restored.
   - The Design Value of Vehicle Floor from Top of Rail complies with the ADA Regulations.
15 Remove wheel chocks.
16 Record Task result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**33/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE (CONT'D):

2-VEHICLE LEVELING

1 The aim of this Task is to :

a) Check and / or restore the Nominal Design Value of the Vehicle Floor from the Top of Rail after:
- Motor Truck or Trailer Truck replacement or changed out.
- Wheels -Tires Re-profiling.
- Wheels Replacement.
- Leveling Valve and / or Air Spring Replacement or Changed Out.

b) Check
- The correct working of all the Pneumatic Components of the Vehicle Leveling System.
- The Working Pressure Values of the Air Springs installed on each Truck.

2 The Task must be performed with the Vehicle in the following conditions:
- Staged in AWO status.
- Positioned on a leveled track.
- All brakes released.
- Lateral Bump Stops not in contact with Truck Frame.

3 The Task must be performed at the same time for all Trucks.
Each Truck must be adjusted to comply Nominal Design Value of the Vehicle Floor (at Door Opening) from the Top of Rail.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**34/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

PRELIMINARY OPERATIONS

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

1. Place the Vehicle over the Car Hoist and Support System.

2. Check that the Trucks are correctly positioned on the Stand up Rail.

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. Turn the Transfer Switch to LOCAL.

6. Apply 2 wheel chocks for each Truck (1 per Axle in both running directions) to prevent Vehicle from moving.

7. Release all Vehicle Brakes as follows (Refer to figures 1 through 4):

WARNING: MAKE SURE THAT 2 WHEEL CHOCKS (1 PER AXLE) ARE APPLIED IN BOTH DIRECTIONS TO EACH TRUCK.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**35/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**
Maintenance Task: **LEVELING**	

PROCEDURE VEHICLE LEVELING (CONT'D):

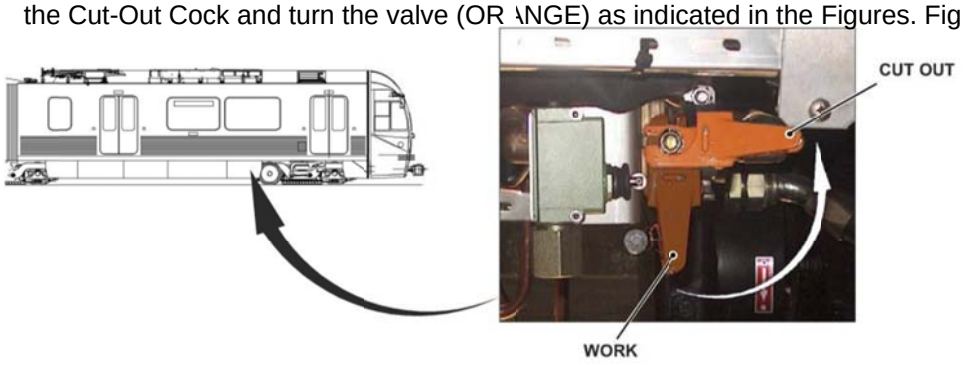
PRELIMINARY OPERATIONS (cont'd)

MOTOR TRUCKS
1-Friction Brakes Releasing

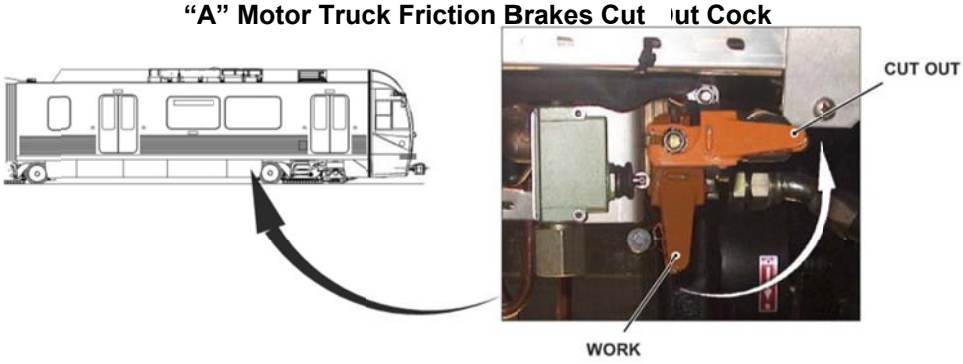
a. Cut out the Friction Brakes Cylinders by rotating the Friction Brakes Cut-Out Cock (ORANGE) to

CUT OUT position.

NOTE: To do so, the Maintainer must open the Underframe Fairing Lid in correspondence with the Cut-Out Cock and turn the valve (ORANGE) as indicated in the Figures. Fig. 1 and 2.



"A" Motor Truck Friction Brakes Cut Out Cock



"B" Motor Truck Friction Brakes Cut Out Cock

Figure 1 - MOTOR TRUCKS FRICTION BRAKES CUT OUT COCKS - LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
36/56

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:

Man Hours::
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING **1**

Man Hours:
VEHICLE LEVELING **2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

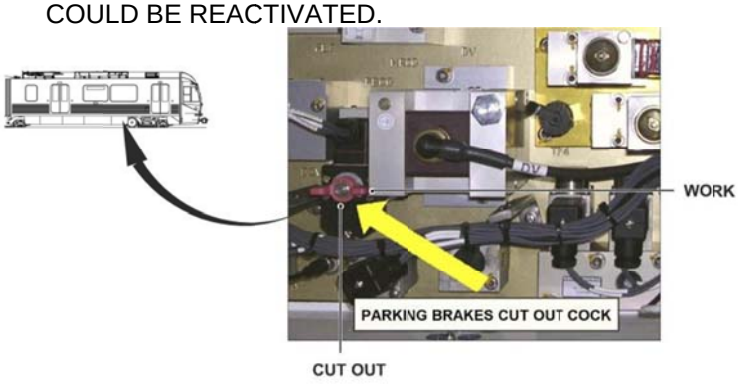
PRELIMINARY OPERATIONS (cont'd)

2. Parking Brakes releasing:

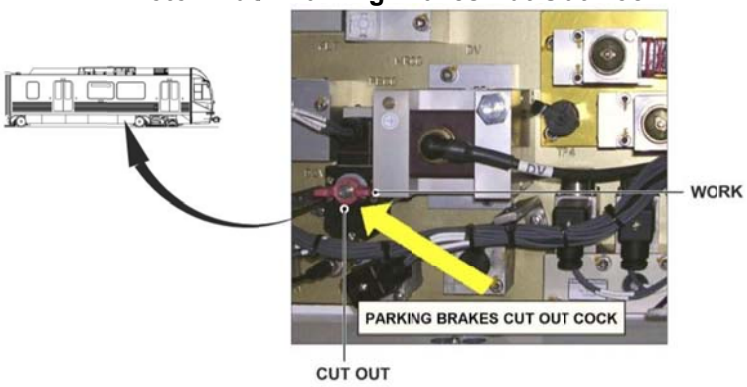
a. Cut out the Parking Brakes Cylinders by rotating the Parking Brakes Cut Out Cock (RED) to CUT OUT (vertical) position.

NOTE: To do so, the Maintainer must open the Underframe Fairing Lid in correspondence with the BCU Box first and then open the BCU Cover and turn the valve (RED) indicated in the figures 3 and 4.

CAUTION: WITHOUT CUT-OUT COCK CUT OUT THE PARKING BRAKE CYLINDERS COULD BE REACTIVATED.



"A" Motor Truck Parking Brakes Cut Out Cock



"B" Motor Truck Parking Brakes Cut Out Cock

Figure 2 - MOTOR TRUCKS PARKING BRAKES CUT OUT COCKS - LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**37/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

b. Operate the Parking Brakes Release Handle to mechanically release the Parking Brakes.

NOTE: To do so, open the door of the locker located in the Cab A for Truck A and in the Cab B for Truck B, (at the left of the Operator seat) and operate the Brake Release Handle (BLACK - LOWER) indicated in the Figure 5.

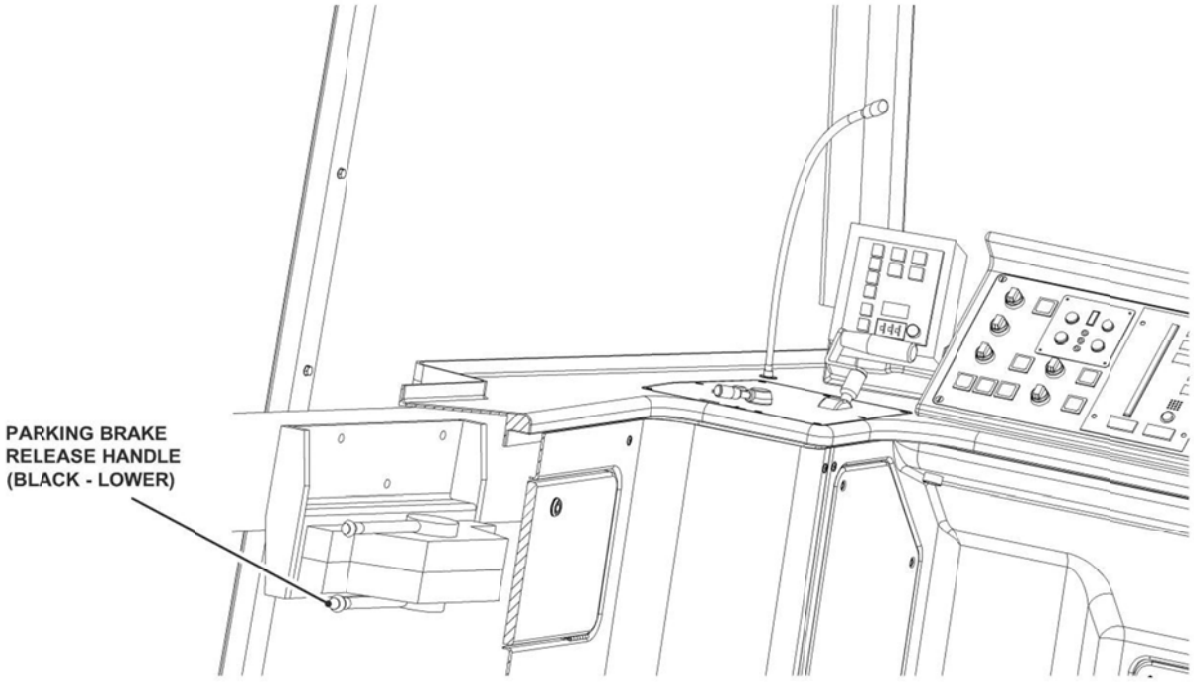


Figure 3 - PARKING BRAKES RELEASE HANDLE (BLACK-LOWER)

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**38/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

TRAILER TRUCK

Friction Brakes Releasing

Release the Friction Brakes as follows :

a. Cut out the Friction Brakes Cylinders by rotating the Friction Brakes Cut -Out Cock (ORANGE) to CUT OUT position.

NOTE: To do so, the Maintainer must open the Underframe Fairing Lid in correspondence with the Cut-Out Cock and turn the valve (ORANGE) as indicated in the Figure 1.

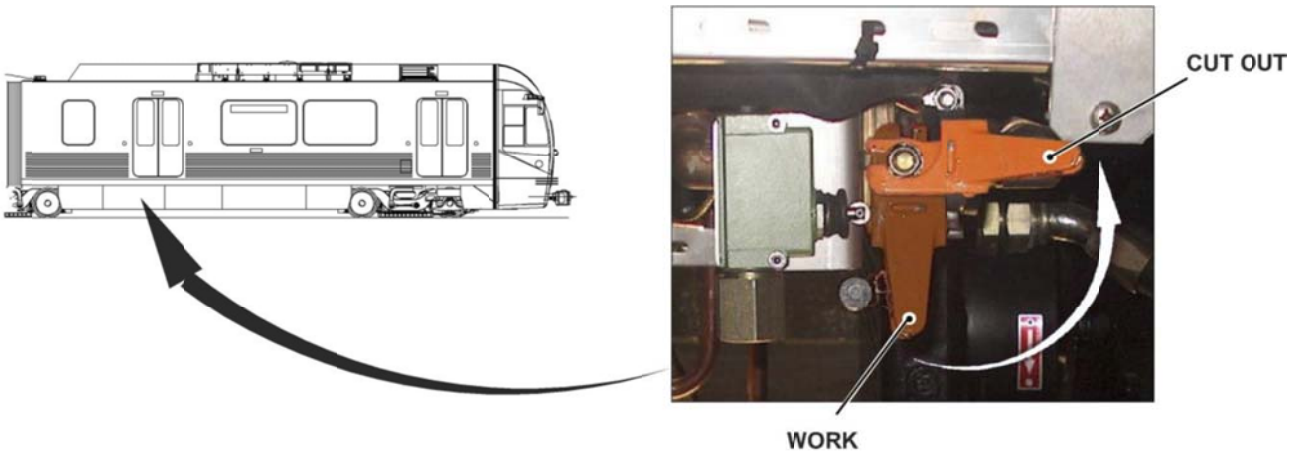


Figure 4 - TRAILER TRUCK FRICTION BRAKES CUT OUT COCKS - LOCATION

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**39/56**

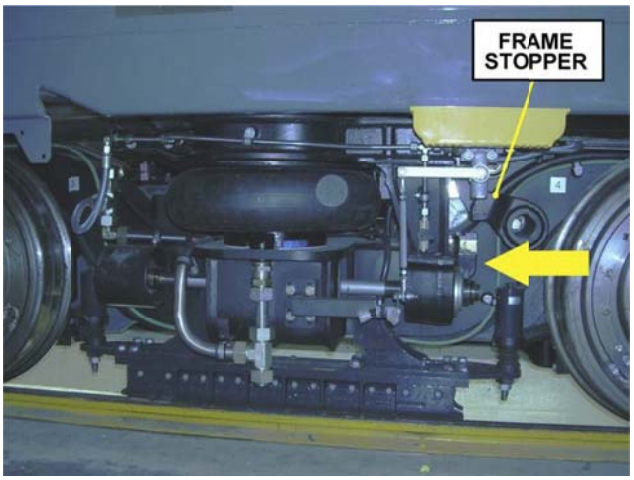
Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

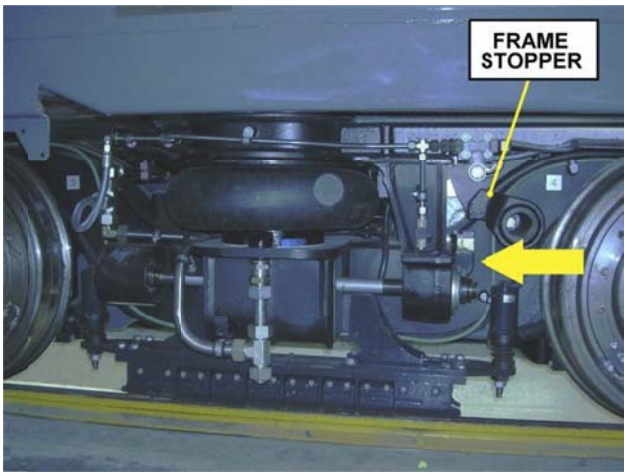
Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

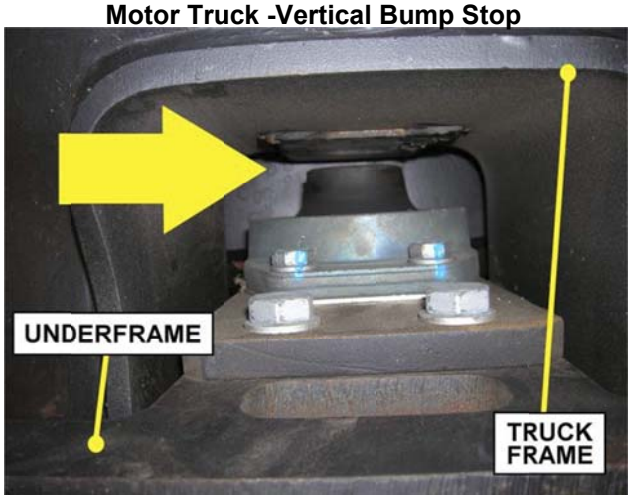
8 Check that Lateral and Vertical Bump Stops of each Truck are free of debris and are not contacting the Truck Frame.



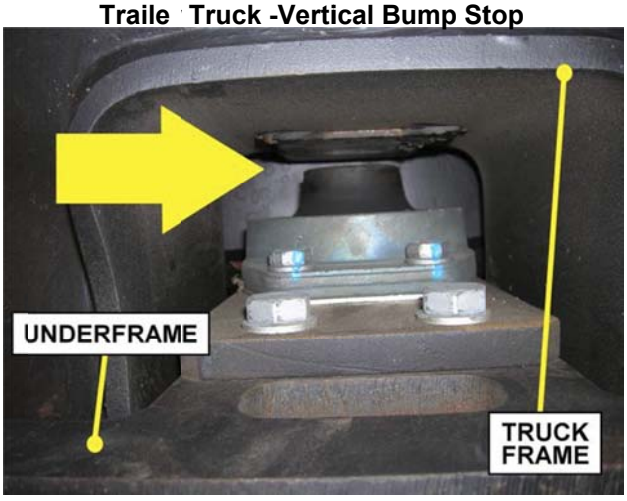
Motor Truck -Vertical Bump Stop



Trailer Truck -Vertical Bump Stop



Motor Truck -Lateral Bump Stop



Trailer Truck -Lateral Bump Stop

Figure 5 - VERTICAL & LATERAL BUMP STOPS - INSPECTION

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
40/56

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:

Man Hours::
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING **1**

Man Hours:
VEHICLE LEVELING **2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

9 Open all Vehicle Doors.

10 Position, at each Doors Opening, as indicated in Fig 6 a Straight Edge on the Vehicle Floor in the center of the Door Opening.

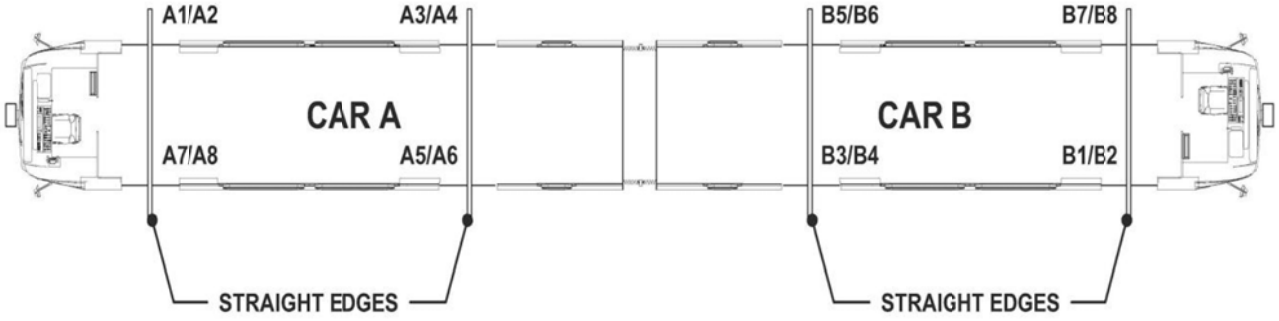


Figure 6 - STRAIGHT EDGES POSITIONING

11 Check (at "A" / "B" Cab -Double Air Pressure Gauge-White Pointer) for the Air Spring Supply Pressure Nominal Value of 140 ± 10 PSI.

12 As per check result proceed with the Task or wait that the Pneumatic Pressure build-up.

Fig 7 AIR SUPPLY PRESSURE NOMINAL -DESIGN DATA

P2550 CORRECTIVE MAINTENA NCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**41/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMI IG	**1**	**VE HICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PRO CEDURE EHICLE LEVELING (CONT'D):

LEVELING

To pe form the Task proceed as follows:

WARNING: HI GH VOLTAGE ON BOARD VEHICLE.

C AUTION: VE RIFY THAT THERE IS NO EQUIPMENT OR ANY IATERIAL ON BOARD THAT C ULD MODIFY THE DISTRIBUTION OF THE VEHI CLE WEIGHS.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**42/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

[redacted]

Figure 9 - AIR SUSPENSION SYSTEM -SCHEMATIC DIAGRAM

P2550 CORRECTIVE MAINTENA ıCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**43/56**

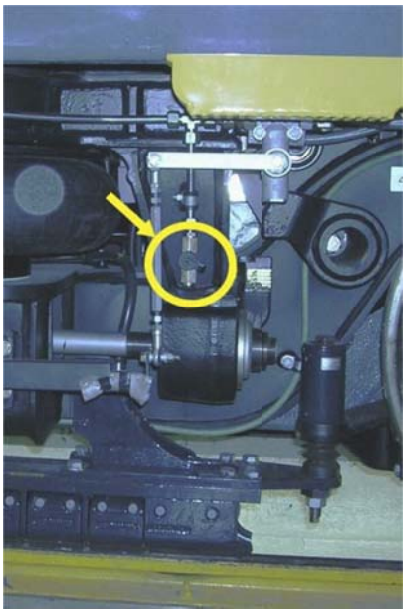
Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMI IG	**1**	**VE HICLE LEVELING**	**2**

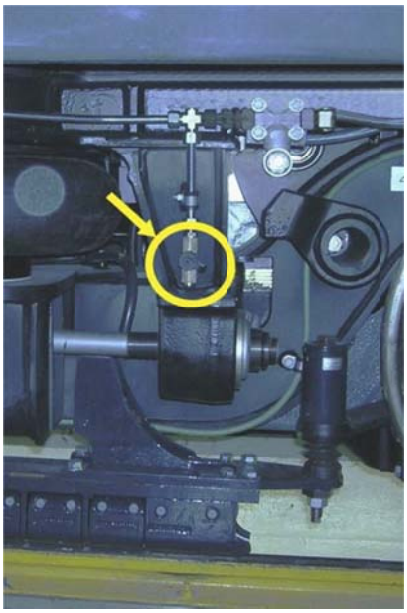
Maintenance Task:
LEVELING

PRO CEDURE EHICLE LEVELING (CONT'D):

Figure 10 - AIR GAUGE -PRE SURE "P" IEASURING



Motor Truck Test Fitting L8



Trailer Truck Test Fitting L8

Figure11 - AIR SPRING -TEST FIT ING

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-01-01-00-00/LL-00**		
System: **VEHICLE SYSTEMS**		Sheet: **44/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:	
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**	
Maintenance Task: **LEVELING**		

PROCEDURE VEHICLE LEVELING (CONT'D):

2 Check the Leveling Valves of each Motor Trucks and of the Trailer Truck for correct working by manually actuating the relevant Operating Lever.

3 Wait that each Leveling Valve reaches a steady working position.

4 On:

- "A" Motor truck (A1/A2 -A7/A8 Door Opening).
- "B" Motor Truck (B1/B2 -B7/B8 Door Opening).
- Trailer Truck (A3/A4 -A5/A6 and B3/B4 -B5/B6 Door Openings).

operate, in sequence, as follows:

a) Position a Straight Edge, at Door Opening, transversally at the track, on the Top of Rail, under and aligned with the relevant Straight Edge previously positioned (refer to Fig 12).

b) Measure at the same time:

- The Dimension "**L**" at Doors Openings (RH & LH) (refer to Fig 12).
- The Dimension "**e**" of Air Springs (RH & LH) (refer to fig 13).
- The Dimension "**f**" of Vertical Bump Stop (RH & LH) (refer to fig 14).
- The pressure Value "**P**" of Air Springs (RH & LH) by means of the previously installed Air Pressure Gauges.

5 Note, on the Report Form provided at the end of this section, each Measured Value.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:
VEHICLE SYSTEMS

Sheet:
45/56

Subsystem/Assy:
VEHICLE AS A WHOLE

Unit:

Man Hours::
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING **1**

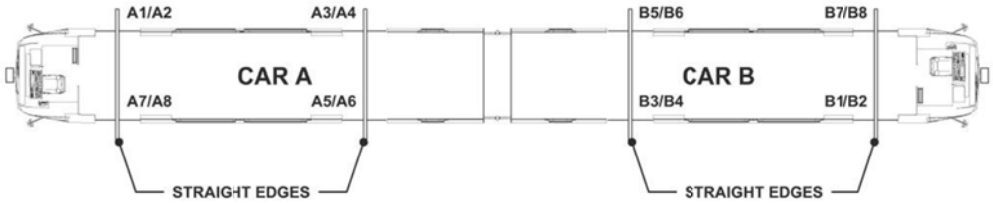
Man Hours:
VEHICLE LEVELING **2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

NOTE: The following Table provides the Nominal Design Values of the Dimensions and Pressure with relevant ranges.

Dimension " L "		Dimension " e"		Dimension " f"		Pressure "P"	
Nominal Value	Range	Nominal Value	Range	Nominal Value	Range	Nominal Value	Range
(Inches)		(Inches)		(Inches)		(PSI)	
38.98	**+0.51 / -0.25**	**6.93**	**+ 0.12 / - 0**	**1.38**	**+0.4 / -0.4**	**62.25**	**+11.6 / -7.25**



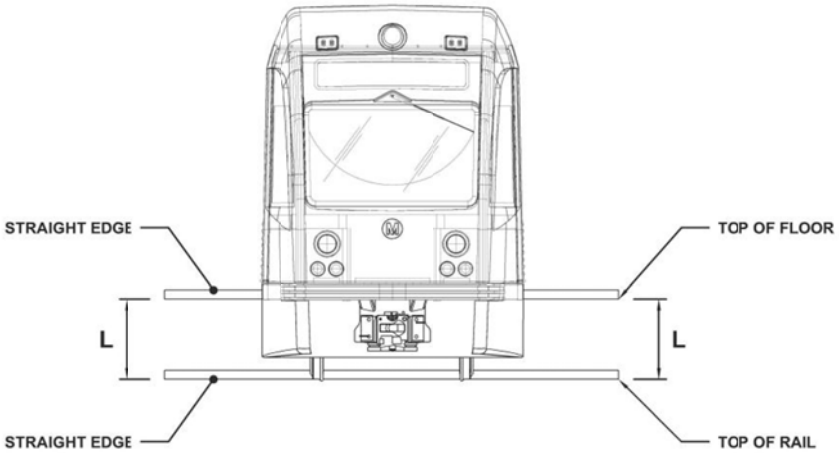


Figure 12 - DIMENSION " L " MEASURING

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**46/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

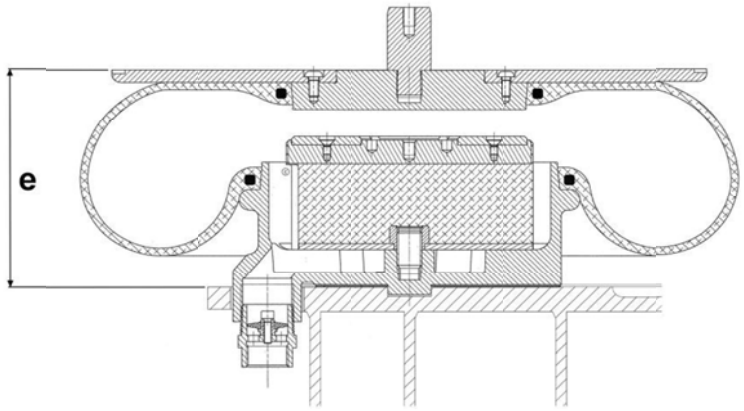


Figure 13 - DIMENSION "e" MEASURING

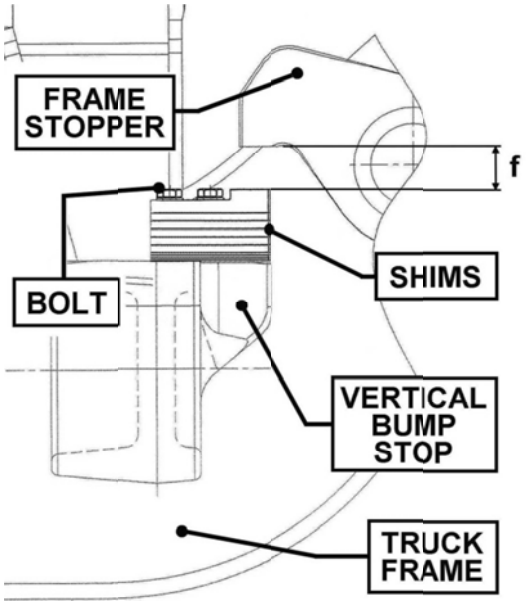


Figure 14 - DIMENSION "f" MEASURING

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**47/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **2**
Maintenance Task: **LEVELING**	

PROCEDURE VEHICLE LEVELING (CONT'D):

NOTE: If any Measured Dimension is Out of Range it is necessary to restore all the Nominal Design Values. To restore the Nominal Design Value of the Vehicle Floor from Top of Rail (Dimension "**L**") complying at the same time the Nominal Design Value of Dimension "**e**" and Dimension "**f**" it is necessary to adjust:

- Each Leveling Valve
- Each Air Spring
- Each Vertical Bump Stop in such a way that the summation of the adjustment reaches the goal

6 As per above measurements proceed as follows:

NOTE: It is assumed that is / are known:

c) The Wheels Average Value of each Truck.
d) The Level difference from Vehicle Floor (at each Doors Opening) and the Station Platform Floor.

a) Check, for each Truck:

a) How many (from the lower)positions each Leveling Valve Adjusting Plate is fixed.
b) How many Air Springs Adjusting Shims are installed on each Air Springs.

NOTE: The Adjusting Plate max sliding from the lower to the upper position is 0.96 inch., corresponding to 4 positions (teeth) since the tooth pitch is 0.24 inch.

NOTE: The thickness of each Air Spring Adjusting Shim is 0.08 inch. The shims is shaped with an open slot to ease the installation / removal.

b) Determine, according to:

- The above known Values,
- The Nominal Design Limits to be complying
- The above Check Result:

a) How many positions each Leveling Valve Adjusting Plate should be moved up or down.
b) How many Air Springs Adjusting Shims are needed to be installed or removed on/ from each Air Springs.

c) Determine if:

- The "new" position of each Leveling Valve Adjusting Plate will be **In** or **Out** of its range (**0.96**inch).
- The "new" thickness of the Air Springs Adjusting Shims will be **In** or **Out** of its range (**0.79** inch).

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**48/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

7 In case that **BOTH RANGES ARE COMPLIANT** with the above Values, the Leveling Procedure should be completed by performing the LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING procedure provided at the beginning of this sheet.

8 In case **ONE OR BOTH RANGES IS / ARE NOT COMPLIANT** with the above Values, the Leveling Procedure must be completed by proceeding as follows:

a) Raise the (Car Hoist System) Body Stands until they put under stress the Car Body Jacking Pads (YELLOW).

b) Close Air Suspension System (Vented) Cut-Out Cock to release Pneumatic Pressure from Air Suspension System (refer to Fig 15).

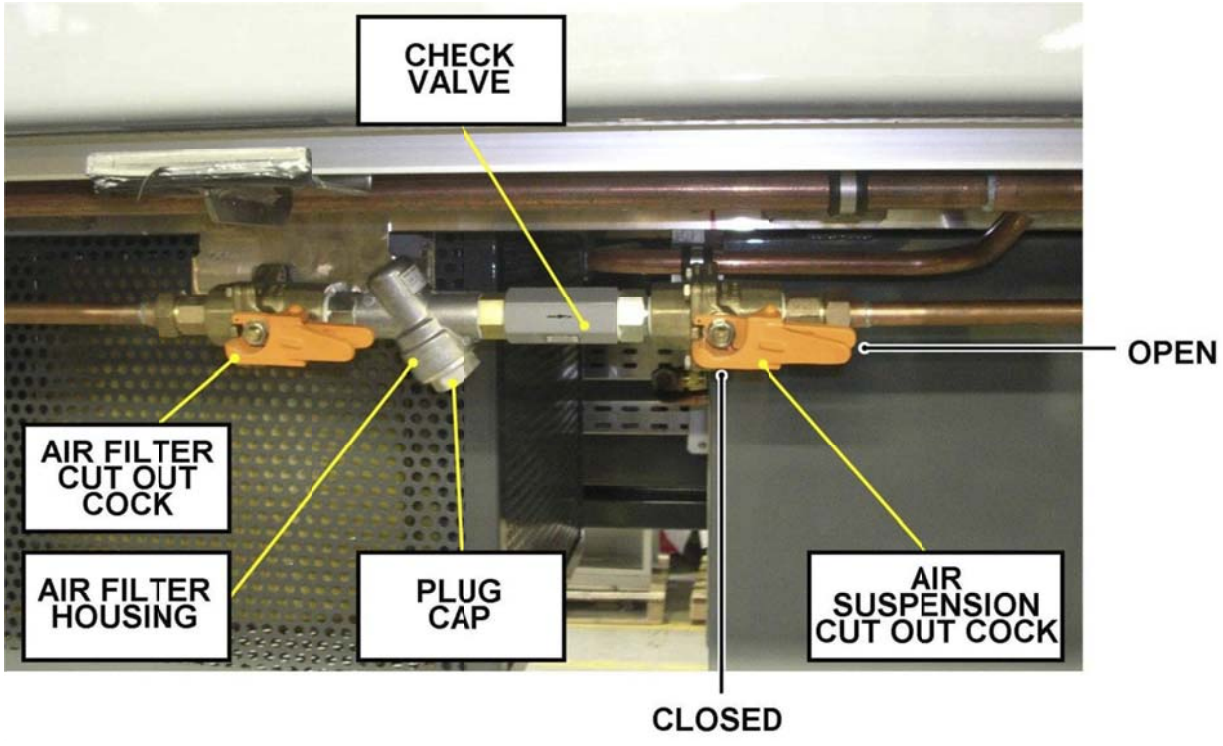


Figure 11 - AIR SUSPENSION (VENTED) CUTOUT COCK

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**49/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

c) Operate the (Car Hoist System) Body Stands in ALL BODY STANDS mode to raise the Vehicle in order to have the clearance necessary to install or remove the Quantity of Air Springs Adjusting Shims previously determined (refer to previous Step 6 b).

WARNING: **(CAR HOIST SYSTEM) BODY STANDS MUST BE CORRECTLY POSITIONED AND INSTALLED AT THE PROPER LOCATIONS BEFORE SUPPORTING THE VEHICLE ON THE CAR BODY JACKING PADS.**

CAUTION SINCE THE AIR SPRINGS ARE NOT PRESSURIZED, PAY ATTENTION TO NOT RAISE THE VEHICLE MORE THAN 1.8" TO AVOID THE DISENGAGEMENT OF THE AIR SPRING PINS FROM THE BOLSTER BEAM OF THE TRUCK.

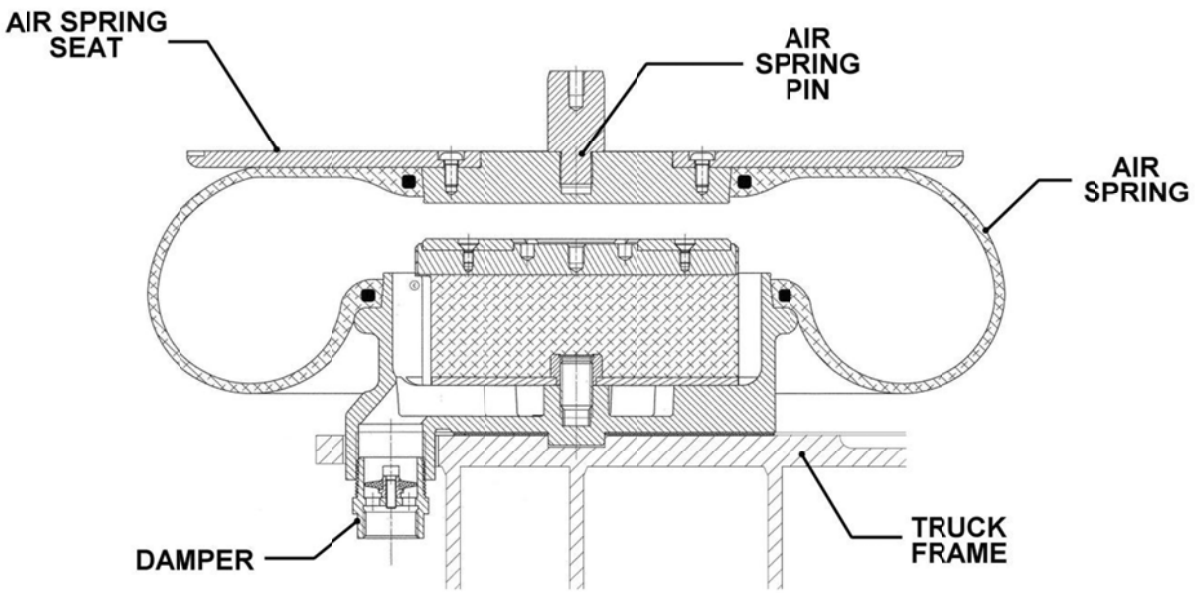


Figure 16 - AIR SPRING -PIN

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**50/56**

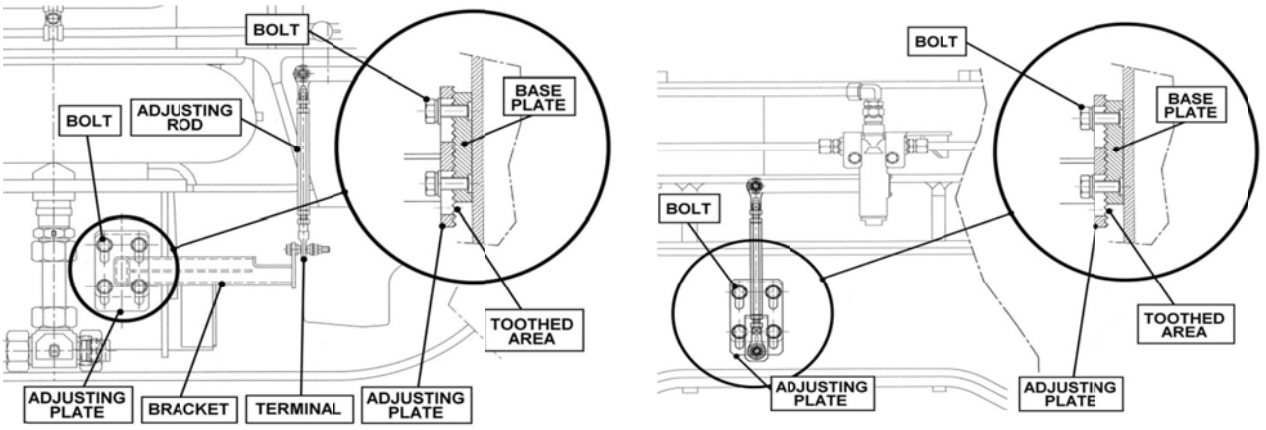
Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

d) Install / remove on / from each Air Spring the Quantity of Air Springs Adjusting Shims previously determined (refer to previous Step 6).
e) Note, on the Report Form provided at the end of this section, the (Final) Qty of Shims and the relevant Shims Total Thickness installed.
f) Loose the four (4) Bolts attaching each Leveling Valve Adjusting Plate to the Truck Frame.
g) Slide **fully down** each Adjusting Plate.
h) Torque the Adjusting Plate Bolts to **30 ft-lb**.



Motor Trucks -Leveling Valve Adjusting Plate **Trailer Trucks -Leveling Valve Adjusting Plate**

Figure 17 - LEVELING VALVE ADJUSTING PLATE

i) Open Air Suspension System (Vented) Cut-Out Cock of each Truck to restore Pneumatic Pressure to Air Suspension System (refer to previous Fig 15).
j) Verify that Pneumatic Pressure build up to Nominal Value of 140±10 PSI (at "A" / "B" Cab -Double Air Pressure Gauge - White Pointer).
k) Lower the Vehicle by operating the (Car Hoist System) Body Stands in LOWER ALL BODY STANDS mode.
l) Wait that the Leveling Valves of all Trucks reach a steady working position.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**51/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

m) Operate on each Truck as follows:

I. Check dimension "**L**".

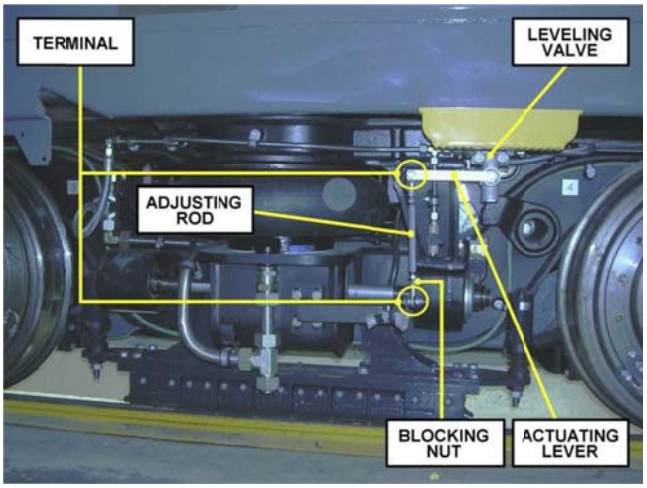
II. Loose the Blocking Nut of each Leveling Valve Adjusting Rod.

III. Rotate the Adjusting Rod in:

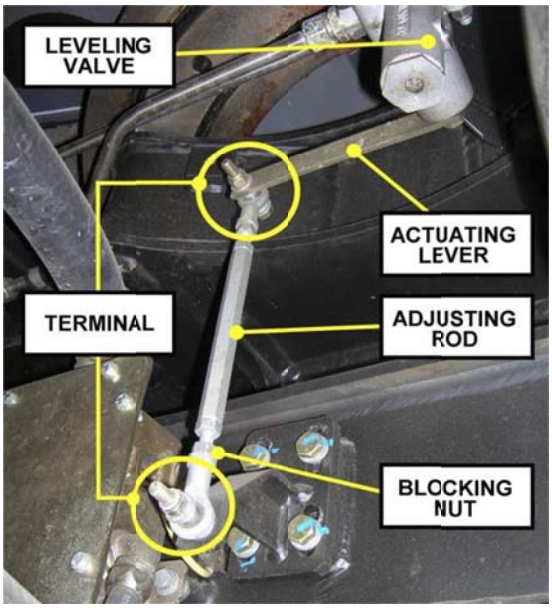
- clockwise direction if it is necessary to decrease the dimension "**L**" to comply its Nominal Design Value.
- counter-clockwise direction if it is necessary to increase the dimension "**L**" to comply its Nominal Design Value.

NOTE: It is recommended to slide up the Leveling Valve Adjusting Plate when the Length of the Adjusting Rod is about or greater than its Nominal Design Value (9.84 inch).

NOTE: Do not torque the Blocking Nut of each Adjusting Rod until the Procedure is completed.



Motor Truck Adjusting Rod



Trailer Truck Adjusting Rod

Figure 18 - LEVELING VALVE ADJUSTING ROD AND BLOCKING NUT

P2550 CORRECTIVE MAINTENANCE SHEET

Card Code: **R-C-01-01-00-00/LL-00**		
System: **VEHICLE SYSTEMS**		Sheet: **52/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:	
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**	
Maintenance Task: **LEVELING**		

PROCEDURE VEHICLE LEVELING (CONT'D):

n) Once Dimension "**L**" is compliant with the Nominal Design Value on all Trucks proceed as follows:

NOTE: It is recommended to operate at the same time on all Trucks.

o) Partially release the pressure in the Air Springs of each Truck by closing and opening alternatively the Air Supply Suspension System Cut-Out Cocks (L1.4 - refer Previous to fig 9) in order to lower the Car Bodies Sections about **1** inch.
p) Verify that the Car Bodies Sections lower.
q) Open the Air Supply Suspension System Cut-Out Cock (L1.4 - refer previous to Fig 9 in order to restore the Air Pressure to the Air Suspension System of each Truck.
r) Wait that the Leveling Valves of all Trucks reach a steady working position.
s) Measure at the same time, on each Truck:

- The Dimension "**L**"at Doors Openings (RH & LH) (refer to previous Fig 12).
- The Dimension "**e**"of each Air Spring (RH & LH) (refer to fig previous Fig 13).
- The Dimension "**f**"of each Vertical Bump Stop (RH & LH) (refer to previous Fig 14).
- The pressure Value "**P**" of each Air Spring by means of the previously installed Air Pressure Gauges (RH & LH).

NOTE: Repeat steps 8m through 8s if any Measured Value is **out** of the relevant Nominal Design Value Range.

t) Torque the Blocking Nut of each Leveling Valve Adjusting Rod when all the Measured Values are in the Range of the relevant Nominal Design Value:
u) Note, on the Report Form provided at the end of this section, each **Final Measured Value.**

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**53/56**
Subsystem/Assy: **VEHICLE AS A WHOLE**	Unit:
Man Hours:: **LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING** **1**	Man Hours: **VEHICLE LEVELING** **2**
Maintenance Task: **LEVELING**	

PROCEDURE VEHICLE LEVELING (CONT'D):

9) Once the Vehicle Floor Level has been restored to Nominal Design Value proceed as follows to complete the Adjustment Operations:

a) Check that the Dimension "**f**" on each Truck is compliant with the Nominal Design Value of **1.38 ± 0.4 in.** (refer to fig 14).

b) As per check result, to restore the Nominal Value of Dimension "**f**" proceed as follows, on each Truck:

I. Unscrews and remove the Bolts, Washers and Nuts retaining the Vertical Bump Stop Shims. Retain hardware for later use.
II. Install or Remove the Vertical Bump Stop Shims, in order to comply the Nominal Design Data Limit of the dimension "**f**".
III. Note, on the Report Form provided at the end of this section, the **(Final) Total Thickness of Shims** installed.
IV. Install the Bolts, Washers and Nuts to retain the Vertical Bump Stop Shims in working position.
V. Torque the Vertical Bump Stop Shims to **25 ft -lb**.

c) Check that Dimension "A" of each Coupler Head is compliant with the Nominal Design Value of **20.08 ±0.8** in. (refer to Fig 19).

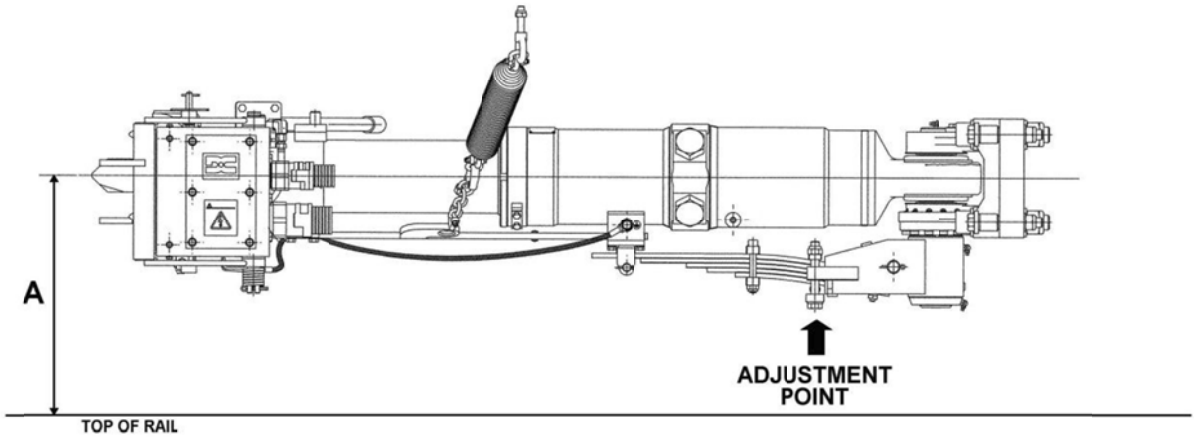


Figure 19 - MECHANICAL COUPLER HEAD -DIMENSION "A" MEASURING

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**54/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

d) As per check result, to restore the Nominal Value of Dimension "**A**" proceed as follows (refer to Fig 20):

- To raise the Coupler:
  - I. Loose the Nuts a couple of threads.
  - II. Turn the Screws clockwise holding the Nuts with a Socket Wrench.
- To lower the Coupler:
  - I. Loose the Nuts a couple of threads.
  - II. Turn the Screws counter clockwise holding the Nuts with a Socket Wrench.
  - III. Turn both Screws the same number of turns.
  - IV. Torque the Screws to **20 ft-lb (27 Nm)**.

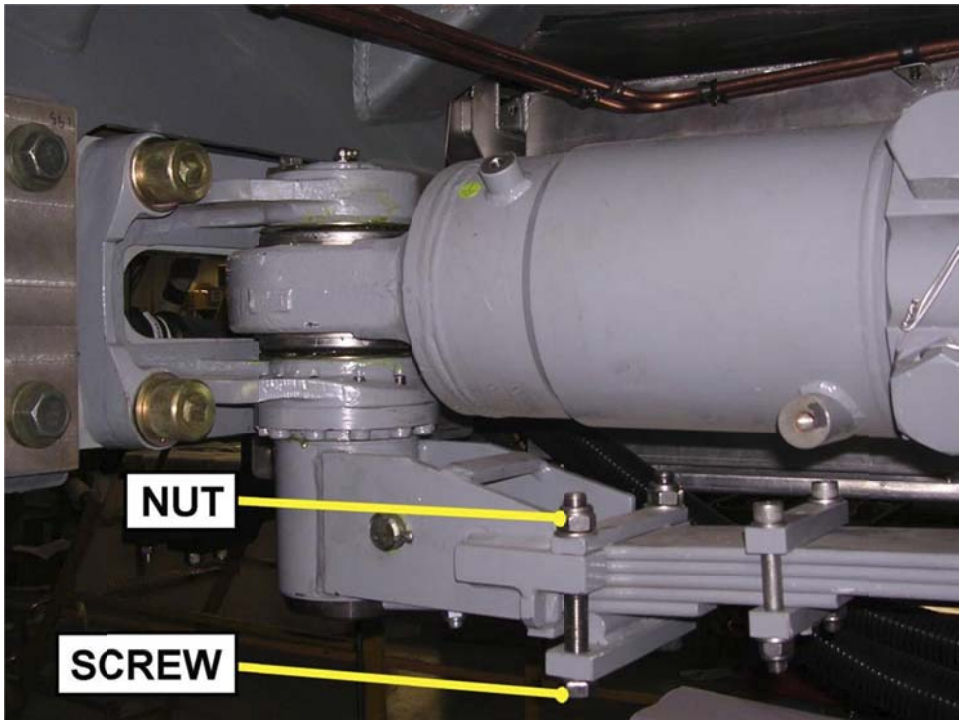


Figure 20 - MECHANICAL COUPLER HEAD -DIMENSION "A" ADJUSTMENT

e) Note, on the Report Form provided at the end of this section, the Measured Value of Dimension "A" for each Coupler.

P2550 CORRECTIVE MAINTENANCE SHEET

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

System:	Sheet:
VEHICLE SYSTEMS	**55/56**

Subsystem/Assy:	Unit:
VEHICLE AS A WHOLE	

Man Hours::		Man Hours:	
LEVELING VALVES ADJUSTMENT & TRUCKS SHIMMING	**1**	**VEHICLE LEVELING**	**2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE LEVELING (CONT'D):

FINAL OPERATIONS

Once complete the Task proceed as follows:

1 Operate the Parking Brake Release Handle (Cab) to NORMAL position.
2 Remove the Parking Brakes Cut Out status by rotating the Parking Brakes Cut Out Cock (RED) to WORK (horizontal) position.
3 Remove the Friction Brakes Cut Out status by rotating the Friction Brakes Cut -Out Cock (ORANGE) to WORK position.
4 Remove all Air Pressure Gauges installed on Test Fittings L8.
5 Remove all Straight Edges.
6 Close all Doors.
7 Set the Transfer Switch to OFF.
8 Record Task result on the Defect Report Card for administrative and maintenance planning.

P2550 CORRECTIVE MAINTENANCE S HEET

Card Code:
R-C-01-)1-00-0)/LL-00

System:
VEHICL E SYS 'EMS

Sheet:
56/56

Subsystem/Assy:
VEHICLE AS A WH)LE

Unit:

Man Hours::
LEVELING VA .VES ADJU TMENT & TRUCKS SHIM MING **1**

Man Hours:
VEHICLE LEVELING **2**

Maintenance Task:
LEVELING

PROCEDURE VEHICLE .EVELING (CONT'D):

VEHICLE LEVELING-REPORT								
P2550	VEHICLE #		DATE	/ / /	RUNNING MILES			
DI IENSION			TRUCK					
IDENT	NOMINAL		"A"		"C"		"B"	
	)ESIGN VALUE		MEASURED VALUES					
	(inches)	Range	RH	LH	RH	LH	RH	LH
e	6.93	+ .12						
f	1.38	- 0 +).4						
		-).4						
	(PSI)	Range						
P	62.25	+11.6						
		-7.25						
	(inches)	Range	CAR "A" DATA		CAR "B " DATA			
			COUPLER "A"		:OUPLER "B"			
A	20.08	+).8						
		-).8						
			DOORS					
	(inches)	Range	A1/A2	A7/A8	A3/A4	A5/A6	B3/B4	B5/B6	B1/B2	B7/B8
L	38.98	+0.51								
		-0.25								
			AIR SPRINGS - SHIMS THIC KNESS							
			RH	LH	RH		LH		RH	LH
			VERTICAL BUMPS STOPS -SHIMS THICKNESS							
			RH	LH	RH		LH		RH	LH

01-III-05 CONSUMABLE MATERIALS LIST (R-CML)

Not Applicable

01-III-06 TEST EQUIPMENT & SPECIAL TOOLS LIST (R-TESTL)

The Tools and Test Equipment needed to accomplish the Vehicle Systems -" Vehicle as a Whole " Running Maintenance are listed, sequenced in alphabetical order, by SUBSYSTEM /ASSY -UNIT / COMPONENT, in the following Table 01-III-06.1.

Refer to "Tools and Test Equipment Manual" for Special Tools / Test Equipment Description and Maintenance.

Table 01-III-06.1 Running -Test Equipment & Special Tools List (R-TESTL)

SYSTEM 01	VEHICLE SYSTEMS			
SUBSYSTEM / ASSY - UNIT / COMPONENT	**LACMTA STANDARD TOOLS KIT**	**LACMTA WORKSHOP DEVICES**	**SPECIAL TOOL / TEST EQUIPMENT**	**PN**
VEHICLE AS A WHOLE		Flexible Steel Meter		
		Straight Edges minimum length: 118 inches, QTY=5		
		Straight Edges minimum length: 118 inches, QTY=5		
		Air Gauges (with adapter for Test Fitting L8), scale 0÷200 PSI, interval 1 PSI, QTY=5		

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