



Metro™

Los Angeles LRV

INTRODUCTION



Section 0000 RUNNING MAINTENANCE & SERVICING MANUAL

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line.

Total number of pages in this section (0000) is **114** consisting of the following:

Original	0	October 2020
Revision	1	April 2021
Revision	2	October 2021
Revision	3	April 2022
Revision	4	October 2022
Revision	5	April 2023
Revision	6	October 2023

<u>PAGE</u>	<u>CHANGE NO.</u>	<u>PAGE</u>	<u>CHANGE NO.</u>
i through ii	6	3-28 through 3-30	0
iii through iv	0	3-31	1
v	1	3-32	0
vi through viii	0	3-33 through 3-34	5
ix	5	3-35 through 3-36	6
x	0	3-37	4
1-1 through 1-2	0	3-38	0
2-1 through 2-4	5	3-39	2
2-5 through 2-10	0	3-40 through 3-42	5
3-1	0	3-43	0
3-2	1	3-44	1
3-3 through 3-7	0	3-45	0
3-8 through 3-14	5	3-46	5
3-15 through 3-18	0	4-1 through 4-6	0
3-19	4	5-1 through 5-2	0
3-20 through 3-23	0	5-3	1
3-24	3	5-4	0
3-25	4	6-1 through 6-2	0
3-26	0	7-1 through 7-5	0
3-27	6	7-6 through 7-8	1

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line.

<u>PAGE</u>	<u>CHANGE NO.</u>	<u>PAGE</u>	<u>CHANGE NO.</u>
8-1 through 8-4	0		
9-1 through 9-2	0		
10-1 through 10-12	5		
11-1 through 11-6	0		
I-1 through I-2	0		

SAFETY SUMMARY

Some of the procedures in this section are preceded by warnings/cautions regarding potential hazards in handling this equipment. These warnings/cautions should be carefully read and understood before proceeding. Failure to observe these precautions may result in serious injury to personnel performing the work and/or bystanders. The key warnings for this equipment are as follows:

Electrical - The electrical equipment described in this manual operates at voltages and currents that are extremely dangerous to life. Personnel should closely observe all generally prescribed cautions and warnings before performing any work on the LRV.

Chemicals – Follow safety precautions for handling hazardous chemicals as provided by the manufacturer. The manufacturer's warnings should be closely heeded to avoid personal injury.

Location – Special caution should be taken when accessing or servicing equipment located on the roof and under the car.

Weight – To prevent possible personal injury when attempting to remove or install equipment on the vehicle, adequate support of a lifting device must be used to prevent the equipment from falling. Personnel's failure to heed these warnings could result in severe injury or death and or damage to the equipment.

Contact – Some components can attain temperatures that can cause severe burns. Closely follow all warnings and recommended procedures for handling components.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

Chapter/Para	Page
LIST OF EFFECTIVE PAGES.....	i
SAFETY SUMMARY	iii
TABLE OF CONTENTS	v
LIST OF ILLUSTRATIONS	vii
LIST OF TABLES.....	ix
1.0 INTRODUCTION.....	1-1
2.0 GENERAL DESCRIPTION	2-1
2.1 Specifications	2-9
3.0 SCHEDULED MAINTENANCE TASKS.....	3-1
3.1 Introduction.....	3-1
3.2 Scheduled Maintenance Index	3-1
4.0 GENERAL MAINTENANCE GUIDELINES.....	4-1
4.1 Introduction.....	4-1
4.1.1 Electric Shock Hazard.....	4-3
4.1.2 Thermal Burns Hazard.....	4-3
4.1.3 Preparing Propulsion Inverter or Auxiliary Power Supply for Inspection...	4-3
4.2 Maintenance Philosophy	4-4
4.3 Safety.....	4-4
4.4 General Maintenance Guide	4-5
5.0 ELECTROSTATIC DISCHARGE	5-1
5.1 Introduction.....	5-1
5.2 Methods of Protection	5-1
5.2.1 Grounding the Maintenance Technician	5-1
5.2.2 Material Handling	5-1
5.2.3 Static-Proofing the Work Station.....	5-2
5.3 ESD Prone Clothing, Materials and Tools.....	5-3
6.0 STORAGE AND HANDLING.....	6-1
6.1 Introduction.....	6-1
7.0 STANDARD REMOVAL AND INSTALLATION SHOP PRACTICES	7-1
7.1 Introduction.....	7-1
7.2 Mounting Hardware.....	7-1
7.3 Torquing Practices.....	7-4
7.4 Torquing Methods	7-4
7.5 General Guide for Maximum Torque Values	7-5
8.0 SAFETY WIRE PRACTICES.....	8-1
8.1 Introduction.....	8-1
8.2 Wire Materials	8-1
8.3 Wire Size.....	8-1
8.4 Common Safety-Wiring Practices.....	8-1

TABLE OF CONTENTS

Chapter/Para	Page
8.5 Methods.....	8-2
8.6 Safety Wire Procedures	8-3
8.7 Twisting With Special Tools	8-3
9.0 COTTER PIN APPLICATION PRACTICES	9-1
9.1 Introduction.....	9-1
9.2 Application Methods	9-1
10.0 ACRONYMS AND ABBREVIATIONS	10-1
10.1 Introduction.....	10-1
11.0 GLOSSARY OF TERMS	11-1
11.1 Introduction.....	11-1
INDEX	I-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
2-1:	LACMTA P3010 LRV Equipment Locations	2-3/4
2-2:	Underfloor Equipment Layout, A-Unit	2-5/6
2-3:	Underfloor Equipment Layout, B-Unit	2-7/8
7-1:	Standard Grade Marking Chart	7-2
7-2:	Metric Grade Marking Chart (2 Sheets)	7-3
8-1:	Single Wire and Double Twist Applications	8-2
8-2:	Double Twist Method by Hand	8-3
9-1:	Correct Cotter Pin Applications	9-1

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table	Title	Page
3-1.	Car Body Scheduled Maintenance.....	3-1
3-1a.	Car Body (including TOA Communications) Scheduled Maintenance	3-8
3-2.	Coupler Scheduled Maintenance	3-15
3-3.	Doors Scheduled Maintenance	3-16
3-4.	HVAC Scheduled Maintenance.....	3-19
3-5.	Lighting Scheduled Maintenance	3-22
3-6.	Propulsion Scheduled Maintenance.....	3-23
3-7.	Pantograph Scheduled Maintenance	3-27
3-8.	Auxiliary Inverter Scheduled Maintenance	3-28
3-9.	Track Brakes Scheduled Maintenance	3-30
3-10.	Battery Scheduled Maintenance	3-31
3-11.	Truck and Suspension Scheduled Maintenance.....	3-32
3-12.	Friction Brakes Scheduled Maintenance.....	3-36
3-13.	Communications Scheduled Maintenance.....	3-39
3-13a.	Communications (TOA) Scheduled Maintenance	3-40
3-13b.	Communications (including TOA Equipment) Scheduled Maintenance	3-41
3-14.	ATC / TWC Scheduled Maintenance	3-43
3-15.	Event Recorder Scheduled Maintenance.....	3-43
3-16.	Data Communications (TCN) Scheduled Maintenance	3-44
3-17.	Train Controls and Diagnostics (MDS) Scheduled Maintenance	3-44
3-18.	CCTV Scheduled Maintenance	3-45
7-1.	Standard Fastener Torques for LACMTA P3010 LRV	7-5
7-2.	Standard Metric Torques for LACMTA P3010 LRV	7-6
9-1.	Cotter Pin Sizes.....	9-2
10-1.	Acronyms and Abbreviations.....	10-1
11-1.	Glossary of Terms	11-1

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 1.0

INTRODUCTION

The Running Maintenance and Servicing Manual provides maintenance technicians with the maintenance information required to maintain, service, lubricate, inspect and adjust the equipment on the LACMTA P3010 Light Rail Vehicles (LRVs).

The complete Running Maintenance and Servicing Manual is divided into volumes which are divided into sections. Each section contains chapters that include specific instructions for running maintenance activities which include scheduled maintenance activities, on-car servicing, inspection, repairing and troubleshooting the equipment covered therein. The data contained in each section is provided by, and in many cases, prepared by each of the equipment manufacturers. Scheduled maintenance is a predetermined program of maintenance activity, where properly functioning equipment is inspected, serviced and repaired while remaining in service or withdrawn from service to allow certain maintenance items to be performed. The purpose of this manual is to ensure that the car remains in good running order, and to prevent problems and failures due to ageing and faulty equipment by replacing them before they fail.

The running maintenance tasks outlined in this manual and in the Scheduled Maintenance tables in Chapter 3.0, should be used as a guide for inspecting and servicing the vehicles. This table is provided to help the maintenance technicians perform maintenance tasks in a periodic manner according to this table. Each task then refers the reader to the appropriate manual section where the maintenance procedure is defined. Detailed procedures will be available in the appropriate maintenance manuals for the system / subsystem.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 2.0

GENERAL DESCRIPTION

The LA P3010 Light Rail Vehicles (LRVs) consist of several major car systems and subsystems. See Figures 2-1 through 2-3. These systems are designed to interface and generate the most efficient and safe train operation available while in service. The LA P3010 LRV Running Maintenance and Servicing Manual, to the greatest extent possible, is divided according to these systems and subsystems. The major systems include, but are not limited to the following:

- 0100, Vehicle Systems
 - Various Suppliers (See Figure 2-1)
- 0200 Carbody and Articulation
 - Kinki Sharyo Co. Ltd.
- 0201 Carbody and Articulation (including TOA Communications)
 - Kinki Sharyo Co. Ltd.
 - TOA Engineering
- 0300 Coupler
 - Dellner, Inc.
- 0400 Doors
 - IFE North America
- 0500 Heating, Ventilation and Air Conditioning (HVAC)
 - Merak North America
- 0600 Lighting
 - Teknoware USA (formerly Trans-Lite)
- 0700 Propulsion
 - Toyo Denki USA
- 0800 Pantograph
 - TransTech Power Transfer Systems
- 0900 Auxiliary Inverter
 - PowerTech Converter Corporation (formerly KB Powertech Corp. USA)
- 1000 Track Brakes
 - Knorr Brake Company, LLC.

- 1100 Battery
 - Saft America Inc.
- 1200 Truck and Suspension
 - Kinki Sharyo Co. Ltd.
- 1300 Friction Brakes
 - Knorr Brake Company, LLC.
- 1400 Communications
 - Rail Transit Consultants, Inc.
- 1401 TOA Communication System
 - TOA Engineering
- 1402 Communications (including TOA Equipment)
 - Rail Transit Consultants, Inc.
 - TOA Engineering
- 1500 Automatic Train Control (ATC) / Train-to-Wayside Communications (TWC)
 - Hitachi Rail STS, USA, Inc. (formerly Ansaldo, STS — USA)
- 1600 Event Recorder
 - Rail Transit Consultants, Inc.
- 1700 Data Communications (TCN)
 - Rail Transit Consultants, Inc.
- 1800 Train Controls & Diagnostics (MDS)
 - Rail Transit Consultants, Inc.
- 1900 CCTV
 - Rail Transit Consultants, Inc.

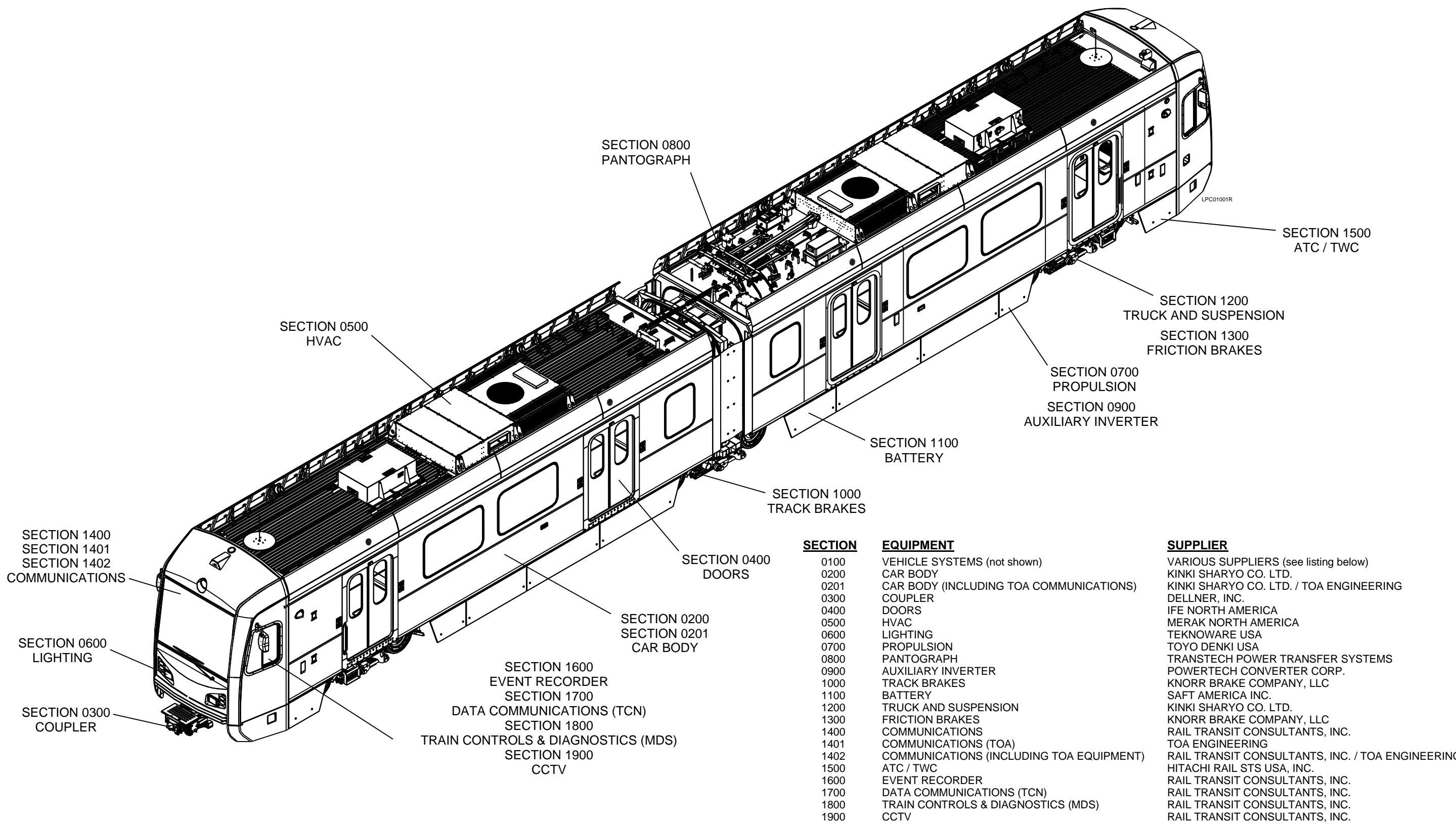


Figure 2-1: LACMTA P3010 LRV Equipment Locations

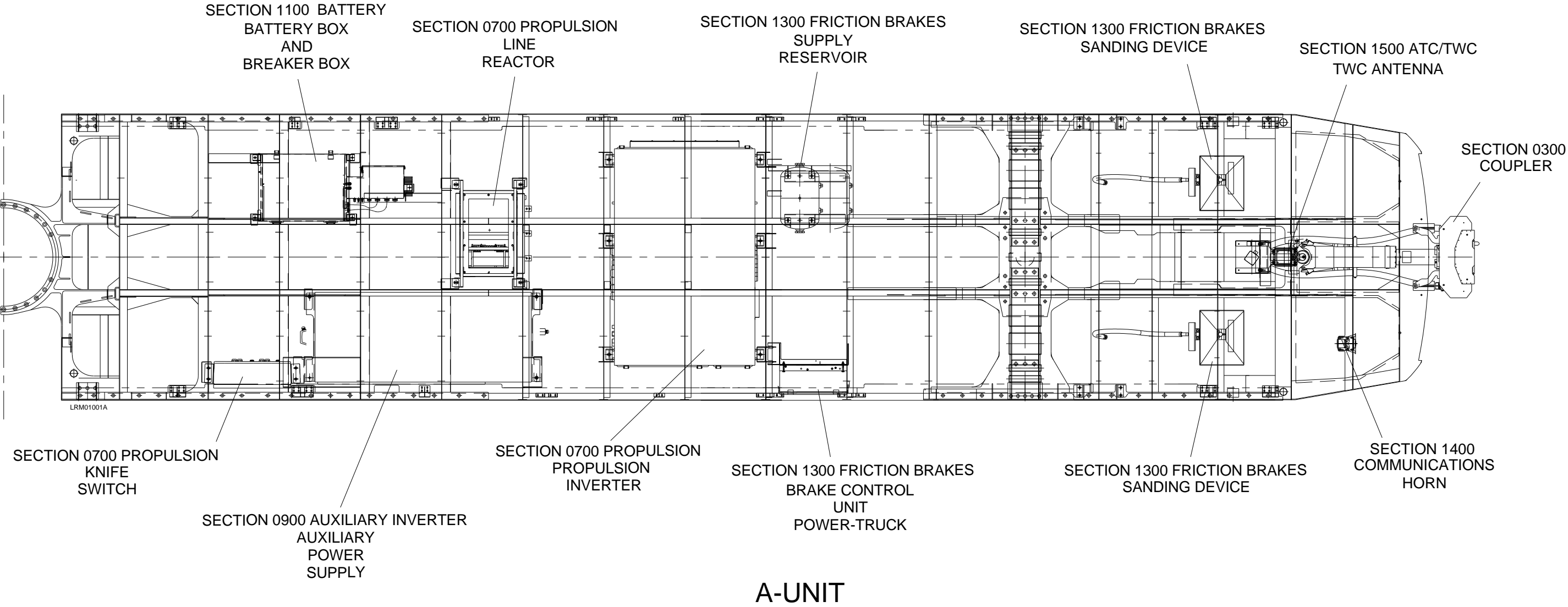


Figure 2-2: Underfloor Equipment Layout, A-Unit

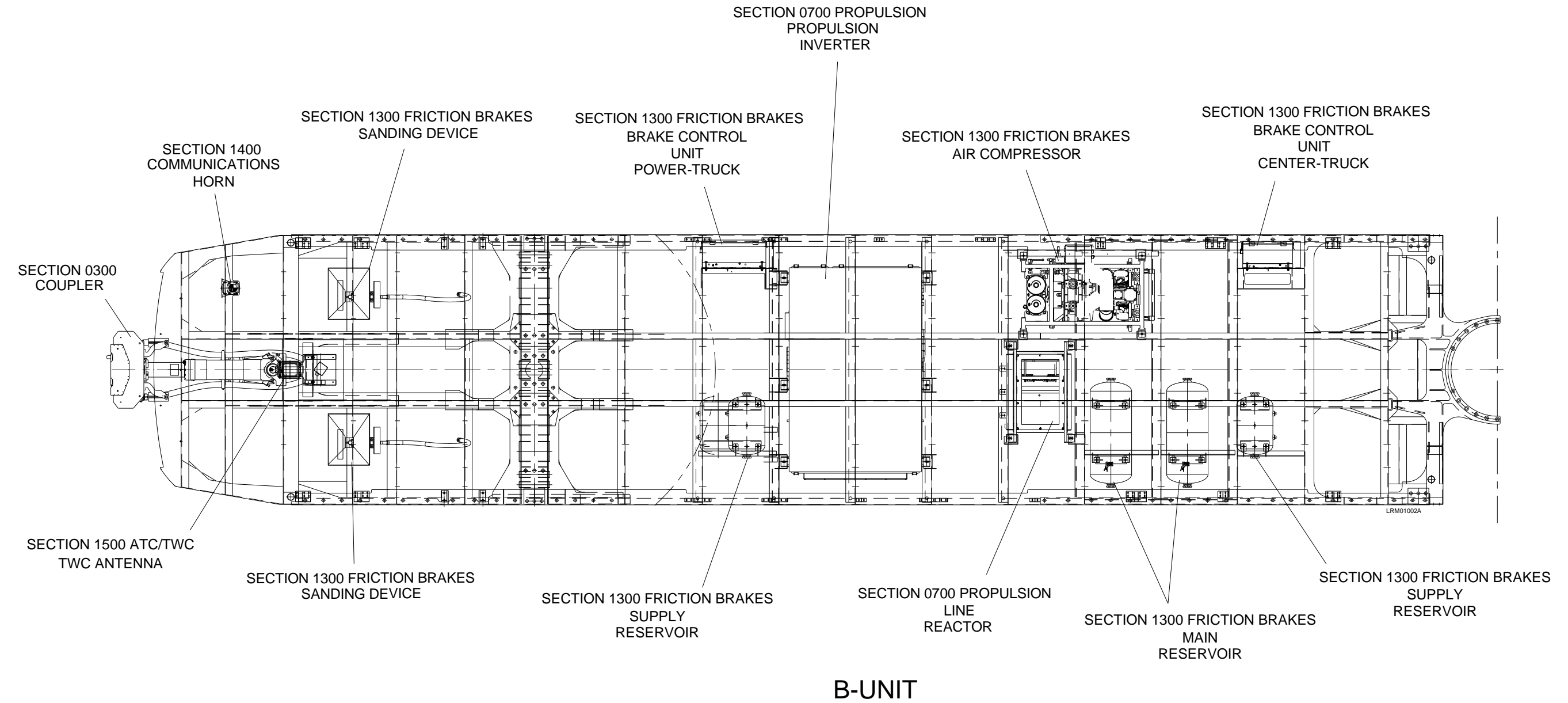


Figure 2-3: Underfloor Equipment Layout, B-Unit

2.1 Specifications

General Dimensions

Length of car on center line over anti-climber	26,548mm (87 ft. 1 in.)
Length of car over coupler pulling faces	27,218mm (89 ft. 4 in.)
Width of car, overall	2,652mm (8 ft. 8 in.)
Wheel diameter, new wheels	711mm (28 in.)
Wheel diameter, worn wheels	660mm (26 in.)
Distance, center to center of trucks	8,675mm (28 ft. 6 in.)
Truck wheel base:	
power truck	2,150mm (7 ft. 1 in.)
center truck	2,150mm (7 ft. 1 in.)
Maximum height of car from top of rail with locked down pantograph	3,810mm (12 ft. 6 in.)
Minimum OCS height to operate car	4,039mm (13 ft. 3 in.)
Maximum OCS height to operate car	7,163mm (23 ft. 6 in.)
Height of car floor from top of rail	996mm (3 ft. 3 in.)
Height of center line of coupler face from top of rail	510mm (1 ft. 8 in.)

Vehicle Weight and Capacity

AWO: Empty car operating weight	45,000 kg (99,208 lbs.)
AW1: Seated - 68 Passengers + 1 Operator	49,830 kg (109,856 lbs.)
AW2: Service - 68 Passengers + 1 Operator & 95 Standees	56,480 kg (124,517 lbs.)
AW3: Crush - 68 Passengers + 1 Operator & 143 Standees	59,840 kg (131,925 lbs.)

Vehicle Speed and Acceleration

Maximum Operational Speed	105 km/h (65 mph)
Maximum Design Speed	113 km/h (70 mph)
Car Wash Speed	less than 3.2 km/h (2.0 mph)
Towing Speed Restriction	56 km/h (35 mph)
Maximum Acceleration Rate	1.34 m/s/s (3.0 mphps)
Full Service Braking Rate	1.56 m/s/s (3.5 mphps)
Emergency Braking Rate (minimum based on average)	2.3 m/s/s (5.2 mphps)

Wayside Power Supply

The source of the overhead catenary system voltage is 12-pulse rectification

Overhead Catenary System Voltage Conditions

Nominal	750 Vdc
Maximum Sustained	900 Vdc
Maximum Non-Sustained	1000 Vdc
Minimum Sustained	525 Vdc
Minimum Non-Sustained	475 Vdc

CHAPTER 3.0

SCHEDULED MAINTENANCE TASKS

3.1 Introduction

This chapter lists the scheduled maintenance index of maintenance and service that is necessary in order to maintain performance and reliability of the LA P3010 LRVs. The following index and its procedures must be properly accomplished for equipment warranty conditions to apply and to also assist in maintaining product performance over an extended period of time.

3.2 Scheduled Maintenance Index

The following tables list the frequency of all maintenance tasks required for the P3010 LRVs. These tables are listed in the order of the P3010 manual breakdown.

These schedules describe the minimum recommended maintenance to be regularly performed on the vehicle. More frequent maintenance of these tasks may be required if environmental or other conditions so dictate. The reference column indicates the sections of the Running Maintenance and Servicing Manual that details the procedures.

Table 3-1. Car Body Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
Daily	Operator's Seat	Operate seat through a full functional test. Make sure all seat controls operate properly	5.3.1.3.1
Daily	Operator's Seat	Inspect seat cushions for condition and cleanliness	5.3.1.3.2
Daily	Cab Light	Functionally test the Cab Light for proper operation	5.3.1.5 & Section 0600
Daily	Cab Console Light	Functionally test the Cab Console Light for proper operation	5.3.1.6 & Section 0600
Daily	Front Destination Sign	Visually inspect all signs	5.3.1.12
Daily	Wayside Worker Alert System	Visually inspect for damage	5.3.1.35
Daily	Windows	Wipe clean window assembly	5.3.2.5.1
Daily	Windows	Visually inspect window assembly	5.3.2.5.2
Daily	Windows	Visually inspect gaskets for damage	5.3.2.5.3
Daily	Grab Rails	Inspect for loose or missing hardware and clean	5.3.3.1
Daily	Side Destination Signs	Visually inspect for defective LED's	5.3.3.7

Table 3-1. Car Body Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
Weekly	Floor Panels	Clean floor panels (Abrastop™)	5.3.3.8
10,000 miles	Operator's Seat	Clean seat assembly	5.3.1.3.3
10,000 miles	Operator's Seat	Inspect seat for loose or missing fasteners	5.3.1.3.4
10,000 miles	Windshield Sun Shade	Visually inspect for rips, holes, loose hardware, proper operation and alignment	5.3.1.7
10,000 miles	Side Window Sun Shade	Visually inspect for rips, holes, loose hardware, proper operation and alignment	5.3.1.7
10,000 miles	Windshield Wiper	Inspect wiper arm flex	5.3.1.8
10,000 miles	Electronic Control Unit	Visually inspect for damage and loose connectors	5.3.1.20.10 & Section 1300
10,000 miles	Fire Extinguisher	Visually inspect for damage	5.3.1.23
10,000 miles	Cab Camera	Visually inspect for loose components. Clean lens of camera	5.3.1.25
10,000 miles	Forward View Camera	Visually inspect for loose components. Clean lens of camera	5.3.1.26
10,000 miles	Rear View Monitors	Visually inspect for loose components. Clean screen of displays	5.3.1.27
10,000 miles	Ethernet Switches	Visually inspect for loose components and secure panel mounting hardware	5.3.1.30
10,000 miles	Ethernet Switch (camera)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.31
10,000 miles	Ethernet Switch (wireless)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.32
10,000 miles	12Vdc Power Supply	Visually inspect for loose components and secure panel mounting hardware	5.3.1.34
10,000 miles	Wayside Worker Alert System	Test function of unit	5.3.1.35
10,000 miles	DC / DC Converter	Visually inspect for loose components and secure panel mounting hardware	5.3.1.37
10,000 miles	HSC-V Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.38
10,000 miles	Horn Controller Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.40
10,000 miles	Exterior Mirror	Visually inspect for damage, cracked glass	5.3.2.3
10,000 miles	Cab Hinged Window	Operate window to ensure smooth movement	5.3.2.5.2
10,000 miles	Rear View Camera	Visually inspect for damage and dirt	5.3.2.6 & Section 1900
10,000 miles	Stanchions	Visually inspect for loose components and secure mounting hardware	5.3.3.1

Table 3-1. Car Body Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
10,000 miles	Windscreens	Visually inspect for loose components and secure mounting hardware	5.3.3.2
10,000 miles	Interior View Camera	Visually inspect the lens for cracks and scratches	5.3.3.5
10,000 miles	Passenger Emergency Intercom	Verify operation	5.3.3.6
10,000 miles	Seats	Functionally check flip seat operation. Seat must stow correctly and lower correctly with five pound force	5.3.4
10,000 miles	Seats	Clean the upholstery	5.3.4.1
10,000 miles	Ethernet Switches	Visually inspect for loose components and secure panel mounting hardware	5.3.5.9
10,000 miles	Sanding Device	Visually inspect air lines and ejector alignment. Verify operation	5.3.6.3
10,000 miles	Roof Mounted Camera	Visually inspect the lens for cracks and scratches	5.3.7.13
30,000 miles	Cab Console	Visually inspect for adverse wear and loose components	5.3.1.1
30,000 miles	Console Panel 1	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.1
30,000 miles	Console Panel 2	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.2
30,000 miles	Console Panel 3	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.3
30,000 miles	Console Panel 4	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.4
30,000 miles	Trainer's Seat	Visually inspect for damage and loose hardware	5.3.1.4
30,000 miles	Windshield Wiper	Visually inspect for loose components and proper operation	5.3.1.8
30,000 miles	Cab Heater	Visually inspect for loose components and secure mounting hardware. Check for airflow exiting the heater outlet	5.3.1.9
30,000 miles	Cab Defroster / Demister	Visually inspect for loose components and secure mounting hardware. Check for airflow exiting the heater outlet	5.3.1.10
30,000 miles	Foot Switch	Visually inspect for loose components and proper operation	5.3.1.15
30,000 miles	Bypass Panel	Visually inspect for loose components and secure panel mounting hardware. Replace any missing seals	5.3.1.21
30,000 miles	Convenience Outlets	Visually inspect for loose components and proper operation	5.3.1.24
30,000 miles	Remote I/O	Visually inspect for loose components and secure panel mounting hardware	5.3.1.29

Table 3-1. Car Body Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
30,000 miles	Interior View Camera	Clean the lens	5.3.3.5
30,000 miles	Seats	Visually check for loose or missing hardware	5.3.4.2
30,000 miles	Seats	Visually check components for wear and damage	5.3.4.2
30,000 miles	Convenience Outlets	Visually inspect for loose hardware and damage	5.3.5.11
30,000 miles	Balancing Device	Visually inspect for damage	5.3.8.9
30,000 miles	Door Control Unit	Visually inspect for loose connectors and wiring damage	5.3.3.11
60,000 miles	Heater Defroster Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.11
60,000 miles	Coupler Loop Switch	Visually inspect for loose components and secure mounting hardware	5.3.1.13
60,000 miles	Foot Rest Assembly	Visually inspect for loose components and proper operation	5.3.1.14
60,000 miles	Arm Rest	Visually inspect for loose components and secure mounting hardware	5.3.1.16
60,000 miles	Radio Power Supply	Visually inspect for loose components and secure panel mounting hardware	5.3.1.17
60,000 miles	Cab Speakers	Visually inspect for loose components and secure mounting hardware	5.3.1.18
60,000 miles	Upper Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.19
60,000 miles	ACP1A / ACP1B Panels	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.1
60,000 miles	CRP1A / CRP1B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.2
60,000 miles	CRP2A / CRP2B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.3
60,000 miles	CRP3A / CRP3B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.4
60,000 miles	CRP4A / CRP4B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.5
60,000 miles	CRP5A / CRP5B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.6
60,000 miles	CRP6A / CRP6B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.7
60,000 miles	CRP7A / CRP7B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.8
60,000 miles	CRP8A Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.9

Table 3-1. Car Body Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
60,000 miles	Event Recorder	Visually inspect for loose components and secure mounting hardware	5.3.1.20.11
60,000 miles	TCN Controller	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.12
60,000 miles	Hour Meter / Odometer Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.13
60,000 miles	Trainline Interface Module	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.14
60,000 miles	Communication Control Unit (CCU)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.15
60,000 miles	Monitoring and Diagnostic System (MDS) Control Unit	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.16
60,000 miles	Circuit Breaker Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.22
60,000 miles	Convenience Outlets	Functionally test for proper operation	5.3.1.24
60,000 miles	Local Bus Contactor	Visually inspect for loose components and secure panel mounting hardware	5.3.1.28
60,000 miles	Track Brake Panel	Visually inspect for loose components and secure panel mounting hardware. Blow out any dust or foreign matter from enclosure	5.3.1.33
60,000 miles	Washer Reservoir	Visually inspect of signs of leakage, dents, breaks and other signs of deterioration. Check for loose and missing hardware. Check drain for clogs and corrosion.	5.3.1.39
60,000 miles	Exterior Speaker	Visually inspect for loose hardware, electrical connections	5.3.2.2 & Section 1400
60,000 miles	Windows	Check handles and latches for proper operation	5.3.2.5
60,000 miles	Interior Speakers	Visually inspect for loose components and proper operation	5.3.3.4 & Section 1400
60,000 miles	APC Analyzer	Visually inspect for loose cables and that the green power LED is lit	5.3.3.9
60,000 miles	Automatic Passenger Counter (APC) Sensor	Visually inspect for loose components	5.3.3.10
60,000 miles	Auxiliary Circuit Breaker	Visually inspect for loose components and secure panel mounting hardware	5.3.5.1
60,000 miles	AC Circuit Breaker Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.2
60,000 miles	LVDC Terminal Block	Visually inspect for loose components and secure panel mounting hardware	5.3.5.3
60,000 miles	HSCB Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.4

Table 3-1. Car Body Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
60,000 miles	APC COPILOTpc	Visually inspect for loose components and secure panel mounting hardware	5.3.5.5
60,000 miles	Network Video Recorder	Visually inspect for loose components and secure mounting hardware	5.3.5.6
60,000 miles	Electronic Control Unit Center Truck	Visually inspect for loose components and secure panel mounting hardware	5.3.5.7
60,000 miles	Terminal Board	Visually inspect for loose components and secure panel mounting hardware	5.3.5.8
60,000 miles	Track Brake Contactor Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.10
60,000 miles	Convenience Outlets	Functionally test for proper operation	5.3.5.11
60,000 miles	Electronic Control Unit Pull Down Resistor	Visually inspect for loose components and secure panel mounting hardware	5.3.5.12
60,000 miles	ARP1B Relay Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.13
60,000 miles	Coupler Height Adjustment	Check coupler height	5.3.6.1
60,000 miles	Bellows Assembly	Visually inspect for dirt and debris accumulation in the bellow	5.3.8.6
60,000 miles	Operator's Seat	Lubricate baseplate tube	6.1.1
60,000 miles	Operator's Seat	Lubricate fore/aft slide	6.1.1
120,000 miles	Front Destination Sign	Clean exterior sign display window	5.3.1.12
120,000 miles	Exterior Components	Visually inspect to check for damaged sealant and if found, replace	5.3.2.1
120,000 miles	Skirts	Inspect for damage, cracks, pitting, discoloration and other signs of deterioration	5.3.2.4
120,000 miles	Ceiling Panels	Visually inspect	5.3.3.3
120,000 miles	Floor Panels	Visually inspect the seals	5.3.3.8
120,000 miles	Automatic Passenger Counter (APC) Sensor	Clean the optic of the sensor with a soft cotton cloth	5.3.3.10
120,000 miles	Automatic Passenger Counter (APC) Sensor	Visually inspect for loose cables	5.3.3.10
120,000 miles	Roof Shrouds	Inspect the Roof Shrouds for cuts, cracks, pitting, discoloration and other signs of deterioration	5.3.7.7
120,000 miles	Ceiling Panels	Visually inspect for loose hardware and damage	5.3.8.1

Table 3-1. Car Body Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0200 Car Body Running Maintenance & Servicing Manual Section Reference
120,000 miles	Side Interior Panels	Visually inspect for loose hardware and damage	5.3.8.2
		Inspect for cleanliness	5.3.8.2
120,000 miles	External Panels	Visually inspect for loose hardware and damage	5.3.8.3
120,000 miles	Turntables	Visually inspect for damage	5.3.8.4
120,000 miles	Rub Plates	Visually inspect for damage	5.3.8.5
120,000 miles	Bellows Assembly	Visually inspect suspension cable for sufficient tension	5.3.8.6
120,000 miles	Art. Middle Frame	Visually inspect for damage	5.3.8.7.1
120,000 miles	Pivot Bearing	Visually inspect for damage	5.3.8.7.2
120,000 miles	Bellows Assembly	Visually inspect rubber parts	5.3.8.6
120,000 miles	Art. Shaft and Bearing	Visually inspect for damage	5.3.8.8
120,000 miles	Master Controller	Apply lubricant to the key lock cylinder of the Transfer Switch	6.1.3.1
960,000 miles	Articulation Wiring	Visually inspect for damage	5.3.8.10
1 million switching cycles or every 5 years	Master Controller	Clean all parts with dry compressed air	5.3.1.36.1
		Visually check all mechanical connections and the detent desk for any discernable damage	5.3.1.36.2
		Replace all snap-action switches	5.3.1.36.3
		Replace detent spring complete and detent spring short	5.3.1.36.4
		Lubricate detent mechanism and gears	5.3.1.36.4

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
Daily	Operator's Seat	Operate seat through a full functional test. Make sure all seat controls operate properly	5.3.1.3.1
Daily	Operator's Seat	Inspect seat cushions for condition and cleanliness	5.3.1.3.2
Daily	Cab Light	Functionally test the Cab Light for proper operation	5.3.1.5 & Section 0600
Daily	Cab Console Light	Functionally test the Cab Console Light for proper operation	5.3.1.6 & Section 0600
Daily	Front Destination Sign	Visually inspect all signs	5.3.1.12
Daily	Wayside Worker Alert System	Visually inspect for damage	5.3.1.35
Daily	Onboard Test	Initiate Onboard Test via CCH to inspect test tones from Interior and Exterior speakers and test patterns on PID Displays and Destination Signs, and verify no fault on the CCH	5.3.1.41 & Section 1401
Daily	Windows	Wipe clean window assembly	5.3.2.5.1
Daily	Windows	Visually inspect window assembly	5.3.2.5.2
Daily	Windows	Visually inspect gaskets for damage	5.3.2.5.3
Daily	Grab Rails	Inspect for loose or missing hardware and clean	5.3.3.1
Daily	Side Destination Signs	Visually inspect for defective LED's	5.3.3.7
Weekly	Floor Panels	Clean floor panels (Abrastop™)	5.3.3.8
10,000 miles	Operator's Seat	Clean seat assembly	5.3.1.3.3
10,000 miles	Operator's Seat	Inspect seat for loose or missing fasteners	5.3.1.3.4
10,000 miles	Windshield Sun Shade	Visually inspect for rips, holes, loose hardware, proper operation and alignment	5.3.1.7
10,000 miles	Side Window Sun Shade	Visually inspect for rips, holes, loose hardware, proper operation and alignment	5.3.1.7
10,000 miles	Windshield Wiper	Inspect wiper arm flex	5.3.1.8
10,000 miles	Electronic Control Unit	Visually inspect for damage and loose connectors	5.3.1.20.10 & Section 1300
10,000 miles	Fire Extinguisher	Visually inspect for damage	5.3.1.23
10,000 miles	Cab Camera	Visually inspect for loose components. Clean lens of camera	5.3.1.25

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
10,000 miles	Forward View Camera	Visually inspect for loose components. Clean lens of camera	5.3.1.26
10,000 miles	Rear View Monitors	Visually inspect for loose components. Clean screen of displays	5.3.1.27
10,000 miles	Ethernet Switches	Visually inspect for loose components and secure panel mounting hardware	5.3.1.30
10,000 miles	Ethernet Switch (camera)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.31
10,000 miles	Ethernet Switch (wireless)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.32
10,000 miles	12Vdc Power Supply	Visually inspect for loose components and secure panel mounting hardware	5.3.1.34
10,000 miles	Wayside Worker Alert System	Test function of unit	5.3.1.35
10,000 miles	DC / DC Converter	Visually inspect for loose components and secure panel mounting hardware	5.3.1.37
10,000 miles	HSC-V Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.38
10,000 miles	Horn Controller Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.40
10,000 miles	Exterior Mirror	Visually inspect for damage, cracked glass and loose hardware	5.3.2.3
10,000 miles	Cab Hinged Window	Operate window to ensure smooth movement	5.3.2.5.2
10,000 miles	Rear View Camera	Visually inspect for damage and dirt	5.3.2.6 & Section 1900
10,000 miles	Stanchions	Visually inspect for loose components and secure mounting hardware	5.3.3.1
10,000 miles	Windscreens	Visually inspect for loose components and secure mounting hardware	5.3.3.2
10,000 miles	Interior View Camera	Visually inspect the lens for cracks and scratches	5.3.3.5
10,000 miles	Passenger Emergency Intercom	Verify operation	5.3.3.6
10,000 miles	Seats	Functionally check flip seat operation. Seat must stow correctly and lower correctly with five pound force	5.3.4
10,000 miles	Seats	Clean the upholstery	5.3.4.1
10,000 miles	Ethernet Switches	Visually inspect for loose components and secure panel mounting hardware	5.3.5.9
10,000 miles	Sanding Device	Visually inspect air lines and ejector alignment. Verify operation	5.3.6.3

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
10,000 miles	Roof Mounted Camera	Visually inspect the lens for cracks and scratches	5.3.7.13
30,000 miles	Cab Console	Visually inspect for adverse wear and loose components	5.3.1.1
30,000 miles	Console Panel 1	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.1
30,000 miles	Console Panel 2	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.2
30,000 miles	Console Panel 3	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.3
30,000 miles	Console Panel 4	Visually inspect for loose components and secure panel mounting hardware	5.3.1.2.4
30,000 miles	Trainer's Seat	Visually inspect for damage and loose hardware	5.3.1.4
30,000 miles	Windshield Wiper	Visually inspect for loose components and proper operation	5.3.1.8
30,000 miles	Cab Heater	Visually inspect for loose components and secure mounting hardware. Check for airflow exiting the heater outlet	5.3.1.9
30,000 miles	Cab Defroster / Demister	Visually inspect for loose components and secure mounting hardware. Check for airflow exiting the heater outlet	5.3.1.10
30,000 miles	Foot Switch	Visually inspect for loose components and proper operation	5.3.1.15
30,000 miles	Bypass Panel	Visually inspect for loose components and secure panel mounting hardware. Replace any missing seals	5.3.1.21
30,000 miles	Convenience Outlets	Visually inspect for loose components and proper operation	5.3.1.24
30,000 miles	Remote I/O	Visually inspect for loose components and secure panel mounting hardware	5.3.1.29
30,000 miles	Ethernet Interface Module	Visually inspect LED indicator to confirm the status of network connections	5.3.1.42 & Section 1401
30,000 miles	Ethernet Switch	Visually inspect LED indicator to confirm the status of network connections	5.3.1.45 & Section 1401
30,000 miles	Interior View Camera	Clean the lens	5.3.3.5
30,000 miles	Seats	Visually check for loose or missing hardware	5.3.4.2
30,000 miles	Seats	Visually check components for wear and damage	5.3.4.2
30,000 miles	Convenience Outlets	Visually inspect for loose hardware and damage	5.3.5.11
30,000 miles	Balancing Device	Visually inspect for damage	5.3.8.9

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
30,000 miles	Door Control Unit	Visually inspect for loose connectors and wiring damage	5.3.3.11
60,000 miles	Heater Defroster Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.11
60,000 miles	Coupler Loop Switch	Visually inspect for loose components and secure mounting hardware	5.3.1.13
60,000 miles	Foot Rest Assembly	Visually inspect for loose components and proper operation	5.3.1.14
60,000 miles	Arm Rest	Visually inspect for loose components and secure mounting hardware	5.3.1.16
60,000 miles	Radio Power Supply	Visually inspect for loose components and secure panel mounting hardware	5.3.1.17
60,000 miles	Cab Speakers	Visually inspect for loose components and secure mounting hardware	5.3.1.18
60,000 miles	Upper Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.19
60,000 miles	Audio Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.1
60,000 miles	CRP1A / CRP1B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.2
60,000 miles	CRP2A / CRP2B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.3
60,000 miles	CRP3A / CRP3B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.4
60,000 miles	CRP4A / CRP4B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.5
60,000 miles	CRP5A / CRP5B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.6
60,000 miles	CRP6A / CRP6B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.7
60,000 miles	CRP7A / CRP7B Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.8
60,000 miles	CRP8A Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.9
60,000 miles	Event Recorder	Visually inspect for loose components and secure mounting hardware	5.3.1.20.11
60,000 miles	TCN Controller	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.12
60,000 miles	Hour Meter / Odometer Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.13
60,000 miles	Trainline Interface Module	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.14
60,000 miles	Communication Control Unit (CCU)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.15

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
60,000 miles	Monitoring and Diagnostic System (MDS) Control Unit	Visually inspect for loose components and secure panel mounting hardware	5.3.1.20.16
60,000 miles	Circuit Breaker Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.1.22
60,000 miles	Convenience Outlets	Functionally test for proper operation	5.3.1.24
60,000 miles	Local Bus Contactor	Visually inspect for loose components and secure panel mounting hardware	5.3.1.28
60,000 miles	Track Brake Panel	Visually inspect for loose components and secure panel mounting hardware. Blow out any dust or foreign matter from enclosure	5.3.1.33
60,000 miles	Washer Reservoir	Visually inspect for signs of leakage, dents, breaks and other signs of deterioration. Check for loose and missing hardware. Check drain for clogs and corrosion.	5.3.1.39
60,000 miles	Interface Unit	Visually inspect for loose components and secure panel mounting hardware	5.3.1.43
60,000 miles	Communication Control Head (CCH)	Visually inspect for loose components and secure panel mounting hardware	5.3.1.44
60,000 miles	Exterior Speaker	Visually inspect for loose hardware, electrical connections	5.3.2.2 & Section 1400
60,000 miles	Windows	Check handles and latches for proper operation	5.3.2.5
60,000 miles	Interior Speakers	Visually inspect for loose components and proper operation	5.3.3.4 & Section 1400
60,000 miles	APC Analyzer	Visually inspect for loose cables and that the green power LED is lit	5.3.3.9
60,000 miles	Automatic Passenger Counter (APC) Sensor	Visually inspect for loose components	5.3.3.10
60,000 miles	Auxiliary Circuit Breaker	Visually inspect for loose components and secure panel mounting hardware	5.3.5.1
60,000 miles	AC Circuit Breaker Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.2
60,000 miles	LVDC Terminal Block	Visually inspect for loose components and secure panel mounting hardware	5.3.5.3
60,000 miles	HSCB Control Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.4
60,000 miles	APC COPILOTpc	Visually inspect for loose components and secure panel mounting hardware	5.3.5.5
60,000 miles	Network Video Recorder	Visually inspect for loose components and secure mounting hardware	5.3.5.6

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
60,000 miles	Electronic Control Unit Center Truck	Visually inspect for loose components and secure panel mounting hardware	5.3.5.7
60,000 miles	Terminal Board	Visually inspect for loose components and secure panel mounting hardware	5.3.5.8
60,000 miles	Track Brake Contactor Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.10
60,000 miles	Convenience Outlets	Functionally test for proper operation	5.3.5.11
60,000 miles	Electronic Control Unit Pull Down Resistor	Visually inspect for loose components and secure panel mounting hardware	5.3.5.12
60,000 miles	ARP1B Relay Panel	Visually inspect for loose components and secure panel mounting hardware	5.3.5.13
60,000 miles	Coupler Height Adjustment	Check coupler height	5.3.6.1
60,000 miles	Bellows Assembly	Visually inspect for dirt and debris accumulation in the bellow	5.3.8.6
60,000 miles	Operator's Seat	Lubricate baseplate tube	6.1.1
60,000 miles	Operator's Seat	Lubricate fore/aft slide	6.1.1
120,000 miles	Front Destination Sign	Clean exterior sign display window	5.3.1.12
120,000 miles	Ethernet Interface Module	Verify all M12 connectors are tightened to the proper torque	5.3.1.42
120,000 miles	Ethernet Switch	Verify all M12 connectors are tightened to the proper torque	5.3.1.45
120,000 miles	Exterior Components	Visually inspect to check for damaged sealant and if found, replace	5.3.2.1
120,000 miles	Skirts	Inspect for damage, cracks, pitting, discoloration and other signs of deterioration	5.3.2.4
120,000 miles	Ceiling Panels	Visually inspect	5.3.3.3
120,000 miles	Floor Panels	Visually inspect the seals	5.3.3.8
120,000 miles	Automatic Passenger Counter (APC) Sensor	Clean the optic of the sensor with a soft cotton cloth	5.3.3.10
120,000 miles	Automatic Passenger Counter (APC) Sensor	Visually inspect for loose cables	5.3.3.10
120,000 miles	Roof Shrouds	Inspect the Roof Shrouds for cuts, cracks, pitting, discoloration and other signs of deterioration	5.3.7.7
120,000 miles	Ceiling Panels	Visually inspect for loose hardware and damage	5.3.8.1

Table 3-1a. Car Body (including TOA Communications) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0201 Car Body w/TOA Communications Running Maintenance & Servicing Manual Section Reference
120,000 miles	Side Interior Panels	Visually inspect for loose hardware and damage	5.3.8.2
		Inspect for cleanliness	5.3.8.2
120,000 miles	External Panels	Visually inspect for loose hardware and damage	5.3.8.3
120,000 miles	Turntables	Visually inspect for damage	5.3.8.4
120,000 miles	Rub Plates	Visually inspect for damage	5.3.8.5
120,000 miles	Bellows Assembly	Visually inspect suspension cable for sufficient tension	5.3.8.6
120,000 miles	Art. Middle Frame	Visually inspect for damage	5.3.8.7.1
120,000 miles	Pivot Bearing	Visually inspect for damage	5.3.8.7.2
120,000 miles	Bellows Assembly	Visually inspect rubber parts	5.3.8.6
120,000 miles	Art. Shaft and Bearing	Visually inspect for damage	5.3.8.8
120,000 miles	Master Controller	Apply lubricant to the key lock cylinder of the Transfer Switch	6.1.3.1
960,000 miles	Articulation Wiring	Visually inspect for damage	5.3.8.10
1 million switching cycles or every 5 years	Master Controller	Clean all parts with dry compressed air	5.3.1.36.1
		Visually check all mechanical connections and the detent desk for any discernable damage	5.3.1.36.2
		Replace all snap-action switches	5.3.1.36.3
		Replace detent spring complete and detent spring short	5.3.1.36.4
		Lubricate detent mechanism and gears	5.3.1.36.4

Table 3-2. Coupler Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0300, Coupler Running Maintenance Manual Section Reference
10,000 miles	Support and Centering	Inspect Support and Centering	Section 5.7
30,000 miles	Mechanical Coupler	Inspect Mechanical Coupler	Section 5.4
		Lubricate Mechanical Coupler	Section 6.4
30,000 miles	Manual Uncoupling	Test Manual Uncoupling	Section 5.5
30,000 miles	Uncoupling	Test Uncoupling	Section 5.6
30,000 miles	Support and Centering	Inspect Support and Centering	Section 5.7
		Lubricate Support and Centering	Section 6.5
30,000 miles	Pivot Pin	Lubricate Pivot Pin	Section 6.6
30,000 miles	Electrical Coupler	Inspect Electrical Coupler	Section 5.8
		Inspect Electrical Coupler Actuator	Section 5.9
60,000 miles	Pneumatic System	Inspect Pneumatic System	Section 5.10
60,000 miles	Buffer	Inspect Buffer	Section 5.11
60,000 miles	Support and Centering	Test Support and Centering	Section 5.12
60,000 miles	Mounting Bolts	Inspect Mounting Bolts	Section 5.13
60,000 miles	Cables and Grounding	Inspect Cables and Grounding	Section 5.14
60,000 miles	Automatic Coupler	Test Automatic Coupler	Section 5.15
60,000 miles	Electrical Coupler	Inspect Electrical Coupler Contacts	Section 5.16
120,000 miles	Automatic Coupler	Inspect Automatic Coupler	Section 5.17
120,000 miles	MRP Valve	Inspect MRP Valve	Section 5.18
120,000 miles	Ball Valve	Inspect Ball Valve	Section 5.19
120,000 miles	Air Filter	Clean Air Filter	Section 5.20
720,000 miles / 96 months	Coupler Overhaul	Replacement for Overhaul	Refer to HRMM, Section 3.24
720,000 miles / 96 months	Automatic Coupler	Overhaul	Refer to HRMM Section 3.25

Table 3-3. Doors Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0400, Doors Running Maintenance Manual Section Reference
After two weeks in service of first operation	Safety Check	Inspect Mounting Hardware	4.3.1
30,000 miles or 3 Months (whichever comes first)	Safety Check	Inspect Mounting Hardware	4.3.1
30,000 miles or 3 Months (whichever comes first)	Door System Wiring	Inspect	4.3.1.2
30,000 miles or 3 Months (whichever comes first)	Torsion Springs	Inspect	4.3.1.3
30,000 miles or 3 Months (whichever comes first)	Lock Unit	Inspect	4.3.1.4
30,000 miles or 3 Months (whichever comes first)	Doorhanger Rollers	Inspect	4.3.1.5
30,000 miles or 3 Months (whichever comes first)	Door Hardware	Inspect	4.3.1.6
30,000 miles or 3 Months (whichever comes first)	DCU	Fault Check	4.3.2
30,000 miles or 3 Months (whichever comes first)	Emergency Manual Release	Function Check	4.3.3
30,000 miles or 3 Months (whichever comes first)	Emergency Manual Release	Function Check at Speed	4.3.3.1
30,000 miles or 3 Months (whichever comes first)	Pushbuttons and Indicators	Function Check	4.3.4
30,000 miles or 3 Months (whichever comes first)	Door Cutout Lever	Function Check	4.3.5
30,000 miles or 3 Months (whichever comes first)	Limit Switches	Function Check	4.3.6
30,000 miles or 3 Months (whichever comes first)	Door Obstruction Detection	Test	4.3.7
30,000 miles or 3 Months (whichever comes first)	Painted Components	Inspect	4.3.8
60,000 miles or 6 Months (whichever comes first)	Finger Protection Rubber	Clean and Grease	4.3.9
120,000 miles or 1 Year (whichever comes first)	Locking Unit	Inspect and Grease	4.3.10

Table 3-3. Doors Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0400, Doors Running Maintenance Manual Section Reference
120,000 miles or 1 Year (whichever comes first)	Locking Lever/Locking Pawl	Clean and Grease	4.3.11
120,000 miles or 1 Year (whichever comes first)	Spring Actuator	Inspect	4.3.12
120,000 miles or 1 Year (whichever comes first)	Rubber Buffer Assembly	Inspect	4.3.13
120,000 miles or 1 Year (whichever comes first)	Spindle	Inspect	4.3.14
120,000 miles or 1 Year (whichever comes first)	Spindle	Clean and Grease	4.3.15
120,000 miles or 1 Year (whichever comes first)	Release Lever	Clean and Grease	4.3.16
600,000 miles or 5 Years (whichever comes first)	Door Leaf Rollers	Inspect Wear	HRM
600,000 miles or 5 Years (whichever comes first)	Ring Gear	Inspect Wear	HRM
1,200,000 miles or 10 Years (whichever comes first)	NOVRAM	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Door Control Unit EPROM	Re-flash	HRM
1,800,000 miles or 15 Years (whichever comes first)	Geared Motor (M1)	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Ring Gear	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Door Locked Switch (S1)	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Emergency Operation Switch (S3)	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Door Out of Service Switch (S5)	Replace	HRM

Table 3-3. Doors Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0400, Doors Running Maintenance Manual Section Reference
1,800,000 miles or 15 Years (whichever comes first)	Door Leaf Left Closed Switch (S8)	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Door Leaf Right Closed Switch (S9)	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Spindle and Spindle Nuts	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Door Leaf Rollers	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Connecting Cable	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Springs in Spring Actuator	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Rubber Buffers	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Finger Protection Rubbers	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Bowden Cable -Interior Manual Release	Replace	HRM
1,800,000 miles or 15 Years (whichever comes first)	Bowden Cable - Exterior Manual Release	Replace	HRM

Table 3-4. HVAC Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0500, HVAC Running Maintenance Manual Section Reference
10,000	HVAC Unit	Check HVAC system for faults	3.6
10,000	HVAC Unit	Clean and Inspect drain traps (outside HVAC unit)	5.3.1.1
*10,000	Air Filter	Change return air filter	5.3.1.3
*10,000	Air Filter	Change fresh air filter	5.3.1.3
30,000	HVAC Unit	Clean and Inspect drain traps (Inside HVAC unit)	5.3.2.1
30,000	HVAC Unit	Inspect HVAC Unit	5.3.2
60,000	Condenser Coil	Clean condenser coil using pressure washer	5.3.5
60,000	Condenser Coil	Inspect condenser coil after cleaning	5.3.5
120,000	HVAC Unit	Clean and Inspect HVAC Unit	5.3.3
120,000	HVAC Unit	Perform leak test of HVAC unit	5.3.4
120,000	Evaporator Coil	Clean and Inspect evaporator coil	5.3.6
120,000	Moisture Indicator	Clean and Inspect Moisture Indicator	5.3.7
120,000	Temperature Sensor	Test Fresh Air Temperature Sensor	5.3.8
120,000	Temperature Sensor	Test Return Air Temperature Sensor	5.3.9
120,000	Temperature Sensor	Test Supply Air Temperature Sensor	5.3.10
120,000	HVAC Unit	Perform HVAC System Functional Test (ACCU Self-Test)	5.3.13
120,000	Pressure Transducer	Test High and Low Pressure Transducers	5.3.14
120,000	Pressure Switch	Test High and Low Pressure Switches	5.3.15 and .16
120,000	Thermostat	Test Overhead Heater Protective Thermostat 1	5.3.11
120,000	Thermostat	Test Overhead Heater Protective Thermostat 2	5.3.12
600,000	HVAC Unit	Remove HVAC unit from car	HRMM
600,000	HVAC Unit	Clean HVAC unit at overhaul	HRMM
600,000	HVAC Unit	Recover Refrigerant from HVAC unit	HRMM
600,000	HVAC Unit	Refrigeration Circuit Pressure Tightness Test	HRMM
600,000	HVAC Unit	Vacuum & Dehydrate Refrigeration Circuit	HRMM
600,000	HVAC Unit	Charge HVAC System with Refrigerant	HRMM
600,000	ACCU	Clean PCBs	HRMM
600,000	ACCU	Test PCBs using BTE	HRMM

Table 3-4. HVAC Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0500, HVAC Running Maintenance Manual Section Reference
600,000	Air Flow Switch	Replace AFS	HRMM
600,000	Air Filter Switch	Replace Clogged Filter Detector Switch	HRMM
600,000	Compressor	Replace Compressors	HRMM
600,000	Compressor	Replace Compressor Discharge Gas Thermostat	HRMM
600,000	Temperature Sensor	Replace FATS	HRMM
600,000	Temperature Sensor	Replace RATS	HRMM
600,000	Temperature Sensor	Replace SATS	HRMM
600,000	Pressure Switch	Replace HPS1 and HPS2	HRMM
600,000	Pressure Transducer	Replace HPT1 and HPT2	HRMM
600,000	Pressure Switch	Replace LPS1 and LPS2	HRMM
600,000	Pressure Transducer	Replace LPT1 and LPT2	HRMM
600,000	Thermostat	Replace OHPT1 and OHPT2	HRMM
600,000	Thermostat	Replace Layover Thermostat	HRMM
600,000	Thermostat	Replace Floor Heater Thermostats	HRMM
600,000	Solenoid Valve	Replace By-Pass Solenoid Valve Coil	HRMM
600,000	Check Valve	Replace Check Valve	HRMM
600,000	Relief Valve	Replace Safety Pressure Relief Valve	HRMM
600,000	Filter Drier	Replace Filter Drier	HRMM
600,000	Circuit Breaker	Replace Circuit Breakers	7.3.2
600,000	Voltage Detector	Replace AC Voltage Detector	7.3.4
600,000	Transformer	Replace Transformer	7.3.5
600,000	Current Sensor	Replace Current Sensor	7.3.6
600,000	Expansion Valve	Replace Thermostatic Expansion Valve	HRMM
600,000	Motor	Replace Condenser Fan Motor	HRMM
600,000	Motor	Replace Evaporator Blower Motor	HRMM
1,200,000	Relay	Replace Relays	7.3.3
1,200,000	Contactors	Replace Contactors	7.3.1

Table 3-4. HVAC Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0500, HVAC Running Maintenance Manual Section Reference
1,200,000	HVAC Unit	Replace car / HVAC unit interface gasket	HRMM
1,200,000	HVAC Unit	Replace car interface gasket in roof	HRMM
1,200,000	HVAC Unit	Replace return air plenum gasket	HRMM

* Air filters must be changed at 10,000 miles or 30-days, whichever comes first.

Table 3-5. Lighting Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0600, Lighting Running Maintenance Manual Section Reference
Daily	Passenger Area	Check passenger area lighting.	4.3.1
Daily	Emergency Lighting	Check operation of emergency lighting.	4.3.2
Daily	Door Indicators	Check operation of door indicators.	4.3.3
Daily	Cab	Check operation of cab lighting.	4.3.4
Daily	Exterior	Check LRV exterior lighting.	4.3.5
10,000 Miles	Headlight Aiming	Check aim of headlights for compliance with 49 CFR 229.125.	4.3.6 & 4.3.7

Table 3-6. Propulsion Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0700 Propulsion Running Maintenance & Servicing Manual Section Reference
10,000 mile inspection interval			
Initial 10,000 miles	Gear Unit	Replace gear unit lubrication. The gear unit oil can be refilled again after being filtered. For this purpose, using a filter element with a retention rate of 6 μm ($\beta \times \geq 200$, according to ISO 16889 is recommended. If the gear unit oil level is down, fill up with fresh oil to the required level.	4.9.1
		Inspect gear unit and coupling for leaks and external damage	
		Examine fill plug magnet	
10,000 Miles	Brake Resistor	Remove debris from the exterior	4.7.1
		Inspect for loose hardware and signs of overheating	
10,000 Miles	Gear Unit	Inspect gear unit and coupling for leaks and external damage	4.9.1
		Visual check of oil level at oil level gage glass	
		Check the rubber bushings of the transmission/motor connection.	
		Check the rubber bushings in the torque support.	
		Examine fill plug magnet	
10,000 Miles	HSCB Control Panel	Inspect and clean the control panel. Check for loose connections.	4.14.1
10,000 Miles	Traction Motors	Clean traction motor filters	4.8.1
		Inspect cables, connectors of traction motor, speed sensors and cables, bearing covers and painted surfaces for damage.	
		Inspect motor mounts, air filter housing, coupling flange, cover and housing bolts for tightness. Inspect traction motor bearing caps and High Speed Coupling for leaks.	

Table 3-6. Propulsion Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0700 Propulsion Running Maintenance & Servicing Manual Section Reference
At the 30,000 Mile interval, the 10,000 mile inspections listed above are also done.			
30,000 Miles	Line Reactor	Remove debris from protective cage	4.6.2
		Inspect for loose hardware and signs of overheating.	
30,000 Miles	Traction Motor	Clean Filter	4.8.2
		Blow out light debris from inside motor	
30,000 Miles	Lightning Arrestor	Clean debris from the lightning arrestor.	4.12.2
		Check for chips or cracks, and verify that cables are secure	
30,000 Miles	Inverter Air Filter	Clean propulsion inverter air filter mesh screen	4.5.2
		Blow out the collected debris in the self-cleaning filter located behind the mesh screen and clean heat sink fins	
		Inspect fan blades	
		Inspect for loose hardware	
30,000 Miles	Inverter Unit Heatsink	Blow out heat sink fins	4.5.2
At the 60,000 Mile interval, the 10,000 mile and 30,000 mile inspections listed above are also done.			
60,000 Miles	Ground Brushes	Measure the wear of brushes and replace if necessary	4.10.3
		Inspect shunts for loose connections and broken strands	
		Inspect slip rings and connector lug contact areas for wear	
60,000 Miles	Knife Switch	Clean contacts using shop towels	4.13.3
		Lubricate contact interfaces with SHELL ALVANIA #2	
		Inspect contacts for corrosion and wear	
		Inspect for loose hardware	
		Check secondary blade springs	
		Check jaw adjustments	

Table 3-6. Propulsion Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0700 Propulsion Running Maintenance & Servicing Manual Section Reference
60,000 Miles	Propulsion Inverter Equipment Case	Check that discharge resistor cover is clear of debris	4.5.3
		Check the operation of the EBRT.	
		Check access door gaskets for wear and proper sealing	
		Check all interior electrical connections for tightness. This includes the cable lugs, bus bars, control cables at voltage detectors and transducers, and resistor connections.	
		Inspect the resistors and contactors in the propulsion equipment case for tight connects and any signs of overheating	
		Check that the PLU, Power Supply, and Gateway Unit connections and circuit boards are secure.	
		Inspect insulators for cracks or other damage and clean with an approved MTA cleaning agent.	
		Examine the door gaskets ensure the gaskets are not worn, ripped, compressed or missing.	
60,000 Miles	Line Switch Contactor	Measure wear of Line Switch contactor contacts and verify that the movable contacts moved freely.	4.5.3
		Inspect Line Switch contactor for loose hardware.	
60,000 Miles	Line Charging Contactor	Inspect Line Charging Contactor for loose hardware.	4.5.3
60,000 Miles	High Speed Circuit Breaker	Inspect arc chute	4.11.3
		Inspect for loose hardware	
		Inspect mechanical components.	
60,000 Miles	Gear Unit	Start of taking oil sample for extended oil change intervals.	4.9.3
		Additional oil samples and analyses after every 30,000 miles, until a maximum mileage of 180,000 miles.	
		Replace gear unit lubrication (if extended oil change is not permitted). Clean gear unit housing and replace the corrosion protection.	
		Check screw connections.	
		Repair paint and corrosion damage.	
		Check press fit of flange connections on the drive coupling.	

Table 3-6. Propulsion Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0700 Propulsion Running Maintenance & Servicing Manual Section Reference
At the 120,000 Mile interval, the 10,000, 30,000 and 60,000 Mile inspections listed above are also done.			
120,000 Miles	Gear Unit	Change Gear Unit lubricant (If extended oil change is permitted).	4.9.4
		Examine fill plug magnet	
120,000 Miles	High Speed Circuit Breaker	Clean and inspect arc guides	4.11.4
		Check contacts for wear	
3 years or 360,000 miles	Traction Motor	Add grease to traction motor bearings	4.15
5 years or 600,000 miles	Traction Motor	Overhaul	4.16.1
5 years or 600,000 miles	Gear Unit	Inspection and Maintenance	Refer to HRMM Table: 3-1
10 years or 1,200,000 miles	Gear Unit	Overhaul	4.16.2
5 Years or 600,000 miles	High Speed Circuit Breaker	Replace shock absorbers	Refer to HRMM Table: 3-1
10 Years or 1,200,000 miles	High Speed Circuit Breaker	Overhaul	Refer to HRMM Table: 3-1
15 Years or 1,800,000 miles	Propulsion Inverter Equipment Case	Replace filter capacitors	Refer to HRMM Table: 3-1
5 years or 600,000 miles	High Speed Coupling	Replace grease	4.16.3 or Refer to HRMM Table: 3-1
10 years or 1,200,000 miles	Line Charging Contactor	Replace Contactor	RMSM Section 5.7.11

The Knife Switch is the only component in the propulsion system that requires lubrication during each maintenance interval (10K, 30K, 60K and 120K).

Table 3-7. Pantograph Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0800 Pantograph Running Maintenance & Servicing Manual Section Reference
10,000 miles	Pantograph	Inspect for raise/lower operation	4.3
10,000 miles	Base frame	Inspect for physical/arcing damage	4.3
10,000 miles	Arm assemblies	Inspect for physical/arcing damage	4.3
10,000 miles	Head assembly	Inspect for physical/arcing damage	4.3
10,000 miles	Shunts & bolts	Inspect for condition & tightness	4.3
10,000 miles	Collector head	Inspect for physical/arcing damage	4.4
10,000 miles	Carbons	Inspect for wear, cracking, chips	4.4
10,000 miles	Shunts & bolts	Inspect for condition & tightness	4.4
10,000 miles	End horns	Inspect for physical damage, cracks	4.4
30,000 miles	Contact force	Inspect for head contact force	4.5
30,000 miles	Head rests	Inspect for physical damage, cracks	4.6
30,000 miles	Down Stop bumper	Inspect for physical damage, cracks	4.6
30,000 miles	Spring chain	Inspect for physical damage, grease	4.7
120,000 miles	Spindle drive	Inspect for physical damage, wear	4.8
120,000 miles	Insulators	Inspect for physical damage, cracks	4.9
600,000 miles	Pantograph	Complete Overhaul	See HRMM

Table 3-8. Auxiliary Inverter Scheduled Maintenance


Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0900, Auxiliary Inverter Running Maintenance Manual Section Reference
	Warning Before removing the dry section service cover: <ul style="list-style-type: none"> • Isolate the APS from the catenary system and wait three minutes (discharge time of the high-voltage capacitors including factor for safety) • Ensure that the APS cannot become live: Pantograph must be in the down position and must be disabled from being raised and engaged. • Check that the APS is dead. Measure the residual capacitor voltage. Do not start working as long as the residual capacitor voltage is above 50 V. See Section 3.3.2 Residual Capacitor Voltage Check. Verify that battery voltage is disconnected from the APS by opening the Battery Circuit Breaker (BCB) which is located under the car. See Section 3.3.3 Battery Voltage Measurement.		
10,000 miles	Auxiliary Power Supply	Visually inspect the APS.	3.3.4
10,000 miles	Cyclone Type Filter	Clean Cyclone Type Filter (air filter assembly)	3.3.5
60,000 miles	Auxiliary Power Supply	Clean fan blades, air duct and power module heat sinks	3.3.6 through 3.3.8
120,000 miles	Warning Labels	Check warning labels on the APS enclosure for legibility	3.3.9
		Clean if necessary. Warning labels must always be recognizable and legible	3.3.9
120,000 miles	Ground Bolts	Check connection of ground bolts at APS outside. Fix any loose connections	3.3.10
120,000 miles	Dry Section Service Cover	Check gasket of dry section service cover. Replace damaged or worn gasket	3.3.11
		Check fasteners. Lock fasteners. Replace damaged parts	3.3.12
480,000 miles	Cooling Fan	Replace cooling fan M901	5.3.6.2
800,000 miles	Electrolytic Capacitors	Replace all stand-alone electrolytic capacitors. Replace electrolytic capacitors on PCBs.	3.3.15
800,000 miles	Gasket Replacement	Replace all Gaskets.	3.3.16
800,000 miles	Fuses	Replace fuses and spare fuses.	3.3.18
800,000 miles	Relays	Replace Relays on A721 PCB	3.3.19

Table 3-8. Auxiliary Inverter Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 0900, Auxiliary Inverter Running Maintenance Manual Section Reference
1,600,000 miles	AC Filter Capacitors	Replace all capacitors in the AC Filter.	3.3.17
Always when opening a cover	Ground Cables	Check ground cables of covers for fit and damage. Fix loose connections	3.3.13
When necessary	Consumables	Replace approved consumables (not applicable)	N/A

Table 3-9. Track Brakes Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1000, Track Brakes Running Maintenance Manual Section Reference
Daily	Track Brake	Inspect track brake operation	5.3.1
30,000	Track Brake	Inspect track brake	5.3.2
30,000	Track Brake Compression Spring	Inspect track brake compression spring	5.3.3
30,000	Track Brake Intermediate Element/End Piece	Inspect track brake intermediate element/end piece	5.3.4
60,000	Track Brake Panel	Visually inspect Track Brake Panel for loose components and secure panel mounting hardware	5.3.5
120,000	Track Brake	Minor Service Lubrication	Heavy Repair Maintenance Manual Section 1000
600,000	Track Brake	Overhaul Track Brake	Heavy Repair Maintenance Manual Section 1000

Table 3-10. Battery Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1100, Battery, Running Maintenance Manual, Section Reference
60,000 miles	Battery / Battery Compartment	Clean and visually inspect the battery and battery compartment. Replace if damaged or at end of life	5.2.1, 5.2.2 & 6.4
60,000 miles	Vent Plug Assembly	Visually inspect the Vent Plug Assemblies for proper operation. Replace if damaged.	5.2.3
60,000 miles	Terminal Nuts	Visually inspect that all terminal nuts are torqued properly. Replace if damaged.	5.3.1
60,000 miles	Battery Cable Connections	Visually inspect and replace any battery cable connections/assemblies that are frayed or damaged	5.3.1, 6.4
60,000 miles	Battery Metal Connections	Inspect and clean all exposed battery metal connections	5.3.2
60,000 miles	Electrolyte	Top up the Electrolyte Level	5.4
60,000 miles	Charging System	Check and adjust the Charging System	5.7
600,000 miles	Capacity Check	Perform a battery capacity check	5.6
After each Topping Up Operation	Battery	Visually inspect the Battery	5.2.1
1,500,000 miles	Battery Life	Replace battery	6.0

NOTE: The cells should be topped-up with distilled water, (Section 5.4) when the electrolyte level is at the midway point of their electrolyte reserve, between the minimum (lower) and maximum (upper) levels. This method reduces the chances of having a cell run dry if it had been missed at the previous topping-up interval. By monitoring the water consumption once every 6 months for the first twelve months, the actual water consumption rate can be established more accurately for the environmental conditions and type of usage encountered.

Table 3-11. Truck and Suspension Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
Every 2 Weeks	Wheel Tread and Flange Lubricator	Replenish the LCF/HPF sticks	Section 3.3.11
		Inspect the applicators to check for debris build-up. Clean if necessary	
		Visually inspect for impact damage. Look for cracks around the mouths of the applicators. Replace if necessary	
		Check tightness of all fasteners. Tighten if necessary	
	Sanding Nozzle	Inspect the nozzles to check for debris build-up. Clean if necessary	Section 3.3.19
		Visually inspect for impact damage. Look for cracks around the mounting points of the nozzles. Replace if necessary	
		Check tightness of fasteners. Tighten if necessary	
10,000 miles	Wheels and Axles	Inspect wheel wear and flats	Section 3.3.10.1
		Inspect axle, wheel centers and tire for defects	
	Wheel Tread and Flange Lubricator	Check applicator alignment. Adjust if necessary	Section 3.3.11
		Perform routine applicator maintenance	
		Visually inspect the bracket for signs of corrosion and fatigue cracks	
		Check tightness of all bracket mounting fasteners. Tighten to installation specifications if necessary	
	Sanding Nozzle	Check nozzle alignment and height, adjust if necessary	Section 3.3.19
		Visually inspect the bracket for signs of corrosion and fatigue cracks	
		Check tightness of all bracket mounting fasteners. Tighten to installation specifications if necessary	

Table 3-11. Truck and Suspension Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
30,000 miles	Chevron Spring	Inspect for loose or missing adjustment plates	Section 3.3.4.1
		Inspect for loose or missing mounting hardware, pedestal beam and bolts	
	Journal Bearing	Check housing for discoloration, cracks or abnormal appearance	Section 3.3.3.1
		Check grease leakage	
	Wheels and Axles	Inspect shunts and mounting hardware	Section 3.3.10.2
	Slewing Bearing	Bolt inspection	Section 3.3.18.1
		Lubricate slewing bearing	
	Vertical Stop Collar (Gold Line Only)	Check collar thickness	Section 3.3.20
		Measure vertical stop bracket wear	
60,000 miles	Truck Frame	Check for loose or missing pipe and cable clamps, cotter pins, bolts, nuts and brackets	Section 3.3.1.1
		Inspect for oil and dirt deposits and corrosion	
		Inspect for cracked or broken welds	
		Inspect for any misalignment and deformation	
		Inspect for paint chafing, deterioration and condensation	
		Check safety bar and brackets, gear box safety stop, ATP junction box, traction motor safety bracket for mechanical integrity	
		Check all electrical and ground connections for corrosion and loose or missing fasteners	
		Check air piping for leakage	
	Truck Bolster	Check for loose or missing bolts, nuts, cotter pins, and mounting screws	Section 3.3.2.1
		Inspect for oil and dirt deposits and corrosion	
		Inspect for cracked or broken welds	
		Inspect for any misalignment and deformation	
		Inspect for paint chafing, deterioration and condensation	
		Inspect all rubber parts	
		Bolster anchor isolation rubber inspection	
		Inspect bolster anchor rod safety wire for wear	
		Inspect air reservoir drain plug	
		Inspect air suspension system for leakage	

Table 3-11. Truck and Suspension Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
60,000 miles (cont'd.)	Leveling Valve	Visually inspect	Section 3.3.15.1
	Vertical Stop Collar (Blue, Expo and Green Lines Only)	Check collar thickness	Section 3.3.20
		Measure vertical stop bracket wear	
120,000 miles	Truck Bolster	Check air spring height	Section 3.3.2.2
	Wheels and Axles	Measure shunt resistance	Section 3.3.10.3
	Check Valve	Visually inspect	Section 3.3.12.1
	Cutout Cock	Visually inspect	Section 3.3.13.1
	Duplex Check Valve	Visually inspect	Section 3.3.14.1
	Air Filter	Visually inspect	Section 3.3.16.1
	Filter Element	Clean / replace air filter element	Section 3.3.17.1
	Slewing Bearing	Re-torque mounting bolts	Section 3.3.18.2
		Re-apply torque marks	
480,000 miles	Slewing Bearing	Remove slewing bearing and return to Kaydon for rebuild	Section 3.3.18.3
600,000 miles	Chevron Spring	Replace Chevron rubber elements	Section 3.3.4.2
	Air Spring	Replace air spring	Section 3.3.5.1
		Replace O-rings in upper plate	
		Replace O-rings in internal cylinder	
	Lateral Damper	Check for fluid leaks	Section 3.3.9.1
	Journal Bearing	Replace journal bearings	Section 3.3.3.2
	Check Valve	Overhaul	Section 3.3.12.2
	Duplex Check Valve	Overhaul	Section 3.3.14.2
	Leveling Valve	Overhaul	Section 3.3.15.2
600,000 miles or 5 years	Motor Truck Frame	Overhaul	Section 3.3.1.2 HRMM 3.2.1.7
	Motor Truck Bolster	Overhaul	Section 3.3.2.3 HRMM 3.2.2.7
	Center Truck Bolster	Overhaul	Section 3.3.1.2 HRMM 3.3.1.7
	Center Truck Bolster	Overhaul	Section 3.3.2.3 HRMM 3.3.2.7

Table 3-11. Truck and Suspension Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
Perform when de-trucked for other maintenance	Center Pivot Wear Plate	Inspect for wear or check when carbody height adjustments are required	Section 3.3.6
	Center Pivot Bushing	Check center pivot bushing for incorrect seating, abnormal appearance, excessive and uneven wear	Section 3.3.8
Truck Overhaul	Lateral Stop	Inspect the lateral stop	Section 3.3.7
	Wheels/Axle	Remove wheels and gearbox and other components from axle and visually inspect for damage	Section 3.3.10.4
	Truck Frame	Inspect welds	Section 3.3.1.2
	Truck Bolster	Inspect welds	Section 3.3.2.3

Table 3-12. Friction Brakes Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1300, Friction Brakes Running Maintenance Manual Section Reference
After 4 months of operation	ASU Compressor	Replace ASU compressor break-in oil with specified running oil	6.3.2
Every 100 compressor operating hours or monthly	ASU Compressor	Inspect ASU compressor oil level	5.1.1
10,000	ASU Vacuum Indicator	Inspect ASU vacuum indicator, ASU	5.1.2
10,000	ECU	Inspect ECU	5.1.5
30,000	ASU Hoses	Inspect ASU hoses	5.1.6
30,000	Brake Caliper	Inspect brake caliper	5.1.8
30,000	Brake Pads	Inspect brake pads	5.1.9
30,000	ASU Compressor	Evaluate the ASU compressor oil level	5.1.12 & 5.1.13
60,000	ASU Main Reservoir	Inspect ASU main reservoir	5.1.3
60,000	Brake Reservoir	Inspect brake reservoir	5.1.4
60,000	ASU Intake Air Filter	Replace intake air filters, ASU	6.3.1
60,000	ASU Compressor	Replace ASU compressor oil	6.3.2
100,000	Air Suspension Filter	Replace Air Suspension Filter	6.3.12
120,000 or as required	Center Truck Brake Pad	Replace center truck brake pads	6.3.3
120,000	Brake Disc	Inspect brake disc	5.1.7
120,000	BCU Air Filter	Replace BCU air filters	6.3.4
120,000	ASU Desiccant Canister	Replace ASU desiccant canisters	6.3.5
120,000	ASU Cooler	Drain ASU cooler	6.3.6
120,000	Apply and Release BCU Magnet Valves	Inspect apply and release BCU magnet valves	5.1.10
120,000	Parking Brake Cutout Valve	Inspect parking brake cutout valve	5.1.11
600,000	Motor Truck BCU Pressure Transducers	Replace motor truck BCU pressure transducers (BCT, CVT, LWT)	6.3.7
600,000	Center Truck BCU Pressure Transducers	Replace center truck BCU pressure transducers (BCT, CVT, LWT, MRT)	6.3.8
600,000	Disc Brake	Replace disc brake	6.3.9

Table 3-12. Friction Brakes Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1300, Friction Brakes Running Maintenance Manual Section Reference
600,000	MT BCU Pressure Switches	Replace MT BCU pressure switches (PBA, PBR, BCA, BCR)	6.3.10
600,000	CT BCU Pressure Switches	Replace CT BCU pressure switches (BCR and BCA).	6.3.11
600,000	BCU Center Truck	Overhaul Brake Control Unit Center Truck	HRM
600,000	BCU Motor Truck	Overhaul Brake Control Unit Motor Truck	HRM
600,000	Air Supply Unit	Overhaul VV-120 Air Supply Unit	HRM
600,000	Air Supply Unit Starter Box	Overhaul VV-120 Air Supply Unit Starter Box	HRM
600,000	Air Supply Unit Motor Compressor Assembly	Overhaul VV-120 Air Supply Unit Motor Compressor Assembly	HRM
600,000	Air Dryer	Overhaul LTZ-015 Air Dryer Assembly	HRM
600,000	Air Dryer Pressure Gauge	Overhaul Air Dryer Pressure Gauge	HRM
600,000	Air Supply Unit Compressor	Overhaul VV-120 Air Supply Unit Compressor	HRM
600,000	Air Supply Unit Compressor Motor	Overhaul Air Supply Unit Compressor Motor	HRM
600,000	Air Supply Unit Filter Element	Replace Filter Element	HRM
600,000	Check Valve	Overhaul Check Valve (CV)	HRM
600,000	Air Filter	Overhaul Air Filter (FTL, PBFLT)	HRM
600,000	Parking Brake Cutout Cock	Overhaul Parking Brake Cutout Cock (PBCO)	HRM
600,000	Relay Valve	Overhaul Relay Valve (RV)	HRM
600,000	Pressure Limiting Valve	Overhaul Pressure Limiting Valve (LLV)	HRM
600,000	Dump Valve	Overhaul Dump Valve (DV)	HRM
600,000	Magnet Valves	Overhaul Magnet Valves (EMV, FBCV, PBMV)	HRM
600,000	Cutout Valve	Overhaul Cutout Valve	HRM
600,000	Parking Brake Disc Brake Unit	Overhaul Parking Brake Disc Brake Unit	HRM

Table 3-12. Friction Brakes Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1300, Friction Brakes Running Maintenance Manual Section Reference
600,000	Service Brake Caliper	Overhaul Service Brake Caliper	HRM
600,000	Sanding Magnet Valve	Overhaul Sanding Magnet Valve	HRM
--	Park Brake Bowden Cable	Park Brake Bowden cables do not need maintenance.	2.1.3

Table 3-13. Communications Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1400 Communications Running Maintenance & Servicing Manual Section Reference
Daily	Train interconnected network systems	Key vehicle completely off to allow computer controls systems to reset and reinitialize.	
Daily	Front Destination Sign	Visually inspect all signs	6.3.2.1
Daily	Wayside Worker Alert System	Visually inspect for damage	6.3.4
Daily	Side Destination Signs	Visually inspect for defective LED's	6.3.2.2
10,000 miles	Wayside Worker Alert System	Test function of unit	6.3.4
10,000 miles	Passenger Intercom	Verify operation	6.3.1.8
10,000 miles	Horn Controller Panel	Visually inspect for loose components and secure panel mounting hardware	6.3.3.2
30,000 miles	Remote I/O	Visually inspect for loose components and secure panel mounting hardware	6.3.1.6
30,000 miles	PIDs display	Visually inspect for vandalism, loose components and secure mounting hardware	6.3.1.11
60,000 miles	Communication Control Unit (CCU)	Visually inspect for loose components and secure panel mounting hardware	6.3.1.1
60,000 miles	ACP1A / ACP1B Panels	Visually inspect for loose components and secure panel mounting hardware	6.3.1.2
60,000 miles	Radio	Visually inspect for loose components and secure panel mounting hardware	6.3.1.3
60,000 miles	Cab Speakers	Visually inspect for loose components and secure mounting hardware	6.3.1.7
60,000 miles	Exterior Speaker	Visually inspect for loose hardware, electrical connections	6.3.1.9
60,000 miles	Interior Speakers	Visually inspect for loose components and proper operation	6.3.1.10
60,000 miles	Radio Antenna	Visually inspect for dirt and debris on the reflective plate and electrical connections/ground	6.3.1.12
120,000 miles	Ethernet Switches	Verify all M12 connectors are tightened to the proper torque	6.3.1.5
120,000 miles	Front Destination Sign	Clean exterior sign display window	6.3.2.1
120,000 miles	IAADs / PIDS	Replace Battery	6.3.1.11

Table 3-13a. Communications (TOA) Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1401 Communications Running Maintenance & Servicing Manual Section Reference
Daily (Before Operation)	Onboard Test	Initiate Onboard Test via TOA CCH to inspect test tones from Interior/Exterior Speakers and test patterns on PID Displays and Destination Signs, and verify no fault on the TOA CCH	5.4
30,000 miles	TOA Ethernet Switch	Visually inspect LED indicator to confirm the status of network connection	5.3.4
	TOA Ethernet Interface Module		5.3.5
60,000 miles	TOA ACP(A)	Visually inspect for loose components and secure panel mounting hardware	5.3.1
	TOA ACP(B)		
60,000 miles	TOA IFU	Visually inspect for loose components and secure panel mounting hardware	5.3.2
60,000 miles	TOA CCH(A)	Visually inspect for loose components and secure panel mounting hardware	5.3.3
	TOA CCH (B)		
120,000 miles	TOA Ethernet Switch	Verify all M12 connectors are tightened to the proper torque	5.3.4
120,000 miles	TOA Ethernet Interface Module	Verify all M12 connectors are tightened to the proper torque	5.3.5

Table 3-13b. Communications (including TOA Equipment) Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1402 Communications Running Maintenance & Servicing Manual Section Reference
Daily	Train interconnected network systems	Key vehicle completely off to allow computer controls systems to reset and reinitialize.	n/a
Daily	Onboard Test	Initiate Onboard Test via TOA CCH to inspect test tones from Interior/Exterior Speakers and test patterns on PID Displays and Destination Signs, and verify no fault on the TOA CCH	8.3
Daily	Front Destination Signs	Visually inspect for defective LED's	6.3.4.1
Daily	Side Destination Signs	Visually inspect for defective LED's	6.3.4.2
Daily	Wayside Worker Alert System	Visually inspect for damage	6.3.10
10,000 miles	Wayside Worker Alert System	Test function of unit	6.3.10
10,000 miles	Passenger Intercom	Verify operation	6.3.3
10,000 miles	Horn Controller Panel	Visually inspect for loose components and secure panel mounting hardware	6.3.11.1
30,000 miles	TOA Ethernet Switch	Visually inspect LED indicator to confirm the status of network connection	6.3.1.4
30,000 miles	TOA Ethernet Interface Module	Visually inspect LED indicator to confirm the status of network connection	6.3.1.5
30,000 miles	PIDS display	Visually inspect for vandalism, loose components and secure mounting hardware	6.3.2.1
60,000 miles	TOA ACP(A), TOA ACP(B)	Visually inspect for loose components and secure panel mounting hardware	6.3.1.2
60,000 miles	TOA IFU	Visually inspect for loose components and secure panel mounting hardware	6.3.1.3
60,000 miles	TOA CCH(A), TOA CCH (B)	Visually inspect for loose components and secure panel mounting hardware	6.3.1.2
60,000 miles	Communication Control Unit (CCU)	Visually inspect for loose components and secure panel mounting hardware	6.3.8
60,000 miles	Remote I/O	Visually inspect for loose components and secure panel mounting hardware	6.3.7
60,000 miles	Radio Panel	Visually inspect for loose components and secure panel mounting hardware	6.3.12.1
60,000 miles	Cab Speakers	Visually inspect for loose components and secure mounting hardware	6.3.5.3
60,000 miles	Exterior Speaker	Visually inspect for loose hardware, electrical connections	6.3.5.1
60,000 miles	Interior Speakers	Visually inspect for loose components and proper operation	6.3.5.2

Table 3-13b. Communications (including TOA Equipment) Scheduled Maintenance (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1402 Communications Running Maintenance & Servicing Manual Section Reference
60,000 miles	Radio Antenna	Visually inspect for dirt and debris on the reflective plate and electrical connections/ground	6.3.12.2
120,000 miles	TOA Ethernet Switch	Verify all M12 connectors are tightened to the proper torque	6.3.1.4
120,000 miles	TOA Ethernet Interface Module	Verify all M12 connectors are tightened to the proper torque	6.3.1.5
120,000 miles	Front Destination Sign	Clean exterior sign display window	6.3.4.1
120,000 miles	Side Destination Sign	Clean exterior sign display window	6.3.4.2
840,000 miles	PIDS Controller	Replace Battery	6.3.2.4

Table 3-14. ATC / TWC Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1500, ATC/TWC Running Maintenance Manual Section Reference
10,000 miles	ATC / TWC System	Inspect the ATC / TWC System	Section 4.3.1
30,000 miles	ATC / TWC System	Clean the ATC / TWC System	Section 4.3.2
60,000 miles	Wheel Size	Adjust Wheel Size Parameter	Section 4.3.3
60,000 miles	Decelerometer	Calibrate the Decelerometer	Section 4.3.4
Every 4 years	Vital Relay	Inspect and Test the Vital Relay	Section 4.3.5
Every 6 years	Vital Relay	Calibrate the Vital Relay	Section 4.3.6

Table 3-15. Event Recorder Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1600 Event Recorder Running Maintenance & Servicing Manual Section Reference
120,000 Miles	Event Recorder (RER-103)	Run ER Functional Tests: <ul style="list-style-type: none"> • Self Test • User Interface • System Error Verification 	5.3.2
		1. Visually inspect Event Recorder mounting hardware for tightness.	5.3.2
		2. Visually check for loose wiring or connectors.	
		3. Ensure equipment enclosure and screens are clean to prevent dust entering the unit using a clean dry cloth.	
		4. Ensure there are no obstructions blocking ventilation of the Event Recorder unit.	
		5. Using USB stick, download event recorder data and review to confirm functionality	
840,000 Miles or when indicated by Fault Logging	Event Recorder (RER-103)	Replace battery for Real Time Clock (RTC)	5.3.3

Table 3-16. Data Communications (TCN) Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1700 TCN Running Maintenance & Servicing Manual Section Reference
10,000 miles	Ethernet Switches	Visually inspect for loose components and secure panel mounting hardware	5.3.2
10,000 miles	WLAN Transceiver	Visually inspect for loose components and wires	5.3.3
60,000 miles	TCN Rack	Visually inspect for loose components and secure panel mounting hardware	5.3.1
60,000 miles	Enhanced Ethernet Interface (EEI) Panel	Visually inspect for loose components and secure mounting hardware	5.3.5
840,000 miles	TCNIO Real Time Clock Battery	Replace the battery (pn: CR2303)	5.3.6 / 6.4.4
2,400,000 miles	WTB Gateway	Reload the WTB Gateway Firmware	8.2

Table 3-17. Train Controls and Diagnostics (MDS) Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1800 Train Controls & Diagnostics (MDS) Running Maintenance & Servicing Manual Section Reference
30,000 Miles	Monitoring and Diagnostic System (MDS)	Visually inspect for loose components and secure panel mounting hardware	5.3.1
		Confirm log freshness to confirm logging function	
As required	Monitoring and Diagnostic System (MDS)	Download and save the vehicle fault logs. Logs are stored for 30 days	8.3

Table 3-18. CCTV Scheduled Maintenance

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1900 CCTV Running Maintenance & Servicing Manual Section Reference
10,000 Miles	Interior View Camera	Visually inspect the lens for cracks and scratches	5.3.1.1
10,000 Miles	Forward View Camera	Visually inspect for loose components. Clean lens of camera	5.3.2
10,000 Miles	Cab Camera	Visually inspect for loose components. Clean lens of camera	5.3.3
10,000 Miles	Rear View Camera	Visually inspect for damage and dirt	5.3.4
10,000 Miles	Rear View Monitor	Visually inspect for loose components. Clean screen of displays	5.3.5
10,000 Miles	PoE Switch	Visually inspect for loose components and secure panel mounting hardware	5.3.7
10,000 Miles or as required	Roof Camera	Visually inspect for loose components. Clean lens of camera	5.3.9
30,000 Miles	Interior View Camera	Clean the lens	5.3.1.2
30,000 Miles	Train Operator Display (TOD)	Visually inspect for loose components and scratches	5.3.6 5.4.1
		Calibrate TOD touch screen	
		Run TOD functional tests	
60,000 Miles	Network Video Recorder (NVR)	Visually inspect for loose components and secure mounting hardware	5.3.8
120,000 Miles	Train Operator Display (TOD)	Visually inspect for loose wiring or connectors	5.4.2
		Clean screen of displays	
		Ensure there are no obstructions blocking ventilation	
480,000 Miles	NVR Hard Drives	Replace the hard drive	8.2.10
840,000 Miles	Train Operator Display (TOD)	Replace the battery for Real Time Clock	5.4.3

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 4.0

GENERAL MAINTENANCE GUIDELINES

4.1 Introduction

This chapter details general maintenance guidelines that should be adhered to and followed when performing maintenance on the LACMTA P3010 LRV.

The instructions contained herein, are not intended to supersede existing railroad rules and regulations. Should there be a conflict between this manual and LACMTA railroad rules and regulations, at all times, LACMTA rules and regulations will govern.

The electrical equipment described in this manual operates at voltages and currents that are extremely dangerous to life.

Personnel should closely observe all generally prescribed CAUTIONS and WARNINGS, as well as those specifically provided in the LACMTA safety and operating rules and procedures, which if not followed, could result in damage to equipment and/or serious injury and death.

NOTE: The absence of such a warning, DOES NOT, in any way imply the absence of the hazards which, may be present anytime equipment is activated.

WARNING

THE FOLLOWING STATEMENTS OF WARNING APPLY ALL OR IN PART WHEREVER THE WORD WARNING APPEARS IN THE MAINTENANCE PROCEDURE. FAILURE TO OBSERVE THESE PRECAUTIONS MAY RESULT IN SERIOUS INJURY TO THOSE PERFORMING THE WORK AND/OR BYSTANDERS.

1. The use of compressed air, which must be less than 30 psig to blow parts clean or to blow them dry after being cleaned with a solvent, will cause particles of dirt and/or droplets of the cleaning solvent to be airborne. These conditions may cause skin and/or eye irritation.
2. When using compressed air, do not direct it toward another person. Improper use of compressed air could result in bodily injury.
3. Personal eye protection must be worn when performing any work on this device or its component parts to avoid any possible injury to the eyes.
4. The use of solvents as cleaning agents and the use of lubricants can involve health and/or safety hazards. The manufacturers of the solvents and lubricants should be contacted for safety data (such as OSHA FORM OSHA-20 or its equivalent). The recommended precautions and procedures of the manufacturers should be followed.

5. When performing any test or work on devices or equipment while they are on the vehicle, special precautions must be taken to ensure that vehicle movement will not occur which could result in injury to personnel and/or damage to equipment.
6. Assembly may be under a spring load. Exercise caution during disassembly so that no parts fly out and cause bodily injury.
7. All air supply and/or electric power to this device and/or any component part should be removed from the equipment arrangement unless specifically called for in the maintenance procedure.
8. Bottled up air under pressure (even though air supply is cut-off) may cause gaskets and/or particles of dirt to become airborne and an increase in sound level when this device and/or any component part is removed from the equipment arrangement. Personal eye and ear protection must be worn and care taken to avoid possible injury when performing any work on this device and/or component part.
9. Wire brushing may cause particles of dirt, rust, and scale to become airborne. Safety goggles must be worn to protect the eyes from injury.
10. To prevent receiving electrical shock when performing electrical tests, hands must be clear of electrical components, contacts and housing and there must be no bodily contact with the work bench. Failure to heed this warning could result in severe injury or death.
11. Before inspecting any electrical equipment in an electrical system, make sure the circuit breaker is switched to the off position and there is no voltage present where work is performed. Special attention should be paid to reverse feed applications to ensure no voltage is present. The voltages in energized equipment can cause injury or death.
12. Batteries can generate explosive gases, particularly while they are being charged, and which when released can explode and cause serious injury. Never allow sparks, open flames and smoking materials near the battery area. Never lay tools or any other metal parts on tops of the cells as this may cause an arc which might ignite explosive gases. In order to prevent drawing and arc when the batteries are either being connected or disconnected, the charging and load circuits must first be disconnected.
13. To prevent possible personal injury when attempting to remove or install car equipment, adequate support of a lifting device must be used to prevent the equipment from falling. Failure to heed these warnings could result in severe injury or death.
14. To ensure that driven equipment (such as fans and motors) are not unexpectedly started, turn off and lock out or tag power source before maintaining. Failure to observe these precautions could result in personal injury or death.

4.1.1 Electric Shock Hazard

The filter capacitors in the propulsion inverter and auxiliary power supply may be at high voltage for up to three minutes after the vehicle is separated from the catenary supply. Touching any of the main circuit components before the electric charge in the capacitors is completely discharged may cause electric shock to personnel. Make sure not to handle any component of the propulsion inverter or auxiliary power supply for five (5) minutes after the vehicle is separated from the catenary supply.

4.1.2 Thermal Burns Hazard

The filter capacitor discharge resistors can be hot even if the current is not flowing through the resistor. Do not touch the resistor surface until they have cooled to room temperature.

4.1.3 Preparing Propulsion Inverter or Auxiliary Power Supply for Inspection

WARNING

HIGH VOLTAGE!

THE PROPULSION SYSTEM MAY POTENTIALLY BE AT A HIGH VOLTAGE. CHECK THAT THE STEPS LISTED BELOW ARE FOLLOWED TO AVOID CONTACT WITH HIGH VOLTAGE.

1. Remove all high voltage power from the vehicle.
2. Wait for five (5) minutes before opening the equipment case.
3. Filter capacitor voltage amplitude must be checked and verified to be less than 50 volts after 3 minutes.
4. Place the Knife Switch in the OFF position or the Shop Power position.

Shop power can now be used. The knife switch blade must not be moved as long as there is high voltage on the vehicle from any source.

4.2 Maintenance Philosophy

Two objectives of any maintenance program are to keep all equipment in good running order and to restore faulty equipment as quickly as possible after a failure to maximize vehicle availability. Meeting these objectives requires properly trained personnel using the proper tools, test equipment, and repair facilities.

Troubleshooting, repair, and maintenance of equipment performed off the vehicle in a repair shop environment is defined as heavy maintenance. Refer to the Heavy Repair Maintenance Manual for these activities. The lubrication, maintenance, troubleshooting, and removal of equipment while it is installed on the vehicle is defined as running maintenance. This manual addresses those items.

Maintaining a good record keeping system is important because the historical data allows schedulers to predict more accurately when maintenance is required. It also indicates quantities of repair parts that should be stocked and manpower requirements to perform the maintenance. These records should include the mileage and in-service time on each vehicle, dates and types of repairs made, dates and types of inspection, lubrication and overhaul, and dates and descriptions of all problems reported.

4.3 Safety

The importance of safe operation and maintenance cannot be overstressed. These practices are an integral part of all maintenance programs and should be strictly enforced at all times. These are some important points for maintenance personnel to observe:

1. An insulated hard hat should always be worn when working under the vehicle.
2. Safety shoes and hard hats should always be worn when working around the vehicles or in shop areas.
3. Appropriate eye protection should be worn whenever there is a danger of flying particles. This requirement is especially important when performing certain maintenance tasks such as cleaning or drying with compressed air, grinding, or welding.
4. Use proper lifting equipment to remove and replace heavy components. Also make sure the component is securely fastened to the lifting device.
5. Never attempt to perform a two person operation alone. Know and follow emergency procedures.
6. Never work on equipment while electrical power is applied unless it is absolutely necessary as part of the maintenance procedure. Verify that power is removed by checking with reliable equipment.
7. Attach a tag with the name of the person who removed the power from the equipment. That person knows why the power was removed and when it will be safe to restore it. Only the individual whose name appears on the tag or a person who has his approval should remove the tag and restore power.
8. Never take any short cuts that are not clearly defined and approved.

4.4 General Maintenance Guide

Although this manual provides step-by-step procedures for component removal and installation, corrective maintenance, and preventive maintenance, the following information is a general guide for maintenance practices.

1. Hardware:

- a. Always replace hardware with the exact type (material and size). Metric hardware and standard hardware are NOT interchangeable.
- b. When removing either a component or wiring from the vehicle or a subassembly, always reinstall hardware finger tight in the same location from which it was removed. This prevents lost hardware from interfering with mechanical operation of some components and possibly causing electrical shorts.
- c. When reinstalling hardware, use the torque values called out in the maintenance instructions for that component.
- d. Avoid dropping hardware into the assembly.
- e. Install lockwashers first against the bolt head or nut, then the flat washer (if any). Remember, flat washers and lockwashers have a purpose. Always replace them if they are lost.

2. Cable Ties (Tie Wraps):

- a. Cut tie-wraps with a wire cutter. Do not nick the wires. The best method for cutting tie-wraps is to cut out a corner of the square head. This keeps the cutting blades from coming into contact with the wiring.
- b. Wear eye protection when cutting tie-wraps.
- c. Install replacement tie-wraps as close to their original location as possible.
- d. Install tie-wraps with a tie-wrap gun, if possible. Make the tie-wraps snug but movable. In a condition called cold flow, a tie-wrap is installed too tightly around a wire bundle, causing the insulation to flow away from the compressed point. Trim tie-wraps and rotate them so the heads do not rest against other wires.

3. Wiring:

- a. Tag all wires as they are removed so they can be correctly reconnected.
- b. Inspect all crimps and terminals for fatigue and broken wiring strands.
- c. If a component comes with jumpers on its electrical connections, save the jumpers for the replacement part.
- d. After installing and reconnecting the components, check all wiring connections with an ohmmeter and the wiring diagram.

4. Fuses:

- a. Check indicator pins on fuses to see if they have blown and use an ohmmeter to verify continuity.
- b. Check all replacement fuses for the correct rating and check for continuity with an ohmmeter.

5. Lubrication and Cleaning:

- a. Use only recommended cleaning fluid, oil, and grease. Too much lubricant or the wrong types of lubricants may do more harm than good.
- b. Carefully gauge the amount of grease when using a grease gun. Determine the number of squeezes of the grease gun handle required to produce one ounce of grease.
- c. Carefully gauge the amount of oil using a plunger type oil can. Determine the number of strokes of the plunger required to produce one ounce of oil.
- d. Do not lubricate self-lubricated bearings.

CHAPTER 5.0

ELECTROSTATIC DISCHARGE

5.1 Introduction

Static electricity can be a problem with electronics because of its ability to damage certain electronic parts. If the discharge goes through an integrated circuit and the transient current pulse is not effectively diverted by protective circuitry, the resulting current flow through the device can raise the temperature of internal junctions to their melting points. It is a degradation that results in limited life and/or premature part failure. Some electronic circuits can be damaged with as little as 50 volts.

Static electricity is always present in the environment. A person working at a bench, sliding around on a stool, or walking across a floor can develop a charge of thousands of volts. Devices sliding around in non-conductive handling containers or across workbench tops can also develop a static charge. The amount of static potential developed depends on the rate of generation of the charge, the rate of leakage of the charge, and the capacitance of the body holding the charge.

5.2 Methods of Protection

There are several simple methods of reducing Electrostatic Discharge (ESD) damage. Although following these methods does not guarantee that ESD damage will never occur, you can reduce the number of occurrences significantly.

5.2.1 Grounding the Maintenance Technician

When a maintenance technician touches or handles a device, the device is subject to thousands of volts of static electricity with respect to ground. This voltage must be neutralized by grounding the maintenance technician's body the entire time the device is being handled.

When handling electronic assemblies and components; the maintenance technician should wear a conductive wrist strap with a ground wire connected either to earth or to the chassis (vehicle) ground.

A wrist strap set has a built-in one megohm resistor that dissipates any stray voltages present in the ground circuit. Such voltages could injure the maintenance technician.

5.2.2 Material Handling

When a printed circuit board or component is transported, it must be protected from static while in transit. If a defective PC board is subject to improper handling, the amount of damage from ESD could turn a relatively minor component failure into a major problem involving time-consuming troubleshooting and replacing expensive integrated circuit chips.

When removing and transporting a PC board, the following procedures should be followed:

1. Wear a wrist strap wired to the vehicle or earth ground when removing the PC board from its rack, cradle, or secure location.

WARNING

NEVER DISCONNECT A PC BOARD OR PC BOARD CONNECTOR WITH VOLTAGE APPLIED (EITHER CONTROL VOLTAGE OR HIGH VOLTAGE). ENSURE THAT THE BATTERIES HAVE BEEN ISOLATED FROM THE AFFECTED SYSTEM AND THAT THE PANTOGRAPH IS DOWN.

WARNING

NEVER TOUCH OR HANDLE THE PC BOARD BY ITS TRACES, CONNECTOR TEETH, OR COMPONENTS.

2. Immediately place the PC board into a conductive, static-shielding bag.
3. Carry the PC board to a static-free workstation and wear a grounding strap when removing it from the static bag.

The manufacturer typically ships individual devices such as integrated circuits (IC) or discrete components in antistatic tubes or on slabs of conductive foam. Store these components in their shipping containers. If you remove a small quantity of these components from their original shipping container, insert their leads into strips of conductive foam and be sure to transport them in antistatic bags.

If you remove an entire cradle, or other piece of static-sensitive equipment, from the vehicle for repair, transport it in a special conductive tote pan.

5.2.3 Static-Proofing the Work Station

A static-proof workstation includes the following items:

1. A bench top covered with a conductive pad that can be connected to earth ground. Earth ground can be either one of the following:
 - a. The electrical ground in the ac power line running through the building or facility.
 - b. A separate grounding system with a copper rod buried in the ground, much like a lightning rod would be grounded.

WARNING

DO NOT HI-POT OR MEGGAR OR PERFORM ANY OTHER HIGH-VOLTAGE TESTS ON ANY COMPONENTS OR ASSEMBLIES ON THE CONDUCTIVE MATS. THE CONDUCTIVE PROPERTIES OF THESE MATS CAN CAUSE A DANGEROUS CONDITION IN WHICH HIGH VOLTAGE CAN BE SENT THROUGH THE MATS TO GROUND.

2. A conductive pad with a connection to earth ground placed on the floor under the workbench.

The bench pad and floor pad can be electrically connected together to ground along with the cord from the maintenance technicians' wrist strap.

3. Ionized air blowers to provide a constant stream of both positive and negative air ions to neutralize the static charge on nonconductors.

5.3 ESD Prone Clothing, Materials and Tools

Some materials, such as Styrofoam®, wool, nylon, rayon, and silk accumulate a static charge during normal movement through the air or when other materials are touched or placed next to them. Maintenance technicians should avoid wearing clothing or using shop materials containing these or other static-prone materials. Make sure electrically operated tools and test equipment are properly grounded and do not produce stray current if you are planning to come in contact with a PC board or PC board components.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 6.0

STORAGE AND HANDLING

6.1 Introduction

The following provides the proper storage and handling of parts.

1. Store parts received from suppliers in their original packaging.
2. Follow all storage and handling instructions as printed on the original packaging or on instruction sheets inside the package.
3. Store PC boards and semiconductor components such as ICs in approved electrostatic proof containers such as:
 - Conductive bags for PC boards,
 - Conductive foam or storage tubes for ICs and other semiconductors,
 - Conductive totes or boxes with conductive packing materials for electronic assemblies.
4. Store capacitors with their shorting wires if so equipped. Remove shorting wires only when the capacitor is to be put into service or test.
5. When removing capacitors from storage to be put into service, they must first be formed to allow the dielectric to accept the full rated voltage.
6. Store motors and gear units according to the manufacturer's recommendations.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 7.0

STANDARD REMOVAL AND INSTALLATION SHOP PRACTICES

7.1 Introduction

The following paragraphs provide standard practices applicable to all installation and removal work. They are followed by instructions for the installation and removal of undercar mounted equipment, roof mounted equipment, interior mounted equipment and exterior mounted equipment.

7.2 Mounting Hardware

All fastening bolts on the LACMTA P3010 LRV are Grade 5, or higher. When removing any component from the vehicle, replacement fasteners **MUST BE** Grade 5 or better. See Figures 7-1 and 7-2.

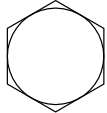
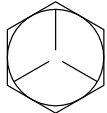
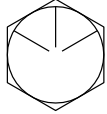



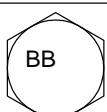
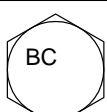
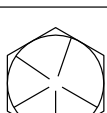
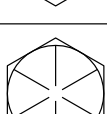
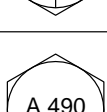
Grade Marking	Specification	Material
 NO MARK	SAE-Grade 1	Low or Medium Carbon Steel
	ASTM-A 307	Low Carbon Steel
	SAE-Grade 2	Low or Medium Carbon Steel
	SAE-Grade 5	Medium Carbon Steel, Quenched and Tempered
	ASTM-A 449	
	SAE-Grade 5.2	Low Carbon Martensite Steel, Quenched and Tempered
	ASTM-A 325 Type 1	Medium Carbon Steel, Quenched and Tempered
	ASTM-A 325 Type 2	Low Carbon Martensite Steel, Quenched and Tempered
	ASTM-A 325 Type 3	Atmospheric Corrosion (Weathering) Steel Quenched and Tempered
	ASTM-A 354 Grade BB	Low Alloy Steel, Quenched and Tempered
	ASTM-A 354 Grade BC	Low Alloy Steel, Quenched and Tempered
	SAE-Grade 7	Medium Carbon Alloy Steel, Quenched and Tempered Roll Threaded After Heat Treatment
	SAE-Grade 8	Medium Carbon Alloy Steel, Quenched and Tempered
	ASTM-A 354 Grade BD	Alloy Steel, Quenched and Tempered
	ASTM-A 490	Alloy Steel, Quenched and Tempered

Figure 7-1: Standard Grade Marking Chart




Property Class Marking	Property Class Designation	Material
	4.6	Low or Medium Carbon Steel
	4.8	Low or Medium Carbon Steel, Fully or Partially Annealed
	5.8	Low or Medium Carbon Steel, Cold Worked
	8.8	Medium Carbon Steel, Quenched and Tempered
	A325M Type 1	
	8.8	Low Carbon Boron Steel, Quenched and Tempered
	A325M Type 2	
	A325M Type 3	Atmospheric Corrosion Resistant Steel, Quenched and Tempered
	9.8	Medium Carbon Steel, Quenched and Tempered
	9.8	Low Carbon Boron Steel, Quenched and Tempered
	10.9	Medium Carbon Alloy Steel, Quenched and Tempered
	A490M Type 1	

Figure 7-2: Metric Grade Marking Chart (Sheet 1 of 2)





Property Class Marking	Property Class Designation	Material
	10.9	Low Carbon Boron Steel, Quenched and Tempered
	A490M Type 2	
	A490M Type 3	Atmospheric Corrosion Resistant Steel, Quenched and Tempered
	12.9	Alloy Steel Quenched and Tempered

Figure 7-2: Metric Grade Marking Chart (Sheet 2 of 2)

The following practices are common to all car equipment removals and installations. They are not repeated in each equipment procedure. Reference should be made to this paragraph when installing or removing carbody equipment.

1. Bolting Arrangement - Undercar Equipment.
2. Resilient Suspension Bolting Arrangement - Undercar Equipment.
3. Bolting Arrangement - Roof Mounted Equipment.
4. Electrical Cable Connections.
5. Air Line Connections.

7.3 Torquing Practices

All *safety* related fasteners, including truck and brake equipment bolts and all fasteners exposed to fatigue loads must be torqued to a minimum preload equal to 75% of their proof load and torqued striped after torquing by paint or equally approved means. All other fasteners must be torqued so that they do not loosen in service. Refer to Sections 7.4 and 7.5 for additional torquing information.

7.4 Torquing Methods

1. Select the correct wrench - Accuracy is best between the 25% and 75% ranges of the scale. Avoid wrenches that are oversize or undersize for the torque required.
2. Pull the wrench - Pulling is no more accurate than pushing, however, when a part fails unexpectedly, finger and knuckle injuries are prevented.
3. Add the run-down resistance - Tight threads and locknuts produce added resistance to the desired torque. Read the scale on the last rotation or as close to the make-up point as possible, then add the ft-lbs. (or in-lbs.) of resistance to the desired torque to obtain the value required.

4. Don't stop at set or seizure - When a fastener pops it has seized. Accurate torque settings are not possible before the point of last rotation. To break a set, back off and again apply torque. Lightly lubricate the thread and seat when conditions allow.
5. When applying torque to a device that has many fasteners (screws, bolts, nuts, etc.), the tightening sequence should be staggered.

7.5 General Guide for Maximum Torque Values

When manufacturer's specifications are not available, Tables 7-1 and 7-2 may be used as a guide to the maximum allowed torque for a given fastener and thread (standard and metric).

Table 7-1. Standard Fastener Torques for LACMTA P3010 LRV

Diameter / Pitch	Force / Torque	Stainless Steel Group 1, 2, 3 Condition CW		Steel Fastener			
				Grade 5		Grade 8	
		A	B	A	B	A	B
1/4 - 20	ft-lbs.	6	5	8	6	12	9
	Nm	8	6	11	8	16	12
	kg cm	80	60	110	80	165	120
5/16 - 18	ft-lbs.	13	10	17	13	25	18
	Nm	18	14	23	18	34	24
	kg cm	180	140	230	180	350	250
3/8 - 16	ft-lbs.	24	18	31	23	44	33
	Nm	33	24	42	31	60	45
	kg cm	330	250	430	320	610	460
7/16 - 14	ft-lbs.	38	28	49	37	70	53
	Nm	52	38	67	50	95	72
	kg cm	530	390	680	510	970	730
1/2 - 13	ft-lbs.	58	43	76	57	105	80
	Nm	78	58	103	77	142	108
	kg cm	800	590	1050	790	1450	1100
5/8 - 11	ft-lbs.	115	85	150	125	210	160
	Nm	155	115	205	170	285	215
	kg cm	1590	1190	2070	1730	2900	2200
3/4 - 10	ft-lbs.	140	105	265	200	370	280
	Nm	190	145	360	270	500	380
	kg cm	1940	1500	3660	2770	5120	3870
7/8 - 9	ft-lbs.	225	170	430	320	600	450
	Nm	305	230	585	435	815	610
	kg cm	3110	2350	5940	4430	8300	6220
1 - 8	ft-lbs.	340	255	640	480	910	580
	Nm	460	345	870	650	1230	925
	kg cm	4700	3530	8850	6640	12500	9400
NOTE A: DO NOT USE LUBRICANT FOR FASTENERS – DRY							
NOTE B: TO BE OILED OR WAXED ON THREADS OF FASTENERS - LUBRICATED							

Table 7-2. Standard Metric Torques for LACMTA P3010 LRV

		Grade 4.6 (4T)		Grade 4.8		Grade 5.6 (5T)	
Nominal diameter	Torque Conversion	Dry	Oil	Dry	Oil	Dry	Oil
M5	ft-lbs.	1.8	1.6	2.4	2.1	2.2	1.8
	N*m	2.5	2.1	3.3	2.8	3	2.5
	kgf cm	25	21	34	29	31	26
M6	ft-lbs.	2.9	2.6	4.1	3.6	3.8	3.2
	N*m	3.9	3.5	5.6	4.8	5.1	4.3
	kgf cm	40	35	57	49	52	44
M8	ft-lbs.	7.2	6.3	10.3	8.9	8.9	7.4
	N*m	9.8	8.5	14	12	12	10
	kgf cm	100	85	140	120	130	110
M10	ft-lbs.	16	13	20	17	18	15
	N*m	22	17	27	23	25	21
	kgf cm	220	170	270	230	250	210
M12	ft-lbs.	27	22	35	30	32	27
	N*m	37	30	47	40	43	36
	kgf cm	380	300	480	410	440	370
M14	ft-lbs.	44	34	55	48	50	43
	N*m	60	46	75	65	68	58
	kgf cm	620	470	760	650	690	590
M16	ft-lbs.	70	53	89	74	81	66
	N*m	95	72	120	100	110	90
	kgf cm	1000	730	1200	1000	1100	920
M18	ft-lbs.	89	74	118	100	111	96
	N*m	120	100	160	135	150	130
	kgf cm	1300	1000	1650	1400	1500	1300
M20	ft-lbs.	125	103	170	144	155	133
	N*m	170	140	230	195	210	180
	kgf cm	1800	1400	2300	2000	2100	1800
M22	ft-lbs.	177	140	229	195	207	177
	N*m	240	190	310	265	280	240
	kgf cm	2500	1950	3160	2700	2900	2400
M24	ft-lbs.	221	181	295	247	266	221
	N*m	300	245	400	335	360	300
	kgf cm	3100	2500	4000	3400	3600	3100
M27	ft-lbs.	340	262	428	361	384	325
	N*m	460	355	580	490	520	440
	kgf cm	4700	3600	5900	5000	5300	4500
M30	ft-lbs.	465	358	575	487	524	443
	N*m	630	485	780	660	710	600
	kgf cm	6500	4900	8000	6800	7200	6100

Table 7-2. Standard Metric Torques For LACMTA P3010 LRV (continued)

		Grade 5.8		Grade 6.8 (6T)		Grade 8.8 (7T)	
Nominal diameter	Torque Conversion	Dry	Oil	Dry	Oil	Dry	Oil
M5	ft-lbs.	3	2.5	3.5	3	4.6	3.8
	N*m	4.1	3.4	4.7	4	6.2	5.2
	kgf cm	41	35	48	41	63	53
M6	ft-lbs.	5.1	4.3	6	5	7.4	6.6
	N*m	6.9	5.8	8	6.8	10	8.9
	kgf cm	70	59	81	69	110	91
M8	ft-lbs.	12	10	14	12	18	16
	N*m	17	14	19	16	25	22
	kgf cm	170	140	200	170	260	220
M10	ft-lbs.	24	21	28	24	37	32
	N*m	33	28	38	32	50	43
	kgf cm	340	290	390	330	510	440
M12	ft-lbs.	43	36	49	42	67	57
	N*m	58	49	67	57	91	77
	kgf cm	590	500	680	580	930	790
M14	ft-lbs.	68	58	81	66	111	89
	N*m	92	78	110	90	150	120
	kgf cm	940	790	1100	920	1500	1300
M16	ft-lbs.	103	89	125	103	170	140
	N*m	140	120	170	140	230	190
	kgf cm	1500	1200	1700	1400	2300	2000
M18	ft-lbs.	148	125	170	140	229	192
	N*m	200	170	230	190	310	260
	kgf cm	2000	1700	2300	2000	3200	2700
M20	ft-lbs.	207	177	236	207	325	273
	N*m	280	240	320	280	440	370
	kgf cm	2800	2400	3300	2800	4500	3800
M22	ft-lbs.	280	236	325	273	443	376
	N*m	380	320	440	370	600	510
	kgf cm	3900	3300	4500	3800	6100	5200
M24	ft-lbs.	354	302	413	347	560	480
	N*m	480	410	560	470	760	650
	kgf cm	4900	4200	5700	4900	7800	6600
M27	ft-lbs.	524	443	605	509	811	701
	N*m	710	600	820	690	1100	950
	kgf cm	7200	6100	8400	7100	11000	9700
M30	ft-lbs.	708	605	811	693	1106	959
	N*m	960	820	1100	940	1500	1300
	kgf cm	9800	8300	11000	9600	15000	13000

Table 7-2. Standard Metric Torques For LACMTA P3010 LRV (continued)

Nominal diameter	Torque Conversion	Grade 9.8		Grade 10.9		Grade 12.9	
		Dry	Oil	Dry	Oil	Dry	Oil
M5	ft-lbs.	5.1	4.4	6.5	5.5	7.4	6.5
	N*m	6.9	5.9	8.8	7.5	10	8.8
	kgf cm	71	60	90	77	110	89
M6	ft-lbs.	8.9	7.4	11	9.6	13	11
	N*m	12	10	15	13	18	15
	kgf cm	120	100	150	130	180	150
M8	ft-lbs.	21	18	27	23	32	27
	N*m	28	24	36	31	43	36
	kgf cm	290	250	370	320	430	370
M10	ft-lbs.	42	35	53	45	62	53
	N*m	57	48	72	61	84	72
	kgf cm	580	490	740	630	860	730
M12	ft-lbs.	74	62	96	81	111	96
	N*m	100	84	130	110	150	130
	kgf cm	1000	850	1300	1100	1500	1300
M14	ft-lbs.	118	96	148	125	170	148
	N*m	160	130	200	170	230	200
	kgf cm	16000	1400	2000	1700	2400	2000
M16	ft-lbs.	177	155	229	199	266	229
	N*m	240	210	310	270	360	310
	kgf cm	2500	2100	3200	2700	3700	3200
M18	ft-lbs.			317	273	369	317
	N*m			430	370	500	430
	kgf cm			4400	3700	5100	4300
M20	ft-lbs.			450	384	524	450
	N*m			610	520	710	610
	kgf cm			6200	5300	7300	6200
M22	ft-lbs.			612	524	715	605
	N*m			830	710	970	820
	kgf cm			8400	7200	9900	8400
M24	ft-lbs.			811	664	885	738
	N*m			1100	900	1200	1000
	kgf cm			11000	9100	13000	11000
M27	ft-lbs.			1106	960	1328	1106
	N*m			1500	1300	1800	1500
	kgf cm			16000	13000	18000	16000
M30	ft-lbs.			1550	1328	1770	1550
	N*m			2100	1800	2400	2100
	kgf cm			21000	18000	25000	21000

CHAPTER 8.0

SAFETY WIRE PRACTICES

8.1 Introduction

The following information provides common practices for using safety wire.

The use of lock wire or safety wire is not a means of obtaining or maintaining torque, it is a safety device to prevent the disengagement or movement of screws, nuts, bolts, snap rings, oil caps, drain cocks, valves, or other parts.

8.2 Wire Materials

1. STAINLESS STEEL – This will be for all general lock wiring purposes. Lockwire for use up to 700°F must be a corrosion resistant steel such as AMS-5685. Lockwire for use up to 1800°F must be a corrosion and heat resistant steel such as AMS-5687.
2. COPPER – This will be for shear and seal wiring applications only. Shear applications are those where it is necessary to break or to shear the wire to permit operation or actuation of emergency devices. Seal applications are those where the wire is used with a lead seal to prevent tampering.

8.3 Wire Size

1. .032 inch minimum diameter wire shall be used for general purpose lock wiring except that .020 inch diameter wire may be used on parts having a nominal hole diameter of less than .045 inch, on parts having a nominal hole diameter between .045 and .062 inches with a spacing of less than 2 inches, or on closely spaced screws or bolts of 1/4 or smaller.
2. Copper wire with a .020 diameter shall be used for shear and seal wire applications.

8.4 Common Safety-Wiring Practices

There are many different combinations of safety-wiring with certain basic rules common to all applications. These rules are as follows.

1. When bolts, screws or other parts are closely grouped, it is more convenient to wire them in series. The number of bolts, nuts, screws, etc. that may be wired together depends upon the application.
2. Drilled boltheads and screws do not need to be safety-wired if installed with self-locking nuts.
3. To prevent failure due to rubbing or vibration, safety wire must be tight after installation.

4. Safety wire must be installed in a manner that will prevent the tendency of the part to loosen.
5. Safety wire must never be overstressed. Safety wire will break under vibration if twisted too tightly. Safety wire shall be pulled taut when twisted, and maintain a light tension when secured.
6. The ends of the safety wire must be bent under and inward toward the part to avoid sharp or projecting ends, which might present a safety hazard.
7. Safety wire inside a duct or tube must not cross over or obstruct a flow passage when an alternate routing can be used.

8.5 Methods

1. **SINGLE WIRE METHOD** – The single wire method of safety-wiring shall be used on screws, bolts, and/or nuts in a closely spaced (2 inches or less between centers) or closed geometrical pattern such as a triangle, square, rectangle, square, or circle except when the closed geometric pattern is used to seal hydraulic or air seals, hold hydraulic pressure, or used in critical areas of clutch mechanisms and superchargers. This method shall be used for all shear and seal wiring applications. The single wire method may also be used on parts in electrical systems and in places that are difficult to reach. See Figure 8-1.

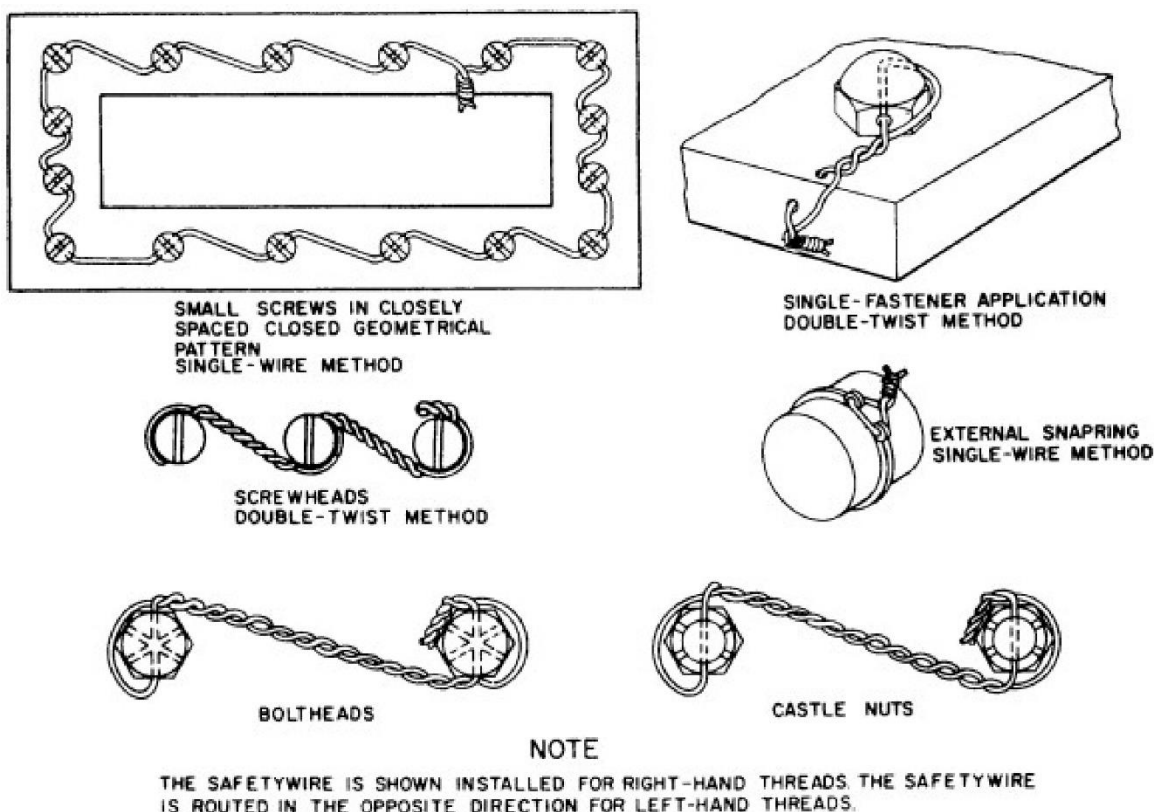


Figure 8-1: Single Wire and Double Twist Applications

2. **DOUBLE TWIST METHOD** – The double twist method of safety-wiring shall be used as the common method of lock wiring. All safety wire applications excluded from the single wire method shall employ the double twist method. See Figure 8-2.

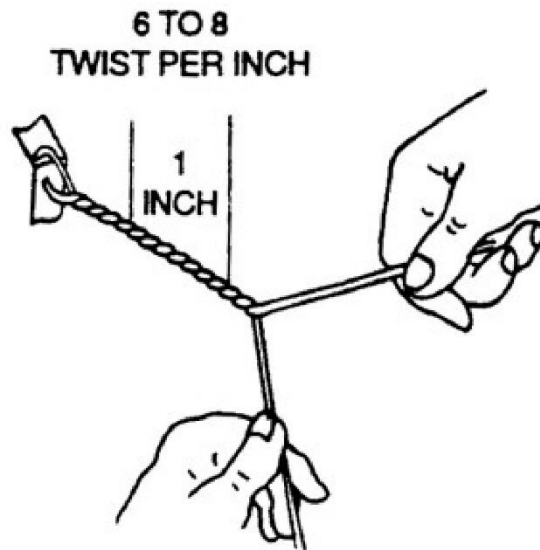


Figure 8-2: Double Twist Method by Hand

8.6 Safety Wire Procedures

1. Check the units to be safety wired to ensure that they have been correctly torqued, and that the wiring holes are properly aligned with each other. When there are two or more units, it is desirable that the holes be aligned with each other. Never over torque or loosen to obtain proper alignment of the holes.
2. To prevent mutilation of the twisted section of wire when using pliers, grasp the wire at the ends. Safety wire must not be kinked, nicked or mutilated. Never twist off the wire ends with pliers, and when cutting wire ends, ensure that at least four to six complete turns are left after the loop ($1/2$ to $5/8$ inches of wire).
3. A pigtail of $1/4$ to $1/2$ inch (3 to 5 twists) shall be made at the end of the wiring. This pigtail shall be bent back or under to prevent snagging.

8.7 Twisting With Special Tools

1. Grip the wire in the jaws of the wire twister and slide the outer sleeve down with the thumb to lock the handles or lock the spring loaded pin.
2. Pull the knob, and the spiral rod spins around and twist the wire.
3. Squeeze handles together to release the wire.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 9.0

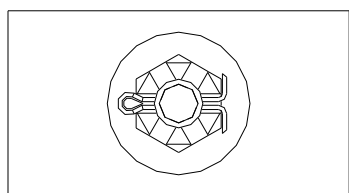
COTTER PIN APPLICATION PRACTICES

9.1 Introduction

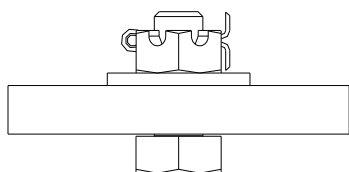
The following information provides common practices for using cotter pins.

9.2 Application Methods

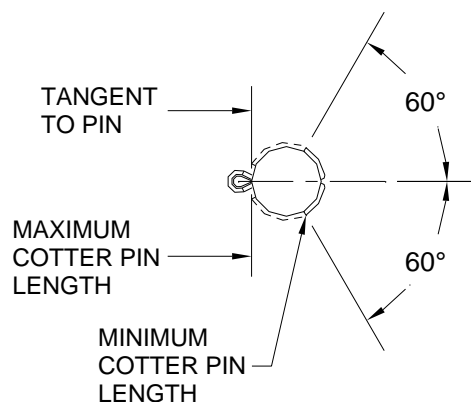
1. Cotter pins shall be new upon each application.
2. When nuts are to be secured to the fastener with cotter pins, tighten the nut to the low side (minimum) of the applicable specified or selected torque range, unless otherwise specified, and if necessary, continue tightening until the slot aligns with the hole: but do not exceed the high side (maximum) torque range.
3. Castellated nuts mounted on bolts may be safetied with cotter pins or lock wire. The preferred method is illustrated in Figure 9-1. An alternate method where the cotter pin is mounted normal to the axis of the bolt may be used where the cotter pin in the preferred method is apt to become a snag.



CASTELLATED NUT ON BOLT
ALTERNATE METHOD



CASTELLATED NUT ON BOLT
PREFERRED METHOD



PIN APPLICATION

Figure 9-1: Correct Cotter Pin Applications

4. When more than 50 percent of the cotter pin diameter is above the nut castellation, a washer shall be used under the nut or a shorter fastener shall be used. A maximum of two washers may be permitted under a nut.
5. In no application to a nut, bolt or screw shall the pin size be less than the sizes listed in Table 9-1.

Table 9-1. Cotter Pin Sizes

Thread Size	Minimum Pin Size
6	.028
8	.044
10	.044
1/4	.044
5/16	.044
3/8	.072
7/16	.072
1/2	.072
9/16	.086
5/8	.086
3/4	.086
7/8	.086
1.0	.086
1-1/8	.116
1-1/4	.116
1-3/8	.116
1-1/2	.116

6. Install the cotter pin with the head firmly in the slot of the nut with the axis of the eye at right angles to the bolt shank, bend prongs so that the head and upper prong are firmly seated against the bolt.
7. In pin applications, install the cotter pin with the axis of the eye parallel to the shank of the clevis pin or rod end. Bend the prongs around the shank of the pin or rod end.

CHAPTER 10.0

ACRONYMS AND ABBREVIATIONS

10.1 Introduction

Table 10-1 is a summary list of the acronyms and abbreviations used in the LA P3010 manuals.

Table 10-1. Acronyms and Abbreviations

Acronym/Abbreviation	Description
208VDK	Inverter Fan Relay
2P	Two Passenger
AADS	Automatic Announcement Display System
AC	Alternating Current
ACCU	Air Conditioning Control Unit
ACD	Alternating Current Detector
ACK	Acknowledge
ACM	Audio Control Modules
ACM	Acoustic Module
ACP	Audio Control Panel
ACP1A	Audio Control Panel 1A
ACP1B	Audio Control Panel 1B
ADC	Analog to Digital Converter
ADD	Auto Drop Device
ADU	Aspect Display Unit
AF	Audio Frequency
AFS	Air Flow Switch
AGC	Automatic Gain Control
AMP	Amperes
AMP	Amplifier
AMV	Apply Magnet Valve
APC	Automatic Passenger Counter
APS	Auxiliary Power Supply
ARP1B	Articulation Relay Panel 1B
ASK	Amplitude Shift Keying
ASTS USA	Hitachi Rail STS, USA, Inc.
ATC	Automatic Train Control
ATO	Automatic Train Operation

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
ATP	Automatic Train Protection
ATP ACK	ATP Acknowledge
AW	Axle Weight
+BAT	24VDC Control Voltage Positive From Train
-BAT	0VDC or Negative From Train
BA	Brake Assurance
BAFS	Brake Assured Full Service Stop
BCA	Brakes Applied Switch
BCH	Brake Chopper 1 and 2
BCR	Brakes Released Switch
BCT	Brake Cylinder Transducer
BCU	Brake Control Unit
BM	Blower Motor
BMC	Blower Motor Contactor
BMCB	Blower Motor Circuit Breaker
BMCBA	Blower Motor Circuit Breaker Auxiliary
BMCT	Blower Motor Current Transformer
CAN-Bus	Controller Area Network – Bus Field Bus System
CCB	Communication Controller Board (PCB)
CCH	Communication Control Head
CCTV	Closed Circuit Television
CCU	Communication Control Unit
CF card	Compact Flash Card
CFM	Condenser Fan Motor
CFMC	Condenser Fan Motor Contactor
CFMCB	Condenser Fan Motor Circuit Breaker
CFMCBA	Condenser Fan Motor Circuit Breaker Auxiliary
CFMCT	Condenser Fan Motor Current Transformer
CHMM	Crash Hardened Memory Module
CHR	Charging Resistor Unit
cm	Centimeter
CM	Coast Motor trainline
CM1	Compressor Motor 1
CM1CT	Compressor Motor 1 Current Transformer
CM2	Compressor Motor 2
CM2CT	Compressor Motor 2 Current Transformer
CMC1	Compressor Motor Contactor 1

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
CMC2	Compressor Motor Contactor 2
CMCB1	Compressor Motor Circuit Breaker 1
CMCB2	Compressor Motor Circuit Breaker 2
CMCBA1	Compressor Motor Circuit Breaker Auxiliary 1
CMCBA2	Compressor Motor Circuit Breaker Auxiliary 2
cN/cm2	Centinewton per centimeter squared
CN1	Connector 1, Power Supply (208VAC)
CN2	Connector 2, 24VDC, Reset
CN3	Connector 3, MVB, Ethernet, I/O's
COMM	Communication Subsystem
COMM	Communication Unit
CONT	Control
COTS	Commercial Off-the-Shelf
CPLD	Complex programmable Logic Device
CPM	Code Per Minute
CPS	Conditional Power Supply
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRP1A	Cab Relay Panel 1A
CRP1B	Cab Relay Panel 1B
CRP2A	Cab Relay Panel 2A
CRP2B	Cab Relay Panel 2B
CRP3A	Cab Relay Panel 3A
CRP3B	Cab Relay Panel 3B
CRP4A	Cab Relay Panel 4A
CRP4B	Cab Relay Panel 4B
CRP5A	Cab Relay Panel 5A
CRP5B	Cab Relay Panel 5B
CRP6A	Cab Relay Panel 6A
CRP6B	Cab Relay Panel 6B
CRP7A	Cab Relay Panel 7A
CRP7B	Cab Relay Panel 7B
CRP8A	Cab Relay Panel 8A
CSRD	Cab Signal Receiver-Demodulator
CTB	Current Transducer Brake Chopper
CTG	Current Transducer Return Current
CTL	Current Transducer Line Current

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
CTU	Current Transducer Output Current U-Phase
CTU2	Current Transducer U-Phase Both Inverters (mis-connected motor)
CTV	Current Transducer Output Current V-Phase
CTW	Current Transducer Output Current W-Phase
CV	Main Reservoir Check Valve
CVT	Control Volume Transducer
DA	Digital Acoustics
DBA	Dynamic Brake Achieved
DBEA	Dynamic Brake Effort Achieved
DC	Direct Current
DCHR	Filter Capacitor Discharge Resistors 1 through 4
DCU	Door Control Unit
DCVD1	Line Voltage Detector
DCVD2	Filter Capacitor Voltage Detector
DDD	Door Diagnostic Description
DDS	Direct Digital Signal
DI/DO	Digital Input / Digital Output
DMS	Deadman Switch
Doc.	Document
DOPWM	Digital Output Pulse Width Modulation Board
DPRAM	Dual Port Random Access Memory
DSP	Digital Signal Processing
DTG	Distance-To-Go
DV	Anti-Skid Valve (Dump Valve)
EB	Emergency Braking
EB	Emergency Brake
EBR	Emergency Brake Relay
EBRT	Emergency Brake Relay Timer
ECN	Ethernet Consist Network (per IEC-61375-3.4 - 2010(E))
ECR	Electrical Coupler Retract
ECS	Electric Coupler Switch
ECU	Electronic Control Unit
EEI	Enhanced Ethernet Interface
EEIM	Enhanced Ethernet Interface Manager
EEPROM	Electrically Erasable Programmable Read Only Memory
ELD	Enable Left Doors
EMD	Electrical Medium Distance

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
EMI	Electro Magnetic Interference
EMV	Emergency Magnet Valve
EPROM	Erasable Programmable Read Only Memory (Flash EPROM)
ER	Event Recorder
ERD	Enable Right Doors
ESL	Enforced Speed Limit
ESNA	Elastic Stop Nut Division
ESS	Emergency Station Stop
ESS	Environmental Stress Screening
ETB	Ethernet Train Backbone (per IEC-61375-2-5 - 2009(E))
ETH	Ethernet
E-VNC	Ethernet Vehicle Network Controller
EXT	Exterior
FAT	Fresh Air Temperature Sensor
FBCV	Friction Brake Cutout Valve
FC	Filter Capacitor
FDD	Frequency Division Duplexing
FDS	Front Destination Sign
FLT	Main Reservoir Filter
FM1R	Inverter Fan Motor Relay
FPGA	Field programmable Gate Array
FSB	Full Service Brake
FSBR	Full Service Brake Relay
FSK	Frequency Shift Keying
ft.	Feet
ft-lbs.	Foot Pounds
FWD	Forward
GND	Ground
GPIO	General Purpose Input and Output
GPS	Global Positioning System
GR	Gear Ratio
GS	Gong Switch
H&K	Hanning & Kahl
HB	Heart Beat
HB24	HSCB Control Panel Power Supply (28.5 Vdc)
HB28	HSCB Control Panel Power Supply Abnormality
HCS-V	Hanning Communication System (Bi-Directional)

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
HE	Head End
HGBP1 & 2	Hot Gas Bypass Valve 1 & 2
HGBPR1 & 2	Hot Gas Bypass Relay 1 & 2
HMI	Human Machine Interface
HP	Horsepower
HPF	High Positive Friction
HPS1 & 2	High Pressure Switch 1 & 2
HPT1 & 2	High Pressure Transducer 1 & 2
HRMM	Heavy Repair Maintenance Manual
HRSB	High Rate Service Brake
HS	Horn Switch
HSCB	High Speed Circuit Breaker
HSCBCK	High Speed Circuit Breaker Control Relay
HVAC	Heating, Ventilation and Air Conditioning
Hz	Hertz
I.D.	Inside Diameter
I/O	Input and Output
IAADS	Independent Automatic Announcement System
IC	Intercom
IC	Integrated Circuit
IC	Intercommunication
ICD	Interface Control Document Bus Description
ID	Identification
IDDB	Identification Database
IEB	Irrevocable Emergency Brake
IEEE	Institute of Electrical and Electronics Engineering
IES	Irrevocable Emergency Stop
I/F	Interface Unit
IFU	Interface Unit
IGBT	Insulated Gate Bipolar Transistor
in.	Inch
INFO	Information
in-lbs.	Inch-Pounds
INT	Interior
IP	Internet Protocol
IPA	Isopropyl Alcohol
KBPS	Kilo Bites Per Second

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
kg	Kilogram
kgf	Kilogram Force
KI	KINKISHARYO International, LLC
km	Kilometer
km/h	Kilometer per hour
kN	Kilo Newton
kW	Kilowatt
LACMTA	Los Angeles County Metropolitan Transportation Authority
LCC	Line Charging Contactor
LCF	Low Coefficient of Friction
LCU	Logic Control Unit
LED	Light Emitting Diode
LFLD	Line Fault Location Detection
LH	Left Hand
LLV	Load Limiting Valve
LOM	Logic Module (Logic Module of the DCU)
LPS1 & 2	Low Pressure Switch 1 & 2
LPT1 & 2	Low Pressure Transducer 1 & 2
LRV	Light Rail Vehicle
LS	Line Switch Contactor
LSR	Line Switch Relay
LVD	Low Voltage Detection
LVDC	Low Voltage Direct Current
LVPS	Low Voltage Power Supply
LVPS GND	Low Voltage Power Supply Ground
LVPS+	Low Voltage Power Supply 24VDC +
LW	Load Weight
LWT	Load Weigh Transducer
M	Motor (M) trainline
m/s	Meters per second
m/s/s	Meters per second per second
MAS	Maximum Authorized Speed
Max.	Maximum
M-axle	Motored or Powered Axle
MBL	Metro Blue Line
MBS	Microprocessor Based Subsystem(s)
MCC	Metro Control Center

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
MCS	Master Controller Switches
MDC(U)	Modular Door Control (Unit)
MDS	Monitoring and Diagnostic System
MDS	Maintenance and Diagnostic System
MGL	Metro Green Line
mHz	Megahertz
MIC	Microphone
MIMO	Multiple Input Multiple Output
Min.	Minimum
mm	Millimeter
MONIT ME	IFE Monitoring Me, IFE PC-software, for local modifying of parameters
MOV	Metal Oxide Varistor
mph	Miles Per Hour
MPH/PS	Miles Per Hour Per Second
MPH/S/S	Miles Per Hour Per Second Per Second
mphps	Miles Per Hour Per Second
MR	Main Reservoir
MRCO	Main Reservoir Cutout Cock
MRP	Main Reservoir Pipe
MRT	Main Reservoir Transducer
ms	Milliseconds
MSEC	Millisecond
MVB	Multifunction Vehicle Bus
MVB	Multi-functional Vehicle Bus
MVB	Multi Vehicle Buss
N/A	Not Applicable
NC	Normally Closed
NC	Normal Closed
NC Contact	Normally Closed Contact
NIC	Network Interface Controller
Nm	Newton Meter
NMRK	Propulsion equipment case No-Motion Relay
No.	Number
NO	Normally Open
NO	Normal Open
NO Contact	Normally Open Contact
NPT	National Pipe Thread

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
NSC1 - 4	EMI Noise Suppression Cores 1 through 4
NVR	Network Video Recorder
O.D.	Outside Diameter
OCC	Operational Control Center
OCS	Overhead Contact System
OCS	Overhead Catenary System
OH1	Overhead Heater 1
OH2	Overhead Heater 2
OHC1	Overhead Heater 1 Contactor
OHC2	Overhead Heater 2 Contactor
OHCA1	Overhead Heater Contactor Auxiliary 1
OHCA2	Overhead Heater Contactor Auxiliary 2
OHCB	Overhead Heat Circuit Breaker
OHCBA	Overhead Heat Circuit Breaker Auxiliary
OHPT1	Overhead Heater Protection Thermostat 1
OHPT2	Overhead Heater Protection Thermostat 2
OL	Overload, Motor, Thermal, CFM & BM
OSI	Open Systems Interconnection
OSL	Operational Speed Limit
Oz	Ounce
Pa	Pascal (unit of pressure)
PA	Public Address
PAD	Personal Alert Device
PB	Pushbutton
PBA	Park Brake Applied Switch
PBCO	Park Brake Cutout Cock
PBED	Power / Brake Effort Demand
PBED	Propulsion and Brake Effort Delivered
PBFLT	Park Brake Filter
PBMRCO	Park Brake Main Reservoir Cutout
PBMV	Park Brake (Magnet) Valve
PBR	Park Brake Released Pressure Switch
PC	Personal Computer
PCB	Printed Circuit Board
PDF	Propulsion and Dynamic Brake Fault
PDM	Process Data Marshaling
PDR	Preliminary Design Review

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
PGL	Pasadena Gold Line
PHW	Programmable Hardware
PIC	Passenger Intercom
PID	Passenger Information Display
PIDS	Passenger Interior Information Displays
PIS	Passenger Information System
PIU	Propulsion Inverter Unit (equipment case)
PLU	Propulsion Logic Unit
PoE	Power Over Ethernet
POM	Power Module (Power Module of the DCU)
POST	Power On Self-Test
PSI	Pressure per Square Inch
psig	Pressure Per Square Inch, Gauge
PSS	Precision Station Stop
PSU	Power Supply Unit
PTC	Positive Temperature Coefficient, Fuse
PTE	Portable Test Equipment
PTT	Push-to-Talk
PTU	Portable Test Unit
PVID	Permanent Vehicle Identification
PWC	Power Cut
PWM	Pulse Width Modulation
Qty	Quantity
R4	Damper Servomotor
R5	Damper Servomotor
RAM	Random Access Memory
RAT	Return Air Temperature Sensor
RER	RER103-LAP3010-001 – Saira Electronics Model Number
RES	Revocable Emergency Stop
RH	Right Hand
RIO	Remote Input / Output
RME	Route Management Editor
RMM	Running Maintenance Manual
RMS	Root Mean Square
RMSM	Running Maintenance and Servicing Manual
RMV	Release Magnet Valve
RMV2	Release Magnet Valve 2

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
ROM	Read Only Memory
RPM	Revolutions Per Minute
RS232	Recommended Standard 232 (serial interface; EIA-232) Serial Interface
RTC	Real Time Clock
RTC	Rail Transit Consultants, Inc.
RTDG	Real Time Data Gathering
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
RV	Relay Valve
RX	Receive Signal
RxD	Receive Data
SAE	Society of Automotive Engineers
SAT	Supply Air Temperature Sensor
SBD	Safe Braking Distance
SCEB	Slide Controlled Emergency Brake
SDS	Safety Data Sheet
SDS	Side Destination Sign
SFD	System Functional Description
SGR	Speed Governor Relay
SP	Speaker
SPDT	Single Pole, Double Throw
SPI	Serial Peripheral Interface
SPKR	Speaker
SPO	Supervisory, Positioning, and Orientation
ST03A	Application Software for Diagnosis of the IFE door system
SW	Switch
T1	Transformer 1
TACH	Tachometer (Speed Sensor)
T-axle	Trailer or Unpowered Axle
TB	Terminal Block
TCN	Train Control Network
TCN	Train Communication Network
TCN	Train Controller Network
TCON	Train Configuration
TCON	Train Configuration Functionality
TL	Trainline
TOD	Train Operator Display

Table 10-1. Acronyms and Abbreviations (cont'd.)

Acronym/Abbreviation	Description
TP-BC	Test Point Brake Cylinder
TP-CV1	Test Point-Control Volume 1
TP-CV3	Test Point-Control Volume 3
TP-CV4	Test Point-Control Volume 4
TP-LW	Test Point Load Weigh
TP-MR	Main Reservoir Test Point
TP-PB	Test Point Park Brake
TS	Transfer Switch
TS	Technical Specification
TTEM	Tools and Test Equipment Manual
T-VNC	TCN Vehicle Network Controller
TWC	Train to Wayside Communication
TX	Transmit Signal
TxD	Transmit Data
UCPB	Uncouple Pushbutton
UEB	Unrecoverable Emergency Brake
UES	Unrecoverable Emergency Stop
UPDATE	IFE Update, IFE PC-software, for local software-download
USB	Universal Serial Bus
V	Volt
VAC	Volts, Alternating Current
VC	Voltage at Filter Capacitors
VDC	Volts, Direct Current
VIA	Versatile Interface Adapter
VLU	Vehicle Logic Unit
VMS	Vehicle Management System
VNC	Vehicle Network Controller
VoIP	Voice Over IP
VPS	Valve Power Supply, Transformer, 230 VAC Input / 24 VAC Output
Vu	Voting Unit
WLAN	Wireless Local Area Network
WSS	Wayside Software
WTB	Wired Train Bus
WWAS	Wayside Worker Alert System
ZNR	Zener Diode

CHAPTER 11.0

GLOSSARY OF TERMS

11.1 Introduction

Table 11-1 is a summary list of the glossary of terms used in the LA P3010 manuals.

Table 11-1. Glossary of Terms

Terms	Definition
A-Unit	One-half of an LRV, where the pantograph is located.
Accessible	Relating to maintainability, the ability to inspect, repair, remove, or reapply a compound or unit of equipment without interference from unrelated equipment.
Accident	An accident is an unplanned event, which results in injury or death to a human being and/or damage to or loss of equipment or property.
Articulation	The location where two halves of a rail car meet and are supported by a center truck.
Assembly	A number of parts, subassemblies, or any combination thereof, joined together to perform a specific function, and being replaceable as a whole.
ATP Bypass	A mode that permits train operation when carborne ATC or ATP has failed.
ATP Speed Limit	The upper limit of train speed as enforced by ATP.
Automatic Coupler	A coupler which when mechanically engaged also engages electrical and pneumatic lines between cars.
Automatic Train Control (ATC)	The system for automatically controlling train movement, enforcing train safety, and directing train operations, ATC includes the ATP and ATO subsystems.
Automatic Train Operation (ATO)	The subsystem of the ATC that performs the functions of speed regulation and programmed station stopping.
Automatic Train Protection (ATP)	The subsystem of ATC that performs the functions of cab signal reception and decoding, speed limit determination and enforcement, brake assurance, propulsion and braking control, unintentional movement protection, berthing verification and supervision of the ATO subsystem.
B-Unit	One half of an LRV, where the battery is located.
Battery	The main vehicle battery that supplies voltage to the vehicle when the Auxiliary Inverter is not running.
Brakes, Friction	Mechanical system, which applies pads on axle discs to provide braking effort through friction.
Braking Effort	Retarding force developed by the traction system, braking system, or a combination of both systems.
Braking, Emergency	Irrevocable open loop braking to a full stop at the maximum design brake rate.
Braking, Full Service	A non-emergency brake application, which obtains the maximum brake rate consistent with the design of the primary brake system(s).
Braking, Regenerative	Electric braking where the power generated by the traction motor, when driven as a generator, is conditioned and returned to the DC bus.

Table 11-1. Glossary of Terms (cont'd.)

Terms	Definition
Braking System	The system of wheels, motors, driving mechanism, friction brakes, controls, and appurtenances that retards the LRV in response to input control signals.
Cab Console	Operator's control station
Car Set	The complete grouping of components specified to perform certain functions and to fulfill specific needs such that compliant car performance is achieved.
Catenary	The droop of a wire from one pole to the next pole. Usually refers to Overhead Contact System (OCS) where a contact wire is held level by hangers from a catenary wire. The OCS supplies 750 volts DC power to the train.
Coast	The mode of operation of a car or train in which propulsion (positive traction) is inactive, and negligible braking effort is in effect.
Console	Control station panel in the Operator's cab from which the Operator monitors and controls train operation.
Consist	One to three cars coupled together. Used interchangeably with train.
Coupler	A device for mechanically coupling LRVs together. This term is also applied to connectors, as in electric coupler and pneumatic coupler, which couple electric and pneumatic trainlines together between LRVs.
Deadman	A device for detecting an inattentive or incapacitated train Operator.
Decibel	Unit for expressing ratio of power levels in electrical communication or sound intensities.
Device	An element of a component, consisting of parts and structure, which performs specific functions necessary to the operation of the component.
Diagnostic Test Equipment	Equipment designed for fault isolation, which is consistent with the maintenance support required to achieve the mean-time-to repair (MTTR) criteria.
Draft Gear	The energy absorbing mechanism that attaches the coupler or drawbar to the anchorage.
Failsafe	A characteristic of a system, which ensure that any malfunction, or malfunctions caused by a single event affecting safety will cause the system to revert to a state that is known to be safe.
Failure	The inability of an item to function or perform its intended function as designed or specified.
Failure Modes, Effects, and Criticality Analysis (FMECA)	It is a systematic, comprehensive, bottom-up evaluation that analyzes the effects of potential failures in a subsystem, as installed, from design data.
Fault Monitoring	Automatic monitoring of train control logic for errors during service from any of the subsystems including brakes, traction, doors, air conditioning, etc.
Floor Height	The vertical distance measured between the upper surfaces of the rail and car floor including floor covering when the unloaded car is in operational condition and stationary on level tangent track.
Friction Brakes	A system of mechanical brake pads that press on the axle mounted brake discs, electro-pneumatic conversion, and controls to slow and stop the train. Also include the air compressor, parking brakes and track brakes.
Handrails	Safety appliances installed on the side, or end of a Car, to assist crewmembers to safely board the car.
Hazard	Any real or potential condition or failure that can cause or contribute to an accident.
Incident	An unexpected event which potentially degrades reliability, maintainability, and thereby system safety, and thereby increases the probability of an accident.
Interface	The points where two or more subsystems, systems, persons, or firms shall meet to ensure continuity of the project.

Table 11-1. Glossary of Terms (cont'd.)

Terms	Definition
Interchangeable	Any component or equipment capable of being selected at random from a batch supplied under the same title and substituted both physically and functionally for its counterpart on the complete equipment or system.
Interlock	An electrical and/or mechanical means of preventing two or more actions from occurring simultaneously.
Inverter	A solid state electronic means of converting a DC source of power into an AC voltage.
Isolation, Subsystem	Galvanic isolation between input and output circuits, and between each input and output circuit and the chassis.
Irretrievable	Relating to a system state, which, once initiated, cannot be altered until specific conditions are achieved or exist.
Jerk/Jerk Rate	The time rate of acceleration and deceleration change, equal to the second time derivative of velocity.
Layover	The condition of a car, which is not in revenue service and has no active or controlling operating station. In layover, selected car loads will be de-energized on a timed, sequential basis. The terms "lay-up" and "standby" are synonymous with layover.
Left Side	Left side of one half of a LRV when looking towards a cab from inside the vehicle.
Light Rail Vehicle	A single articulated rail vehicle with operating cabs at both ends that can be combined to form up to a three-car train/consist, which is powered from an overhead contact wire. All Metro LRVs are designed for high-level platform boarding.
Line Replacement Unit (LRU)	A unit designed to be removed upon failure from a larger subsystem in the field.
Load Weighing	A function incorporated into the tractive and braking systems which measures changes of car body live load. Its purpose is to permit control of tractive effort or braking in order to achieve a constant effort-to-weight ratio.
Longitudinal	Direction parallel to the normal direction of travel of a car.
Lowest Level Replaceable Unit (LLRU)	The lowest unit (component) of a system or subsystem, which is removable and replaceable from an installed position by standard attachments.
Maintainability	The probability that when a corrective maintenance action is required, the system will be restored to an operable condition within a specified period, provided maintenance action is performed in accordance with prescribed procedure.
Maintenance, Corrective	The action taken to restore a failed item of equipment to an operable state.
Maintenance, Preventive	The actions performed in an attempt to retain an item in a specified condition by providing systematic inspection, detection, and prevention of incipient failure.
Manual Train Operation (MTO)	Speed regulation and station stopping are controlled by the train Operator using the Manual Controller.
Manufacturer	The original builder or producer supplying materials, equipment, or apparatus for installation on the car.
Mean-Distance-Between-Failures (MDBF)	The arithmetic mean of the distance between failures, obtained by dividing an established distance by the number of failures in such distance.
Mean-Time-Between-Failures (MTBF)	The arithmetic mean of the time between failures, obtained by dividing an established time period by the number of failures in such time period.
Mean-Time-To-Repair (MTTR)	The total corrective maintenance time divided by the total number of corrective maintenance actions during a given period of time.
Metro	The branded name of the rail and bus system operated by the LACMTA and upon which the LRVs will be operated.

Table 11-1. Glossary of Terms (cont'd.)

Terms	Definition
No Motion	The lowest reliably measured vehicle speed.
Overhead Contact System	The overhead wires that supply the 750 volts DC to power the trains. Also referred to as the catenary.
Pantograph	A mechanical apparatus on the top of a LRV that uses spring pressure to hold a carbon strip up against the OCS to collect the power required to power the LRV.
Reliability	The probability of performing a specified function without failure and within design parameters for the period of time intended under actual operating conditions.
Revenue Service	Service on routes established for train use by the public.
Right Side	Right side of one half of a LRV when looking towards a cab from inside the vehicle.
Safe	The condition in which passengers, operation or maintenance personnel are secure from threat, danger, harm or loss arising from improper design, manufacture, assembly, malfunction, or failure of the car or any of its components or systems.
Safety	The condition in which persons are free from threat or danger, harm, injury, death or loss arising from improper design, manufacture, assembly, malfunction, or failure of the car or any of its components or systems.
Safety Critical	A designation placed on a system, subsystem, element, component, device or function denoting that satisfactory operation of such is mandatory to safety assurance of patrons, personnel, equipment or facilities. Such a designation dictates incorporation of special safety design features.
Scheduled Maintenance	Maintenance actions performed on a calendar or operating hour basis. Preventive and servicing maintenance are sub-categories of scheduled maintenance.
Service	The operation of the cars under normal condition with any number of passengers.
Slide, Wheel	During braking the condition existing when the rotational speed of the wheel is less than that for pure rolling contact between tread and rail.
Slip, Wheel	Any condition existing when the rotational speed of the wheel is different from that for pure rolling contact between the tread and the running rail.
Special Tools	Tools, which are not commonly available for purchase off-the-shelf. A common, off-the-shelf tool becomes a special tool when it is altered in any way to make it more suitable for any specific use.
Spin, Wheel	During acceleration, the condition that exists when the rotational speed of the wheel is greater than that of pure rolling contact between tread and rail.
Stop & Proceed	A mode that is used for normal operation in the Yard and used during failures of wayside ATC equipment on the main line.
Stop, Emergency	The stopping of a train by an emergency brake application.
Stop, Service (Full)	The stopping of a train by application of service braking. Brake application can be released and reapplied.
Subassembly	Two or more parts which form a portion of an assembly and which are replaceable as a whole, but having a part, or parts, which are individually replaceable.
Subsystem	A combination of equipment, groups, etc., which perform an operational function within a system element. Subsystems form the major subdivision of a system element.
System	A combination of subsystem elements that collectively constitute the full system.
System Element	A combination of subsystems or equipment, generally physically separated when in operation, and such other assemblies, subassemblies, and parts as are necessary to perform an operational function.

Table 11-1. Glossary of Terms (cont'd.)

Terms	Definition
Tight (used as a suffix)	Apparatus is designated as watertight, dust-tight, etc., when so constructed that the enclosing case will protect the equipment within the case and exclude the specified material.
Time Constant	Time interval from the beginning of change of a controlled variable in response to a step-forcing function to the attainment of a stated value.
Time, Dead (also Time, Reaction)	Time from the occurrence of a step change of the control signal to the attainment of 10% of the new steady-state value of the controlled variable.
Time, Down	The lapsed time during which equipment is not capable of doing useful work because of maladjustment, malfunction, or maintenance in progress. Downtime starts with a failure event and ends upon the completion of repair.
Time, Response	Time from the occurrence of a step change of control signal to the attainment of 90% of the new steady-state value of the controlled variable, equal to the sum of dead time and rise time.
Time, Rise	Time interval from the end of dead time to the attainment of 90% of the new steady state value of the controlled variable.
Time, Up	The time during which equipment either is operating satisfactorily, or is in an operable state and ready to be placed into operation. Up time is initiated by completion of repair and is terminated by a failure event.
Time, Warm-Up	The elapsed time from application of power to a device until it is capable of performing all of its intended functions.
Top of Rail (TOR)	A height datum coinciding with the upper surface of the running rails.
Track Brakes	A system of electro magnets, suspended between the wheels on a truck, that when energized are attracted to the metal rail to slow a train down. Not for daily use as they do not have replaceable wear pads.
Traction System	The system of wheels, motors, driving mechanisms, brakes, direct controls, and appurtenances that propels or retards a car in response to control signals.
Tractive Effort	Propelling or braking force developed by the propulsion (positive) or braking system (negative) at the wheel/rail interface.
Train	One to three cars coupled together for normal revenue service. Used interchangeably with consist.
Tram	A condition of truck geometry in which the axles are parallel and the wheels longitudinally in alignment. The centers of the journal bearings represent the corners of a perfect rectangle. Tram is checked by measuring the diagonal and longitudinal distances between reference points on the bottom faces of the pedestal legs.
Transverse	Direction perpendicular to the normal direction of travel of a vehicle.
Vital Circuit	Any circuit and its elements, the function of which affects the safety of train operation.
Voltage, High	Any voltage greater than 500 VDC/AC; typically the 750 volt line voltage.
Voltage, Medium	Any voltage between 100 and 500 volts AC or DC; typically 120, 208, or 460 volts AC.
Voltage, Low	Any voltage equal to or less than 100 VDC/AC; typically the 32v battery voltage or the charging voltage of 37.5 volts.
Weights	Car weight designations are defined as follows: AW0: Empty car operating weight, inclusive of lubricants AW1: Full seated load, including the train Operator AW2: Standees at four (4) persons per square meter plus AW1 AW3: Standees at six (6) persons per square meter plus AW1
Weight, Actual	The measured weight of a finished car, ready-to-run, inclusive of lubricants.

THIS PAGE INTENTIONALLY LEFT BLANK

INDEX

A

Abbreviation, 10-1
Acceleration, 2-9
Acronyms, 10-1

B

Brake Resistor, 3-16

C

Cable Ties, 4-5
Capacity, 2-9
Catenary, 2-10
Caution, 4-1
Cleaning, 4-6
Copper, 8-1
Cotter Pin, 9-1, 9-2

D

Double Twist, 8-3

E

Electrostatic Discharge, 5-1

F

Fastener, 7-5
Fastening, 7-1
Fuses, 4-6

G

General Dimensions, 2-9
Glossary, 11-1
Grade, 7-1

H

Handling, 6-1
Hardware, 4-5

L

Lock Wire, 9-1
Lubrication, 3-19, 4-6

M

Maintenance, 4-4, 4-5, 5-1
Materials, 5-3
Metric, 7-5

R

Rules, 4-1

S

Safety, 4-4
Safety Wire, 8-1, 8-2, 8-3
Scheduled Maintenance, 3-1
Single Wire, 8-2
Stainless Steel, 8-1
Standard, 7-5
Static, 5-1, 5-2
Storage, 6-1
Subsystem, 2-1
System, 2-1

T

Terms, 11-1
Torque, 7-4, 9-1

V

Vehicle Speed, 2-9

Vehicle Weight, 2-9

W

Warning, 4-1, 5-2

Wiring, 4-5, 8-1