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NATIONAL RAILROAD PASSENGER CORPORATION
One Massachusetts Avenue, NW, Washington, DC 20001

VIA E-MAIL
06-21-22

Re: Freedom of Information Act Request

Your 02-28-16 request for information made under the Freedom of Information Act (FOIA) was received via Mail by Amtrak's FOIA Office on 03-15-16.

Your request seeks records related to Requesting a copy of the Amtrak operator's manual for the AEM-7 locomotive and the operator's manual for the HHP-8 locomotive

Attached please find the responsive documents.

If you have any questions regarding the processing of your request, please feel free to contact me at foiarequests@amtrak.com. For ease of reference, your request has been assigned tracking number 16-FOI-00120.

Sincerely,

Rebecca Conner
Manager, Records and Information Management

Amtrak

HIGH-SPEED ELECTRIC LOCOMOTIVE

OPERATING INSTRUCTION MANUAL

BOMBARDIER TRANSPORTATION ALSTOM

BOMBARDIER ALSTOM CONSORTIUM

HOW TO USE THIS MANUAL

This manual has been prepared to serve as a guide to Amtrak personnel involved in the operation of the Bombardier Alstom Consortium High-Speed Electric Locomotive.

Locomotive description and operating instructions are divided as follows:

PREFACE

This section includes an explanation of how to use the manual, the Warning Page, List of Revisions, Table of Contents, List of Illustrations, and List of Tables.

CHAPTER 1, INTRODUCTION

This chapter is divided into the following four sections:

Section 1.1, General Information — This section explains the scope of the manual, and provides a list of abbreviations and a glossary of the terms used in the manual.

Section 1.2, Equipment Description — This section briefly describes the equipment characteristics, with locomotive data. It also provides external and internal views of the equipment showing the general features and major components, including items essential to the operation of the locomotive.

Section 1.3, General Description — This section includes a general description of the major systems of the locomotive.

Section 1.4, Principles of Operation — This section briefly describes the principles of operation for the major systems of the locomotive.
Each subsection is dedicated to a major system, listed in the following order:

- 1.4.1 Carbody, Interior Fixtures, Operating Cab
- 1.4.2 Truck and Suspension
- 1.4.3 Coupler
- 1.4.4 Electrical Distribution System
- 1.4.5 Lighting and Indicators
- 1.4.6 Doors, Door Control and Signal System
- 1.4.7 Heating, Ventilation, and Air Conditioning
- 1.4.8 Communication Systems
- 1.4.9 Propulsion and Electric Braking
- 1.4.10 Friction Brake Equipment
- 1.4.11 Cab Signal and Automatic Train Control
- 1.4.12 Train Monitoring and Data Management
- 1.4.13 Water and Waste Retention Systems.

CHAPTER 2, OPERATING INSTRUCTIONS

This chapter is divided into the following three sections:

Section 2.1, Controls and Indicators This section briefly describes the functions of all the locomotive controls and indicators. Each subsection is dedicated to a major system, in the following order:

- 2.1.1 Carbody, Interior Fixtures, Operating Cab
- 2.1.2 Truck and Suspension
- 2.1.3 Coupler
- 2.1.4 Electrical Distribution System
- 2.1.5 Lighting and Indicators
- 2.1.6 Doors, Door Control and Signal System
- 2.1.7 Heating, Ventilation, and Air Conditioning
- 2.1.8 Communication Systems
- 2.1.9 Propulsion and Electric Braking
- 2.1.10 Friction Brake Equipment
- 2.1.11 Cab Signal and Automatic Train Control
- 2.1.12 Train Monitoring and Data Management
- 2.1.13 Water and Waste Retention Systems.

Section 2.2, Operation This section provides information related to normal operation of the locomotive, in the following order:

- 2.2.1 HEP Operation
- 2.2.2 Preparation for Operation
- 2.2.3 Locomotive Departure Test
- 2.2.4 Coupling
- 2.2.5 Multiple Unit Operation
- 2.2.6 Cab Printer Operation
- 2.2.7 En Route Procedures
- 2.2.8 High Voltage Power - Turning Off and On
- 2.2.9 End of Trip Procedures

Section 2.3, Emergency Procedures This section provides information related to emergency procedures for the locomotive, in the following order:

- 2.3.1 Cab Refuge
- 2.3.2 Emergency Escape Hatch
- 2.3.3 Fire Extinguisher Operation
- 2.3.4 Emergency Tools
- 2.3.5 First Aid Equipment
- 2.3.6 Emergency Braking
- 2.3.7 Fire Extinction - Water System
- 2.3.8 Dead Engine Feature
- 2.3.9 Towing Setup

CHAPTER 3, TROUBLESHOOTING PROCEDURES

This chapter includes all the instructions allowing the locomotive crew to troubleshoot the equipment for all the systems.

It lists the symptoms, probable causes and effects, and corrective actions that may be taken as a result of faults or conditions indicated on the Primary Operating Display and Multifunction Displays.

Each troubleshooting table is dedicated to a major system, in the following order:

Section I Carbody, Interior Fixtures, Operating Cab

Section II Truck and Suspension

Section III Coupler

Section IV Electrical Distribution System

Section V Lighting and Indicators

Section VI Doors, Door Control and Signal System

Section VII Heating, Ventilation, and Air Conditioning

Section VIII Communication Systems

Section IX Propulsion and Electric Braking

Section X Friction Brake Equipment

Section XI Cab Signal and Automatic Train Control

Section XII Train Monitoring and Data Management

Section XIII Water and Waste Retention Systems.

INDEX

The index allows the reader to search through the manual by keywords in alphabetical order. All the systems/subsystems and their major components are listed.

CHECK LIST

The check list at the end of the manual describes all the steps required to prepare the locomotive for operation. This includes step-by-step descriptions of all the pre-departure tests and a list of all cut-outs to verify prior to locomotive operation.

PAGE NUMBERS

Page numbers are dedicated to major divisions of the manual: The preface is numbered from page A to F, the contents section numbering starts with page i. Chapter 1 starts with page 1-1, and the other chapters follow in the same manner. Figures are identified by chapter and sequence. For example, figure 1-4 is the fourth figure used in chapter 1.

NOTE:

Words with all letters in capitals indicate that the word used in the manual is the same as the label on the equipment.

WARNING PAGES

To prevent physical injury, all personnel directly or indirectly involved with the operation of the locomotive are advised to follow the safety instructions listed below:

WARNING:

PERSONNEL ENGAGED IN THE OPERATION OF THE LOCOMOTIVE MUST OBSERVE ALL AMTRAK OPERATING RULES AND INSTRUCTIONS APPLICABLE TO THE OPERATION OF HIGH-VOLTAGE EQUIPMENT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY, LOSS OF LIFE OR DAMAGE TO PROPERTY.

WARNING:

BEFORE MAKING ANY 480 V POWER JUMPER CONNECTIONS, VERIFY THAT POWER HAS BEEN CUT OFF IN THE LOCOMOTIVE OR AT THE SHOP/WAYSIDE SUPPLY. HANDLE ALL JUMPERS WITH CARE AND IN ACCORDANCE WITH AMTRAK OPERATING RULES AND INSTRUCTIONS.

WARNING:

HIGH VOLTAGES ARE PRESENT THROUGHOUT THE LOCOMOTIVE. TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK, ALWAYS EXERCISE EXTREME CARE WHEN WORKING NEAR ELECTRICALLY CHARGED APPARATUS.

WARNING:

FOR THE PROTECTION OF ALL PERSONNEL AROUND OR UNDER LOCOMOTIVE, MAKE SURE THE PARKING BRAKES ARE APPLIED OR THAT THE WHEELS ARE CHOCKED. IN THE CASE OF MADE-UP TRAINS, MAKE SURE THE LOCOMOTIVE CREW IS AWARE OF PERSONNEL MOVEMENT.

WARNING:

ALL WARNINGS, CAUTIONS, AND NOTES FOUND THROUGHOUT THIS MANUAL MUST BE FOLLOWED TO MINIMIZE THE RISKS OF PERSONAL INJURY AND EQUIPMENT DAMAGE OR MALFUNCTION. ANYONE WHO USES A SERVICE PROCEDURE THAT IS NOT RECOMMENDED MUST FIRST SATISFY HIMSELF/HERSELF THOROUGHLY THAT NEITHER HIS/HER SAFETY NOR LOCOMOTIVE SAFETY WILL BE JEOPARDIZED BY THE METHOD SELECTED.

WARNING:

WHEN MAKING UP TRAINS, MAKE SURE ALL PERSONNEL IS CLEAR OF TRAIN PRIOR TO MOVEMENT. ALL BLUE SIGNAL PROTECTION AND SAFETY INSTRUCTIONS MUST BE FOLLOWED.

WARNING PAGES

Warnings, Cautions and Notes are used to highlight or emphasize dangerous or important points in the text. These are presented in three different formats as shown below.

WARNING:

THE WARNING IS USED IN THE CASE OF AN OPERATING OR MAINTENANCE PROCEDURE, PRACTICE, CONDITION, STATEMENT, ETC., WHICH, IF NOT STRICTLY OBSERVED, COULD RESULT IN INJURY OR DEATH.

CAUTION:

The Caution is used in the case of an operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE:

The Note is used in the case of an operating or maintenance procedure, practice, condition, statement, etc., which is deemed useful to highlight.

LIST OF REVISIONS

Insert latest change pages and destroy superseded pages. Revision number 0 indicates the original issue. Total number of pages in this Operating Instruction Manual is 274, consisting of:

PAGE NO.	REVISION NO.	ISSUE
Cover/Title	0	January/2000
Copyright	0	January/2000
A through G	0	January/2000
H (blank)	0	January/2000
i through xiii	0	January/2000
xiv (blank)	0	January/2000
1-1 through 1-47	0	January/2000
1-48 (blank)	0	January/2000
2-1 through 2-123	0	January/2000
2-124 (blank)	0	January/2000
3-1 through 3-9	0	January/2000
3-10 (blank)	0	January/2000
3-11	0	January/2000
3-12 (blank)	0	January/2000
3-13	0	January/2000
3-14 (blank)	0	January/2000
3-15	0	January/2000
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3-17 through 3-19	0	January/2000
3-20 (blank)	0	January/2000
3-21 through 3-35	0	January/2000
3-36 (blank)	0	January/2000
3-37 through 3-41	0	January/2000
3-42 (blank)	0	January/2000
3-43 and 3-44	0	January/2000
i-1 through i-34	0	January/2000

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LIST OF ILLUSTRATIONS

LIST OF TABLES

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CHAPTER 1
INTRODUCTION

SECTION 1.1
GENERAL INFORMATION

1.1.1 SCOPE. This Operating Instruction Manual provides information regarding operation as well as setup for service, en route, shutdown, and emergency procedures for the High-Speed Electric Locomotive (HSEL) built for Amtrak by the Bombardier Alstom Consortium.

This manual has been prepared to aid the engineer in the completion of his/her duties. The instructions contained herein are not intended to supersede existing Amtrak operating rules and instructions. Whenever there is a conflict, Amtrak rules and instructions shall govern.

All information, illustrations, and specifications supplied are based on the latest product data available at the time of publication. Some minor differences in the locomotive equipment may be encountered because of modifications that have been incorporated since the publication of this manual. These changes will be covered in subsequent editions of the manual.

The descriptions and instructions contained in this manual are intended to familiarize operating personnel with the high-speed electric locomotive. This manual also contains sufficient troubleshooting information to identify malfunctioning systems and components.

1.1.2 LIST OF ABBREVIATIONS. The following list details all the abbreviations used in this Operating Instruction Manual.

A/C	Air Conditioning
AAR	Association of American Railroads
ABB	Abbreviation
ABCL	Automatic Brake Control Lever
ac	Alternating Current
ACSES	Advanced Civil Speed Enforcement System
ADU	Aspect Display Unit
AGATE	Advanced GEC Alsthom Traction Electronics
Ah	Amperes per hour
ARU	Alerter/Recorder Control Unit
ATC	Automatic Train Control
ATS	Automatic Train Supervision
ATSCO	Automatic Train Supervision Cutout Switch
BCC	Brake Control Computer
BCU	Brake Control Unit

LIST OF ABBREVIATIONS (Cont'd)

BP	Brake Pipe
CB	Circuit Breaker
CDPD	Cellular Digital Packet Data
CAN	Controller Area Network
CDU	Cab Display Unit
CFM	Cubic Feet per Minute
CHAN	Channel
CIN	Car Internal Network
CMU	Car Monitoring Unit
DISP	Display
DMS	Data Management System
DNRA	Detection of Nonrotating Axles
DTMF	Dual Tone Multifrequency
EDR	Extraordinary Data Report
ELD	EMI Limit Detector
EMI	Electromagnetic Interference
EP	Electropneumatic
FCRB	Forced Commutation Rectifier Bridge
FT	Foot/Feet
GTO	Gate Turn-Off Thyristor
HEP	Head End Power
HHP-8	High HorsePower - 8,000 HP
HSEL	The Bombardier Alstom Consortium High Speed Electric Locomotive
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IBCL	Independent Brake Control Lever
IC	Intercom
IFM	Independent Failure Monitor
in	Inch(es)
INT	Intermittent
ITSS	Integrated Truck Surveillance System
ITSU	Integrated Truck Surveillance Unit
kV	Kilovolt

LIST OF ABBREVIATIONS (Cont'd)

kW	Kilowatt
lb	Pound(s)
LED	Light-Emitting Diode
LVBC	Low Voltage Battery Charger
MBS	Microprocessor-Based System
MCB	Main Circuit Breaker
MFD1	Multifunction Display No. 1
MFD2	Multifunction Display No. 2
mph	miles per hour
mphps	miles per hour per second
MPU	Main Processing Unit
MR	Main Reservoir
M. U.	Multiple Unit
N	Neutral
PA	Public Address
PCMCIA	Personal Computer Memory Card Interface Association
PECU	Propulsion Electronic Control Unit
PIN	Personnel Identification Number
POD	Primary Operating Display
psi	Pound per Square Inch
PTE	Potable Test Equipment
PTT	Push-To-Talk
RAD	Radio
RIOM	Remote Input Output Module
RX	Reception
SS	Speed Sensing
SSCO	Speed Sensing CutOut Switch
TX	Transmission
V	Volt
Vac	Volt, Alternating Current
Vdc	Volt, Direct Current
VOL	Volume
WSCC	Wheel Slide Control Computer

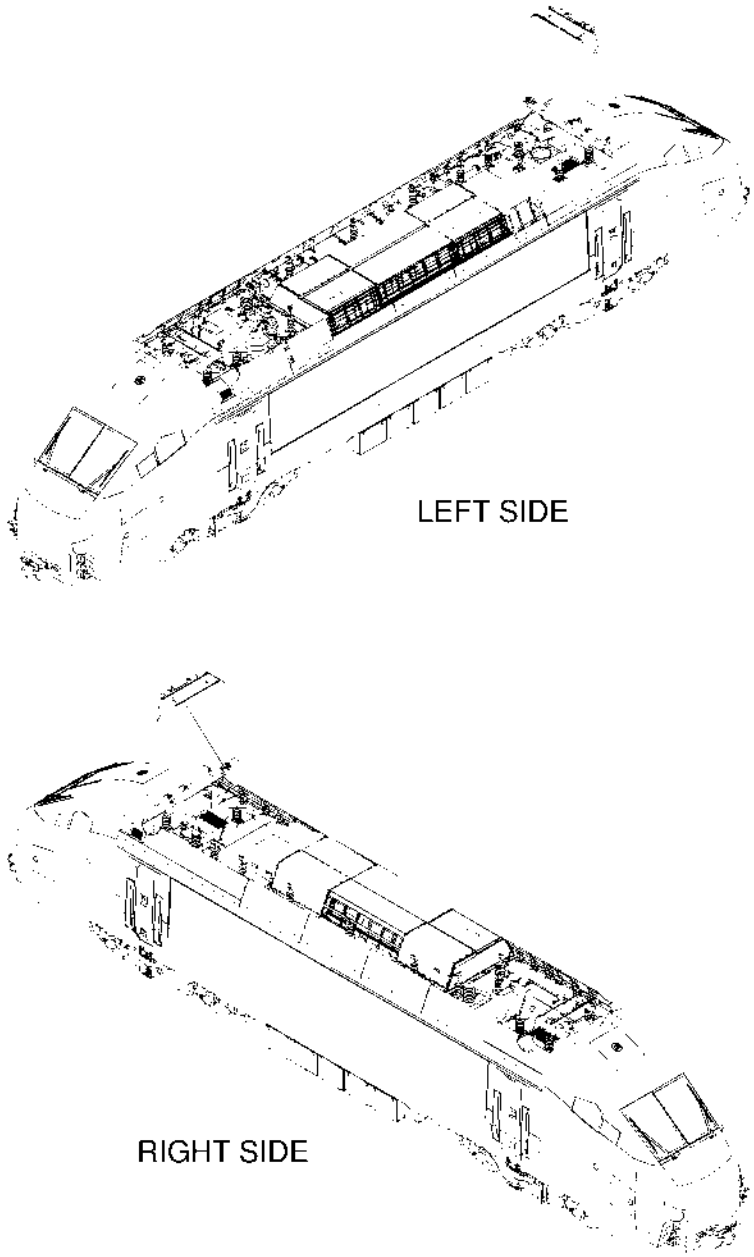


Figure 1-1
High-Speed Electric Locomotive

1.1.3 GLOSSARY. The following glossary provides the meanings of all the specialized terms used in this Operating Instruction Manual.

TERM	ABB	DESCRIPTION
Advanced Civil Speed Enforcement System	ACSES	A transponder and data radio based train control system that supplements the cab signal/speed control system by enforcing permanent speed restrictions, temporary speed restrictions, and a positive stop at interlocking and controlled point signals displaying Stop Signal or Stop and Proceed.
Automatic Train Supervision/ Automatic Train Control/Speed Sensing	ATS/ ATC/ SS	Microprocessor-based cab signaling system that emulates existing equipment, with the addition of expanded aspects, automatic control speed enforcement system (ACSES) interface, and brake suppression. The speed sensing system is used to process speed signals from speed sensors associated with axles No. 2 and No. 3.
Automatic Brake Control Lever	ABCL	Allows automatic electronic control (with pneumatic backup) of the brake system by the engineer.
Auxiliary Block	-	This is the smaller equipment box located in the equipment room. It contains all the auxiliary systems control apparatus and some of the power control system equipment shown on figure 1-15.
Cab Display Unit	CDU	Cab Console screens and processors providing the primary visual interface to the locomotive and its subsystems.
Car Internal Network	CIN	Communication module between the computer-controlled systems, the car monitoring unit and the cab display unit.
Car Monitoring Unit	CMU	Computer managing the locomotive network information and monitoring information through the data management system.
Central Block (Motor Block)	-	This is the bigger equipment box located in the equipment room. It contains all the traction power control system apparatus shown on figure 1-14.
Controller Area Network	CAN	Communication module between the brake control levers and the brake control computer/independent failure monitor.
Data Management System	DMS	Management computer that enables transfer from train data system to wayside facilities.
Detection of Nonrotating Axles	DNRA	Monitors the movement of each truck axle in conjunction with the brake control computer.

GLOSSARY (Cont'd)

TERM	ABB	DESCRIPTION
Dual Tone Multi-frequency	DTMF	Dispatch call tones transmitted by the remote control head.
EMI Limit Detector	ELD	Detects the electromagnetic interferences and protects the locomotive vital systems against a high level of electromagnetic waves emission.
Extraordinary Data Report	EDR	Displays information on maintenance event on the MFD2.
Gate Turn-Off Thyristor	GTO	A bistable semiconductor device comprising three or more junctions that can be switched from the OFF state to the ON state, or vice versa, by the application of a small electric signal.
Independent Brake Control Lever	IBCL	Applies and releases the friction brakes on the locomotive.
Independent Failure Monitor	IFM	Vigilance system that monitors the brake system by comparing the total brake demand and the calculated brake effort.
Integrated Truck Surveillance System/Unit	ITSS/ ITSU	Electronic watchdog monitoring each truck for hot bearings and truck hunting. It displays an alarm on POD when the monitored information is outside normal operating range.
Light-Emitting Diode	LED	A semiconductor diode that emits light when a voltage is applied to it.
Microprocessor-Based System	MBS	Locomotive system (and/or subsystem) controlled by microprocessor (computer chip).
Multifunction Display	MFD	Operating and/or maintenance screen used by the engineer and/or the assistant and maintenance personnel. Display operational values and statuses.
Node	-	Address used by a computer to establish its link to various components of a network.
Primary Operating Display	POD	Main operating screen for the engineer, that displays speed, speed limits, time, cruise control setting, and indications.
Main Processing Unit	MPU	Main computer of the propulsion system.
Propulsion Electronic Control Unit	PECU	Controls electrical energy supply from the catenary to the four motor inverters.
Traction Electronics	-	Control the propulsion electronic control unit.

SECTION 1.2
EQUIPMENT DESCRIPTION

1.2.1 EQUIPMENT CHARACTERISTICS.

1.2.1.1 Introduction. The Bombardier Alstom Consortium high-speed electric locomotive is shown in Figure 1-1. The locomotive is designed to operate as a single unit or in a consist of only two locomotives.

1.2.2 LOCOMOTIVE DATA.

Model Designation: ..... HSEL

Amtrak Model Designation: HHP-8

Locomotive Type: ..... Electric - Dual Cab

Transformer (Silicone Oil Cooled)
Primary Voltages: ..... 12 kV/25 Hz - 12.5 kV/60 Hz - 25 kV/60 Hz

Rectifier (Water/Glycol Cooled): ..... Thyristor Controlled

Continuous Rating: ..... 6000 kW

Equivalent Horsepower: ..... 8046 HP

Traction Motors (4 Total)

Model: 4-FXA-4559C
Type: ..... Asynchronous AC
Maximum Short Time Tractive Effort (Starting Effort): ..... 17,810 lbf
Current Rating Maximum Continuous: ..... 520 A
Current Rating Maximum During Acceleration: ..... 690 A

Driving Wheels (4 Pairs)

Diameter: ..... 40 in
Gear Ratio: ..... 71/23 (3.08:1, Wheel/Motor)
Maximum Speed: ..... 135 Miles Per Hour

Auxiliary Power & HEP Rating: ..... 3-Phase, 480 V, 60 Hz, 1,200 KVA

Pantograph (2 Total) Type: ..... Single-Arm, Transtech of S. C. Inc.

Air Compressor, Rotary Screw

Capacity ..... 120 cubic feet per minute
Compressor Drive ..... 480 Vac Motor

Main Reservoir Capacity: ..... 60,390 cubic in. (3 x 20,130 cubic in.)

Brake Supply Reservoirs Capacity: ..... 12,200 cubic in. (2 x 6,100)

Auxiliary Reservoir Capacity: ..... 3,660 cubic inches

Storage Battery

Number of Cells: 50
Voltage: ..... 72 Vdc Nominal
Rating (8-hour): ..... 235 Ah

Sand: ..... 1.88 cu. ft. each box (4 total, 2 on each end)

Air Brakes:..... 26-L Compatible

Weight on Drivers

Maximum:.....222,000 lb
Maximum Per Axle:.....55,750 lb
On Drivers:..... 100%

Major Dimensions

Length Over Pulling Faces:.....67 ft 1 in.
Height Over Locked Down Pantograph:.....14 ft 5½ in.
Width (Maximum, with Mirrors Retracted):.....10 ft 5 in.
Truck Wheel Base:.....9 ft 4 in. (112 in.)
Truck Centers:.....35 ft 3 in. (423 in.)
Height Over Fully Extended Pantograph: (Greater Than) > 24 ft 6 in. Up to 25 ft 2 in.

Curve Negotiation

Single Unit:.....23.1° or 250 ft Radius
Two Units Coupled
(Limited by Truck Swing):.....23.1° or 250 ft Radius
Locomotive Coupled to Car:.....23.1° or 250 ft Radius

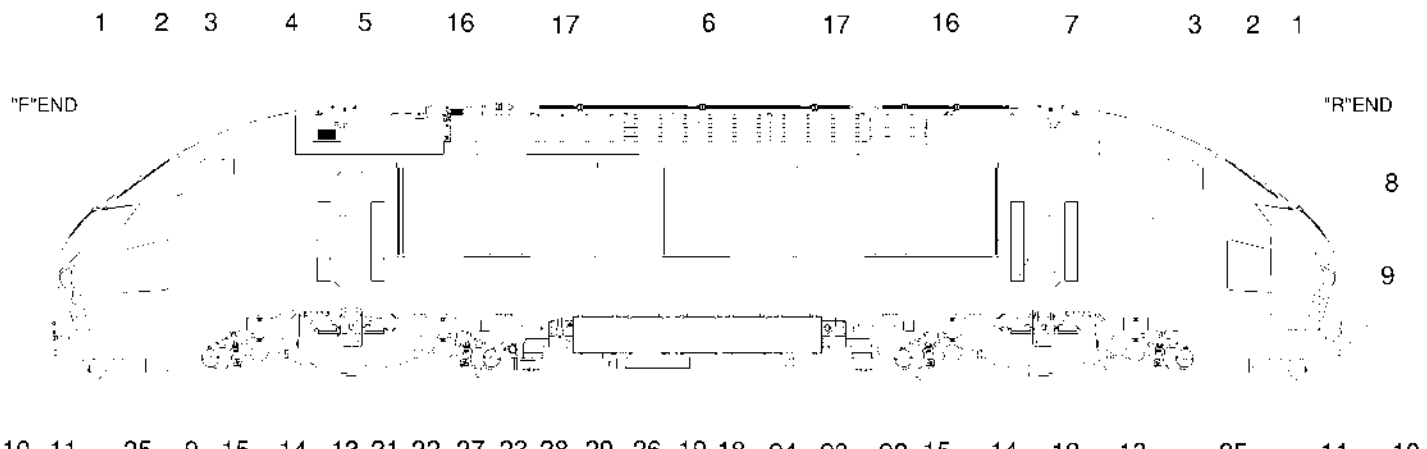
HVAC

Heating Capacity:..... 6.8 kW
Air Conditioning (Cooling) Capacity:.....2.3 Tons
Refrigerant:.....R134A
Air Flow:.....500 CFM
Cab Heaters (2 Total):..... 7 kW.

1.2.3 **LOCATION OF MAJOR COMPONENTS (Fig. 1-2 to 1-15).** The following external and internal views of the equipment show the high-speed electric locomotive general features, essential operating items, and major components and accessories.

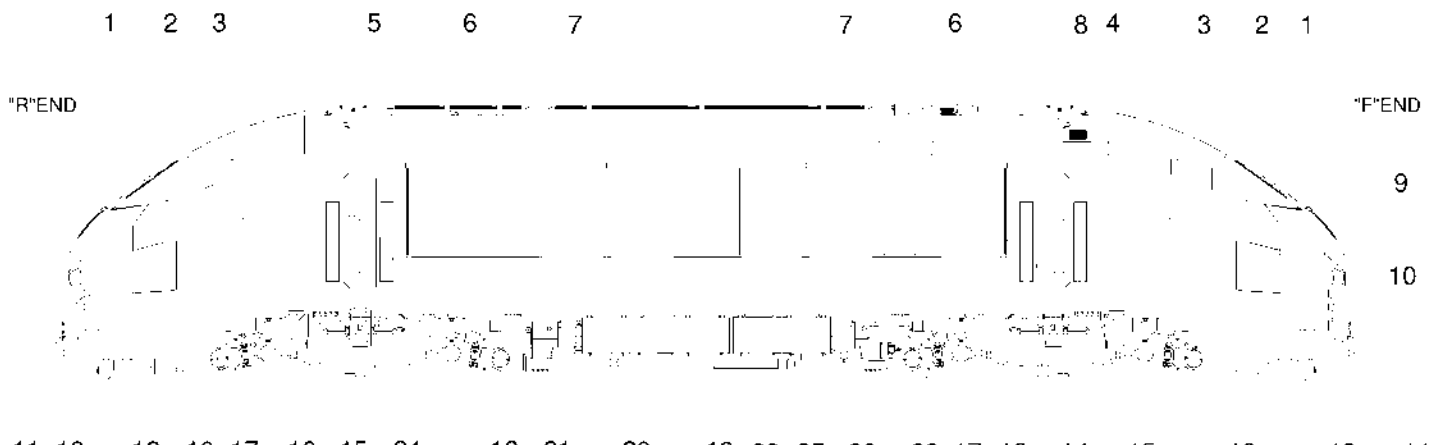
NOTE:

Only the information pertaining to the operating crew is included.



1. Windshield
2. Retractable Mirror
3. Cab Side Window
4. Air Inlet Grille
5. Front Pantograph
6. Equipment Room Intake Air Grille
7. Rear Pantograph
8. Windshield Washer Fillup Cover
9. Sandbox Access Door
10. Coupler with Uncoupling Mechanism (Cutting Lever)
11. Pilot
12. "R" End Truck
13. Grab Iron
14. Ladder
15. Entrance Door
16. Brake Applied Red Indicator
17. Parking Brake Applied Gold Indicator
18. Batteries
19. Main Transformer
20. ACSES Antenna
21. "F" End Truck
22. Wheelslip/Slide Module (Dump Valve Module)
23. Truck Equipment Cutout Cock
24. Fire Extinction System - Water System Snoot
25. Pneumatic Cutout Cocks Access Panel
26. 120 Vac Maintenance Wayside Receptacle
27. Waste Discharge Line
28. Water Filling Pipe

Figure 1-2
Locomotive Exterior Equipment - Left Side



1. Windshield
2. Retractable Mirror
3. Cab Side Window
4. Air Inlet Grille
5. Rear Pantograph
6. Brake Applied Red Indicator
7. Parking Brake Applied Gold Indicator
8. Front Pantograph
9. Windshield Washer Fillup Cover
10. Sandbox Access Door
11. Coupler with Uncoupling Mechanism (Cutting Lever)
12. Pneumatic Cutout Cocks Access Panel
13. Pilot
14. "F" End Truck
15. Grab Iron
16. Ladder
17. Entrance Door
18. Fire Extinction System - Water System Snoot
19. Batteries
20. Main Transformer
21. 120 Vac Maintenance Wayside Receptacle
22. Water Raising Unit
23. Battery Main Circuit Breaker
24. "R" End Truck
25. Water Filling Pipe
26. Waste Discharge Line

Figure 1-3
Locomotive Exterior Equipment - Right Side

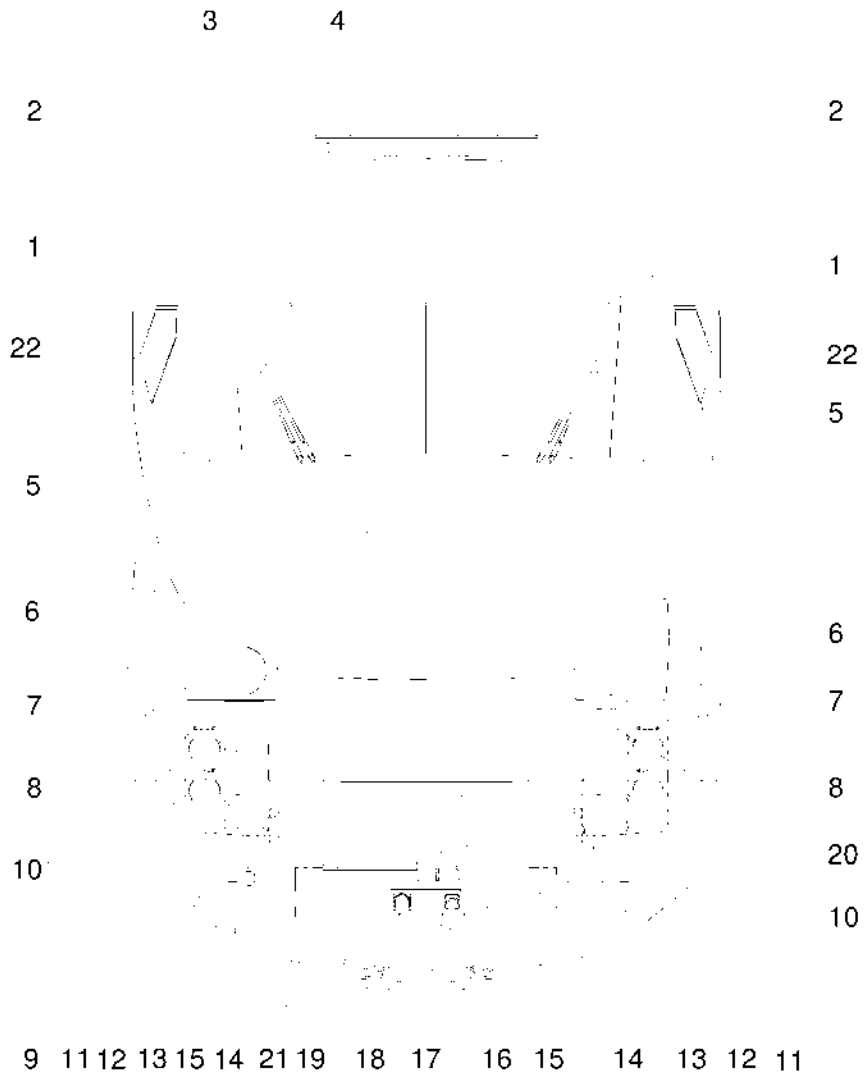


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Figure 1-4
Locomotive End Exterior Arrangement

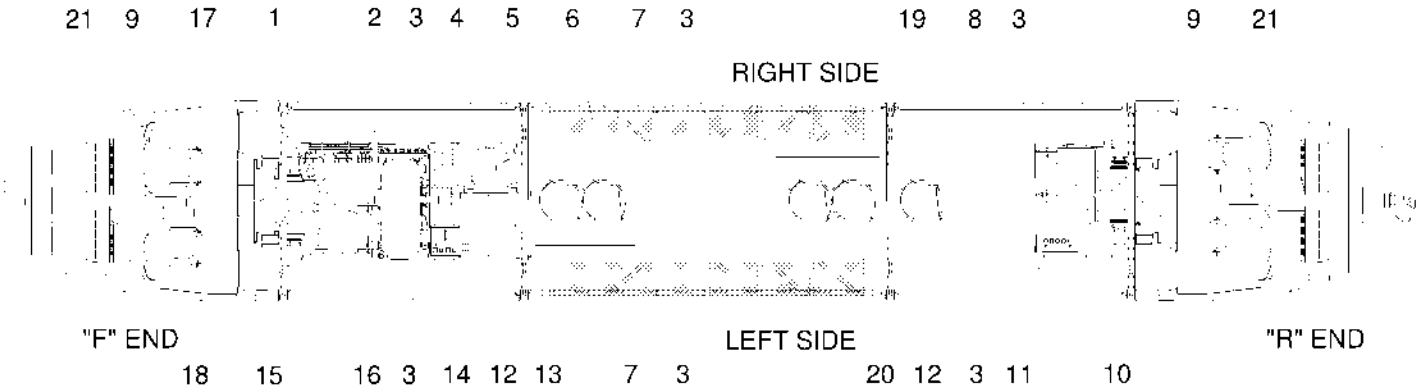
Legend for Figure 1-4

1. Cab Side Window
2. Windshield Wiper
3. Windshield
4. Emergency Escape Hatch
5. Marker Light
6. Headlight
7. Sandbox Access Door
8. Ditch Light
9. Blanking Plate
10. Red 480 V Receptacle
11. White MU 27-Pin Receptacle (See Note)
12. Blue Door Control and Communication 27-Pin Receptacle
13. Application/Release Pipe
14. Main Reservoir/Equalizing Pipe
15. Actuating Pipe
16. Coupler
17. Main Reservoir Pipe
18. Brake Pipe
19. Pilot
20. Black MU 27-Pin Receptacle (See Note)
21. Uncoupling Mechanism (Cutting Lever)
22. Retractable Mirror

NOTE:

In multiple unit operation, the white MU 27-pin receptacle is to be connected to the corresponding white receptacle of the other HHP-8 (HSEL) or AEM-7 locomotive.

The black MU 27-pin receptacle is to be connected to the corresponding black receptacle of any other conventional locomotive or cab car.



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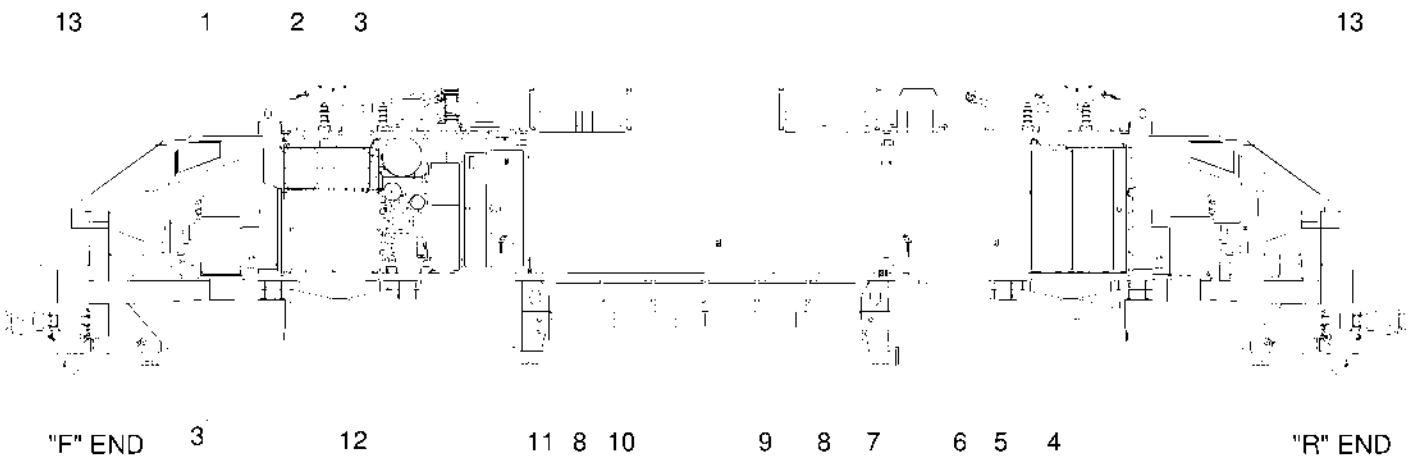
1. Brake Control Unit
2. Pantograph Pneumatic Control Panel
3. 120 V Outlet
4. Transverse Aisle (Leading to Toilet Equipment Access Panel and Back of Electrical Locker No. 3, with EMI Limit Detector)
5. Tap Changer
6. Central Block (Motor Block)
7. Access Grille to Transformer Radiators
8. Auxiliary Block
9. HVAC Unit
10. Electrical Locker No. 1 and No. 2
11. Propulsion Electrical Cubicle
12. Truck Brake Equipment Cutout Cock
13. Toilet Module
14. Electrical Locker No. 3, with 72 Vdc and 120 Vac Circuit Breaker Panels
15. Main Air Reservoirs
16. Air Supply Unit/Compressor
17. Air Dryer Unit
18. Auxiliary Supply Reservoir
19. 27-Pin Jumper Storage
20. Pantograph Pole Storage
21. Locomotive Cab

Figure 1-5
Locomotive Interior Arrangement - Top View



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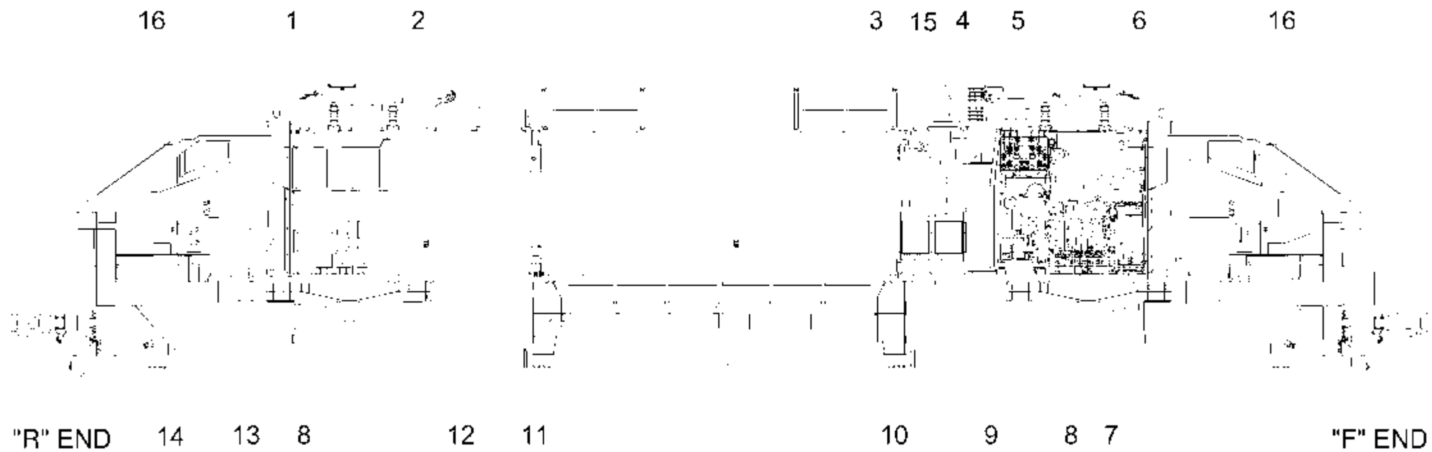
1. HVAC Unit
2. Auxiliary Supply Reservoir (Behind Main Reservoir)
3. Main Air Reservoir
4. Electrical Locker No. 1 and No. 2
5. Propulsion Electrical Cubicle
6. 120 V Outlet
7. Auxiliary Block
8. Truck Brake Equipment Cutout Cock
9. Central Block (Motor Block)
10. Toilet Module
11. Electrical Locker No. 3, with Circuit Breaker Panels
12. Air Supply Unit/Compressor
13. Locomotive Cab

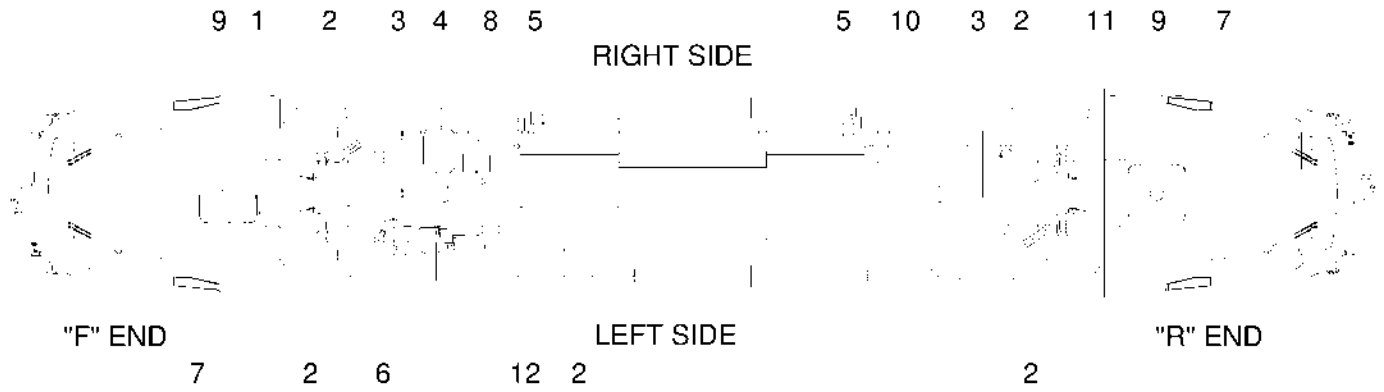
Figure 1-6
Locomotive Interior Arrangement - Left Side



BB010002

1. HVAC Unit
2. Auxiliary Block
3. Tap Changer
4. Roof Access Ladder
5. Pantograph Pneumatic Control Panel
6. Brake Control Unit
7. Air Dryer Unit
8. Traction Motor Blower
9. Air Supply Unit/Compressor, with Auxiliary Compressor
10. Battery Chargers
11. Central Block (Motor Block)
12. 120 V Outlet
13. ATS/ATC Equipment Cabinet (Top of ACSES Equipment Cabinet)
14. 480/120 V Transformer
15. EMI Limit Detector (Back of Electrical Locker No.3)
16. Locomotive Cab

Figure 1-7
Locomotive Interior Arrangement - Right Side



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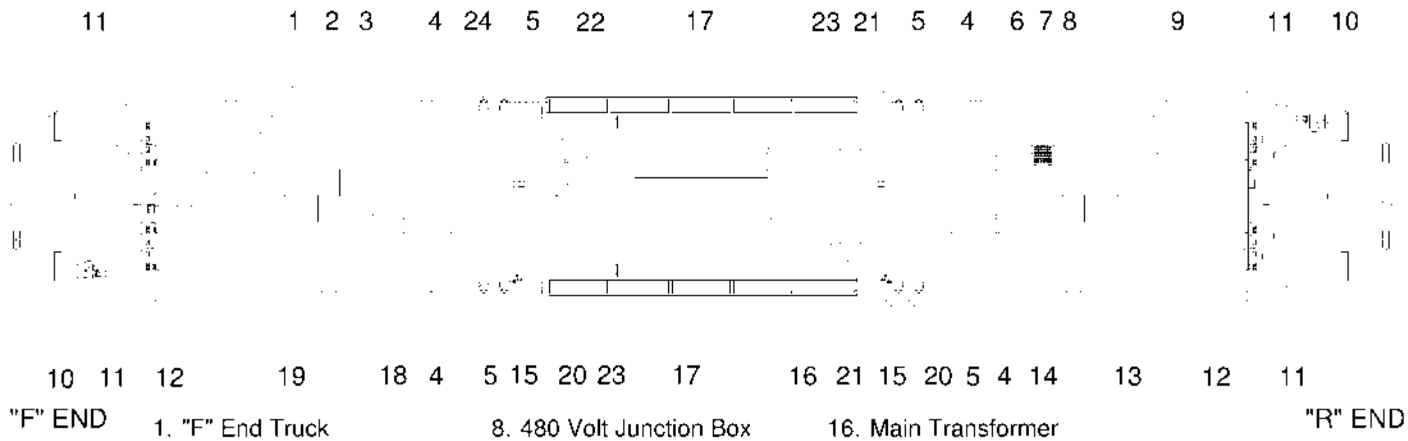
1. Front Pantograph
2. Walkway
3. Pantograph Mechanical Latch
4. Roof Access Hatch
5. Horn
6. Four-Function Unit (Main Circuit Breaker, Catenary Voltage Sensing Transformer, Lightning Arrestor, Grounding Switch)
7. Emergency Escape Hatch
8. Tap Changer
9. Lifting Hook
10. High Tension Bar
11. Rear Pantograph
12. Radio Antenna

Figure 1-8
Locomotive Roof Equipment



1. "F" End Truck
2. Wheel No. R1
3. Wheel No. R2
4. Brake Applied Red Indicator
5. Parking Brake Applied Gold Indicator
6. "R" End Truck
7. Wheel No. R3
8. 480 Volt Junction Box
9. Wheel No. R4
10. Bell
11. Sandbox
12. Track Receiver
13. Wheel No. L4
14. Wheel No. L3
15. Wheelslip/Slide Module (Dump Valve Module)
16. Main Transformer
17. Batteries
18. Wheel No. L2
19. Wheel No. L1
20. Truck Equipment Cutout Cock
21. Fire Extinction System - Water System Snoot
22. Battery Main Circuit Breaker
23. 120 Vac Maintenance Wayside Receptacle
24. Water Raising Unit

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Figure 1-9
Locomotive Underfloor Equipment

1. Assistant's Left Switch Panel
2. Assistant's Console
3. Multifunction Display No. 2 (MFD2)
4. Sun Visor
5. Locomotive Assistant's Headset Station
6. Engineer's Console
7. Engineer's Desk
8. Adjustable Footrest
9. Center Console
10. Assistant's Desk

Figure 1-10
Cab Console Equipment Layout

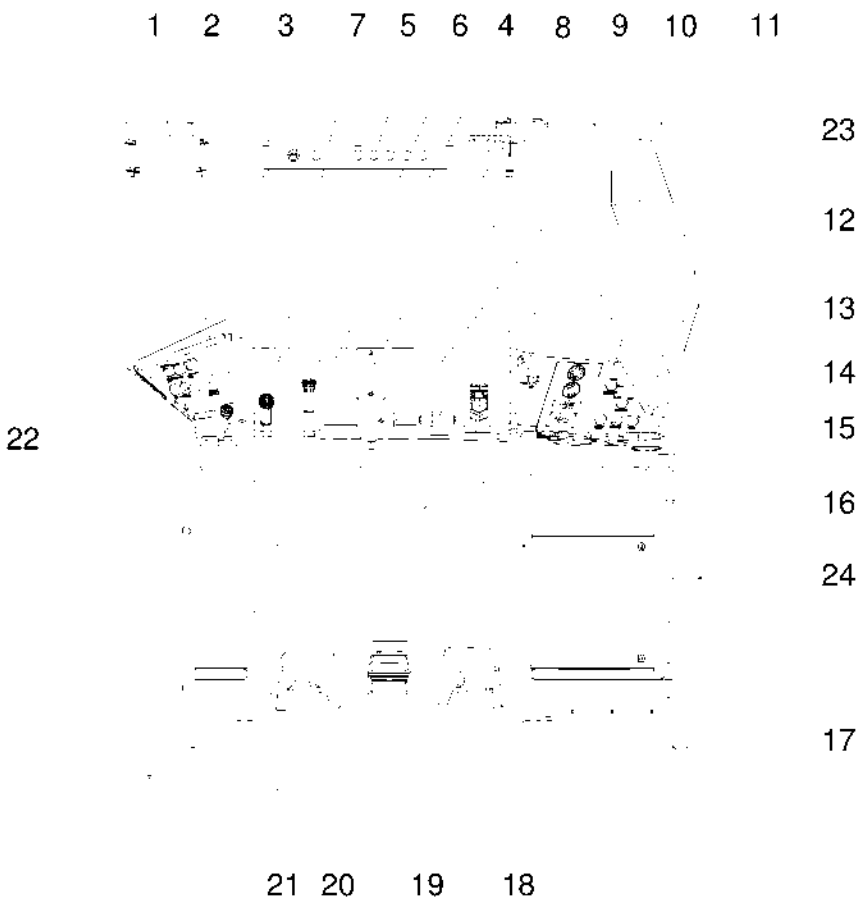
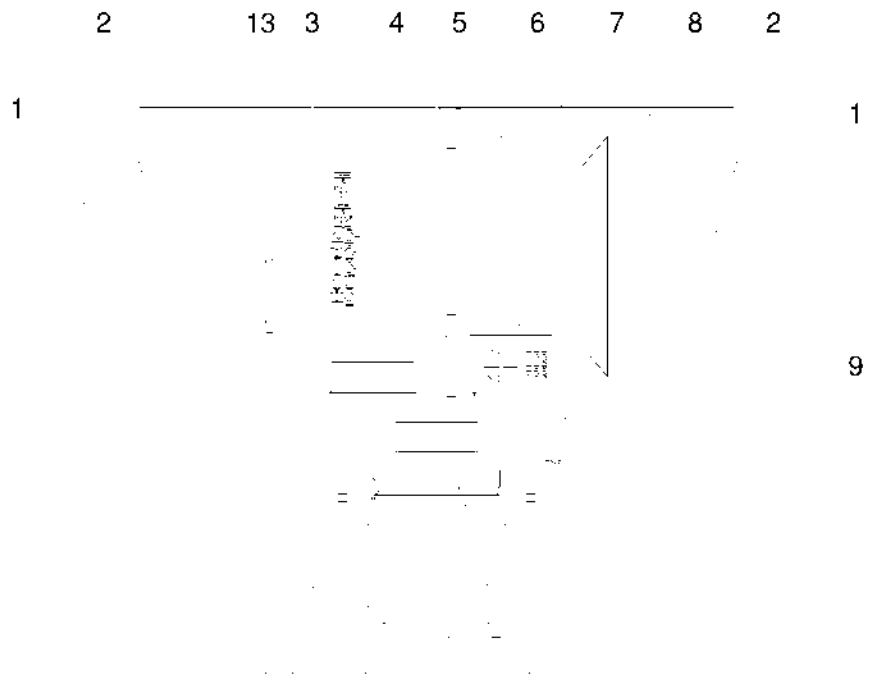


Figure 1-11
Engineer's Console Equipment Layout

Legend for Figure 1-11

1. Engineer's Left Switch Panel
2. Sun Visor
3. Reverser
4. Cruise Control Lever
5. Engineer's Overhead Switch Panel
6. Multifunction Display No. 1 (MFD1)
7. Propulsion Throttle Control Lever
8. Engineer's Microphone
9. Engineer's Console
10. Primary Operating Display (POD)
11. Automatic Brake Control Lever
12. Horn Lever
13. Aspect Display Unit
14. Engineer's Right Switch Panel
15. Engineer's Desk Right Switch Panel
16. Engineer's Desk
17. Horn Footswitch
18. Adjustable Footrest
19. Acknowledge Footswitch
20. Communication Footswitch
21. Adjustable Footrest Switch Panel
22. Engineer's Center Console Switch Panel, with Remote Control Head
23. Independent Brake Control Lever
24. Acknowledge Whisker Switch



1. Cab Door
2. Coat Hook
3. Inspection Form Holder
4. Cab Rear Wall Switch Panel
5. Cab Printer
6. HVAC Blower Fan Access Panel
7. Key Card Reader
8. Security Equipment (First Aid Kit) and Toolbox (Adjustable Wrench, Hammer and Pinch Bar)
9. Trash Receptacle
10. Air Vent
11. Refrigerator, with Seat Cushion (Supervisor Seat) on Top
12. Fire Extinguisher Compartment Access Panel
13. Cab Heat Temperature Sensor

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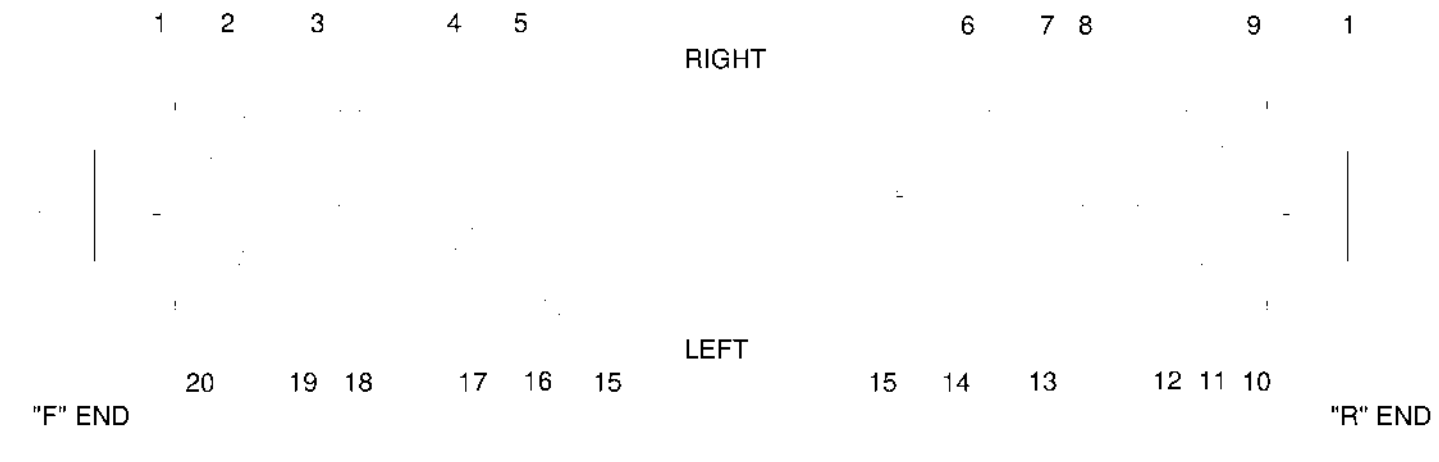
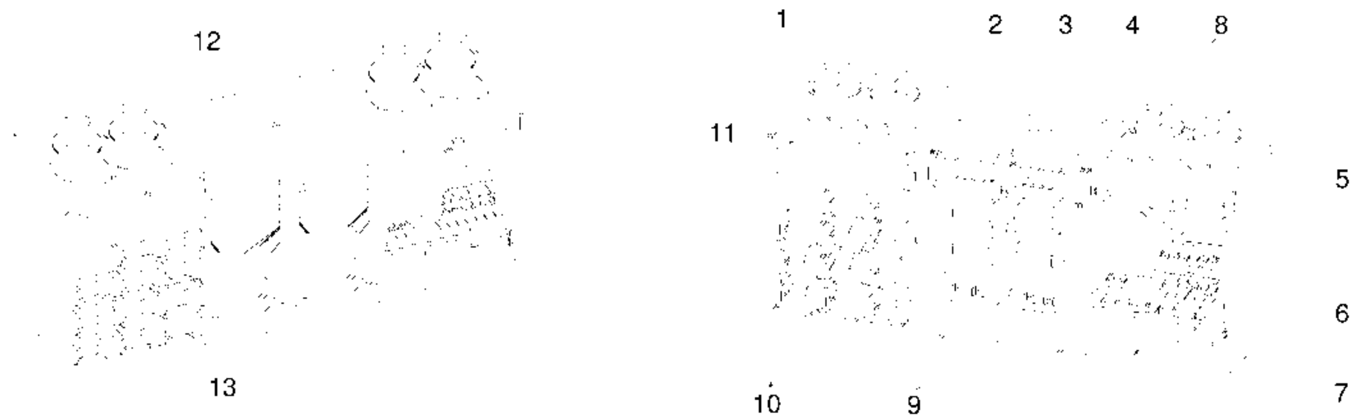
Figure 1-12
Locomotive Cab Wall Equipment Layout



1. ACSES and Wheelslip/ Brakes Speed Sensors
2. "F" End Truck
3. Wheel No. R1
4. Traction Motor No. 2 Speed Sensor
5. Wheel No. R2
6. "R" End Truck
7. Wheel No. R3
8. Traction Motor No. 3 Speed Sensor
9. Wheel No. R4
10. Wheel No. L4
11. Axle No. 4
12. Traction Motor No. 4 Speed Sensor
13. Wheel No. L3
14. Axle No. 3
15. ATC and Wheelslip/Brakes Speed Sensors
16. Wheel No. L2
17. Axle No. 2
18. Traction Motor No. 1 Speed Sensor
19. Wheel No. L1
20. Axle No. 1

Figure 1-13
Locomotive Trucks, Wheels and Speed Sensors Arrangement (Top View)



LEFT SIDE

RIGHT SIDE

1. Central Block Blower
2. Access Panel to Sensors, Relays, Contactors, and Knife Switches
3. Low Voltage Connectors for: AGATE/MPU, Master Controller, Speed and Current Sensors, Fire Suppression Equipment, Control Electronics
4. Fire Suppression FE13 Extinguishing Agent High-Pressure Container
5. Cooling Liquid (Glycol/Water) Pump
6. Power Converters Isolation Switches and Contactors
7. Filtering Capacitors (Condenser Banks)
8. AGATE Control Modules
9. Power Supply
10. Power Modules, Main Components of Rectifiers (FCRB) and Inverters
11. Liquid Cooling Radiator
12. Rheostatic Brake Resistor
13. Rheostatic Brake and Main Transformer Blower

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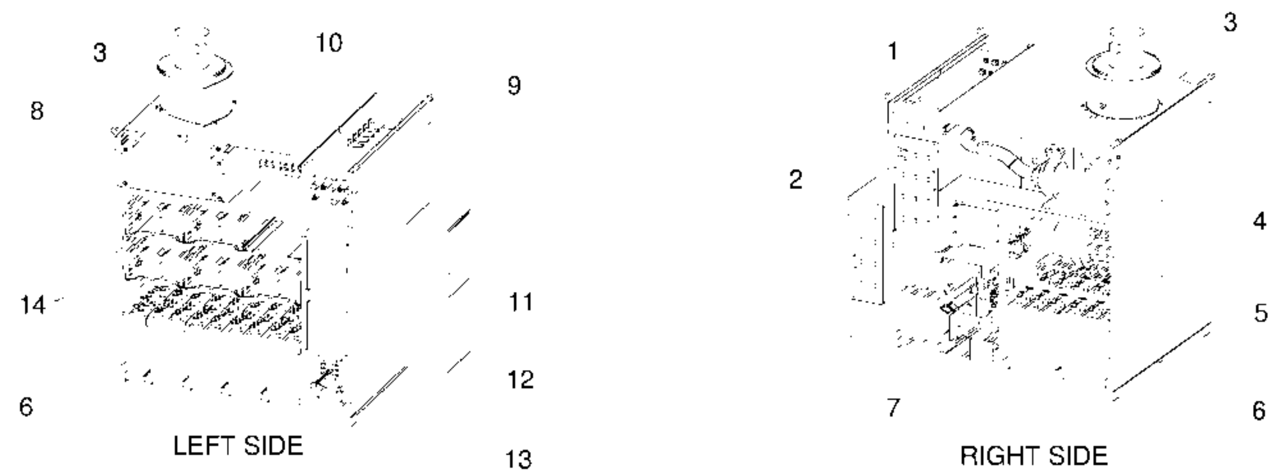
Figure 1-14
Central Block Equipment Arrangement



1. AGATE Control Module
2. Auxiliary Block Circuit Breaker Panel
3. Auxiliary Block Blower
4. Cooling Liquid (Glycol/Water) Pump
5. Auxiliary Circuits Power Supply Contactors
6. Auxiliary Filtering Capacitors (Condenser Banks)
7. Auxiliary Circuits Contactor
8. Liquid Cooling Radiator
9. Resistor Assembly
10. Contactor Subcompartment
11. Low Voltage Connectors for: 72 Vdc Power Supply, AGATE/MPU, Current Sensors, Fire Suppression System and Control Electronics, Trainlines
12. 4000 Volt LED Display (DC Link Capacitors Discharge Indicators)
13. Auxiliary Block Key Switch
14. Power Modules, Main Components of Rectifiers (FCRB) and Inverters

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Figure 1-15
Auxiliary Block Equipment Arrangement

SECTION 1.3
GENERAL DESCRIPTION

This section contains a general description of the major systems of the locomotive.

1.3.1 INTRODUCTION. The High-speed Electric Locomotive (HSEL, or HHP-8) is shown in Figure 1-1. The locomotive is designed to operate as a single unit or in a consist of only two locomotives: two HHP-8 or one HHP-8 and one AEM-7. It is fully compatible with the existing Amtrak rolling stock.

Consists of more than two locomotives (HHP-8 and AEM-7) can only be achieved when the two powered locomotives are coupled to one another, both having the M.U. LOOPING switch in the coupled cab set to TRAIL position. Any other locomotive in the consist must keep its pantograph down. The CMU of any nonpowered HSEL locomotive must also be OFF.

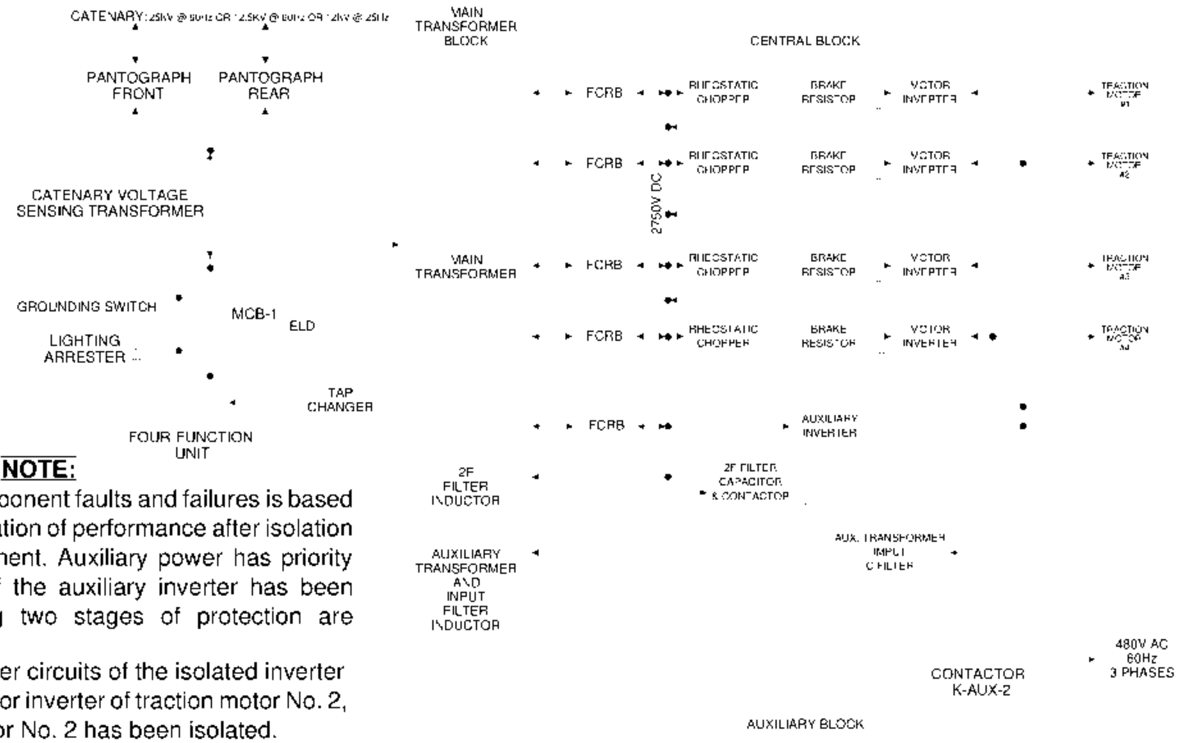
1.3.2 LOCOMOTIVE GENERAL ARRANGEMENT. A brief description of the major systems of the locomotive is provided in the following subsections. The location of components is shown in figures 1-2 to 1-15.

1.3.2.1 Propulsion System. Power for operating the locomotive is obtained through a pantograph to the main circuit breaker, MCB-1, from an overhead alternating current supply of 12kV at 25 Hz, 12.5 kV at 60 Hz, or 25 kV at 60 Hz. Output from the main circuit breaker is applied to two primary windings of the main transformer. The two primary windings are connected in parallel when the overhead line voltage is 12 kV at 25 Hz or 12.5 kV at 60 Hz. The two primary windings are connected in series when overhead line voltage is 25 kV at 60 Hz. A motor driven tap changer switch which makes the parallel or series connection is located next to the central block, over the Low Voltage Battery Chargers (LVBCs).

The main transformer is a fixed ratio type, multiple secondary transformer. Five forced commutation rectifier bridges (FRCBs) operate between the five secondaries and a common bus. This bus, called the DC-Link, has a nominal voltage of 2750 Vdc. Four motor inverters operate between the DC-Link and the four asynchronous alternating current traction motors. A fifth inverter, the auxiliary inverter, is fed by the DC-Link and produces a 1780 Vac, three-phase, 60 Hz output that the auxiliary transformer steps down to produce the HEP. The auxiliary inverter is the first inverter to be activated at startup. Four of the five forced commutation rectifier bridges, and the four motor inverters are located in the central block. The auxiliary inverter is located in the auxiliary block.

Both the forced commutation rectifier bridges and the inverters are based on gate turnoff thyristors (GTO). The direction and amount of power flow is controlled by the timing and sequencing in the operation of the GTOs. In traction mode, the power flows from the catenary to the traction motors. In braking mode, the power flows to the catenary if receptive, or, if not, either to the auxiliary inverter or, through rheostatic choppers, to brake resistors.

The direct current bus voltage is smoothed by a filter, called the 2F Filter, designed to filter out the second harmonic of the catenary voltage 25 Hz or 60 Hz fundamental. The 2F filter reactor is located in the main transformer block undercar. The 2F filter capacitor bank is located in the auxiliary block. The filter is changed by switching the reactor in or out.



NOTE:

Protection against component faults and failures is based on a controlled degradation of performance after isolation of the affected component. Auxiliary power has priority over traction power. If the auxiliary inverter has been isolated, the following two stages of protection are provided:

1. The auxiliary power circuits of the isolated inverter are fed by the motor inverter of traction motor No. 2, after traction motor No. 2 has been isolated.
2. If this is not possible, the motor inverter of traction motor No. 4, after traction motor No. 4 has been isolated, does the feeding.

Figure 1-16
Main Electrical Power Flow Diagram

There are four alternating current traction motors on each locomotive, two per truck. They are 4-pole, squirrel cage motors.

1.3.2.2 Cooling Equipment. The locomotive has three different cooling systems for the propulsion equipment:

- Water cooling: Two water pumps circulate a water/glycol mixture through two radiators in the central block, and another one circulates a water/glycol mixture through the radiator in the auxiliary block.
- Oil cooling: Two oil pumps circulate oil through the main transformer radiators.
- Forced air cooling: Four blowers circulate air through the central block, another one circulates air in the auxiliary block; two others are used for the main transformer and the rheostatic brake resistors. Traction motor cooling is provided by two traction motor blowers, one per truck.

All pumps and blowers are powered by 480 Vac power.

1.3.2.3 Pantographs. A pantograph is located at each end of the locomotive. Only the trailing pantograph is raised during normal operation.

The pantograph is raised by an air cylinder mounted between the base frame and lower arm. It is raised from the active cab, and lowered from either cab, whether active or not. To keep the pantograph up, a magnet valve is energized by the 72 Vdc supply. When the magnet valve is deenergized, the air in the system is vented and the pantograph is lowered.

1.3.2.4 Blended Brakes. Locomotive braking, when controlled by the automatic brake valve, results in the application of both the electric (dynamic) and pneumatic braking system. The blended brake system maintains a uniform braking rate using both the electric (dynamic) and air brake systems simultaneously. The blended system is designed to engage automatically whenever the automatic brake valve handle is applied in the service zone while moving.

The blended brake system makes full use of electric (dynamic) brake capability by using the maximum electric (dynamic) brake and supplementing this braking effort with brake cylinder pressure on the locomotive. Using electric (dynamic) braking during automatic brake operation results in less wear to the tread and disc brake components.

1.3.2.5 Air Brakes. In addition to electric (dynamic) brakes, the locomotive is equipped with air-operated mechanical brakes. The air-operated system consists of both disc type and tread cleaning brake shoes mounted at each wheel.

The majority of the locomotive air brake capability is provided by the disc brakes. The brake discs are bolted into a recess on each side of the wheel. Composition brake pads on each side of the wheel contact the disc when the air brakes are applied. Additional braking effort is provided by a composition tread brake shoe at each wheel. The primary purpose of the tread brake is to clean the wheel surface for maximum adhesion between wheel and rail.

1.3.2.6 Low Voltage Battery Charger. The HEP feeds the Low Voltage Battery Charger (LVBC). The LVBC generates the 72 Vdc that supplies the low voltage distribution system, and that charges the battery.

1.3.2.7 Fire Suppression System. The central element of the fire suppression system is the fire suppression control box with heat sensing switch and heat sensing cable sensor inputs. The fire suppression control box controls the FE13 extinguishing agent, which is stored in a high pressure container in the central block. The fire suppression control box is located in the electrical cubicle. The other components are spread throughout the central and the auxiliary blocks.

NOTE:

The FE-13 is a colorless, odorless gas, low in toxicity. It is liquefied by compression and stored in the high pressure container. In case of fire, the liquid transformed into vapor is discharged in the equipment room with accompanying refrigeration effects to effectively suppress the fire.

An audio alarm and a visual alarm displayed on the Primary Operating Display (POD) and Multifunction Display No. 1 (MFD1) warn the engineer of a fire. When the alarm is not acknowledged on the MFD1, automatic fire suppression occurs after a two-minute delay. When the alarm is acknowledged, the automatic fire suppression is inhibited in the local locomotive (the alarm can also be acknowledged by the FIRE SUPP. INHIBIT pushbutton, on the cab rear wall switch panel). The engineer can then stop the train, get up, check if there is a fire and manually activate the fire suppression system (or do nothing).

NOTE:

In any case, pressing on the red FIRE SUPP. ACTIVATION pushbutton, on the cab rear wall switch panel, resumes the fire extinguishing process.

1.3.2.8 Cab Signal and Automatic Train Control Systems. The Automatic Train Supervision/Automatic Train Control/Speed Sensing (ATS/ATC/SS) system is a microprocessor-based cab signaling system. It emulates existing cab signal equipment, with the addition of expanded aspects, Advanced Civil Speed Enforcement System (ACSES) interface, and penalty brake suppression.

1.3.3 HIGH VOLTAGE POWER REMOVAL (Fig. 2-64). Whenever access to the roof, or to the central or auxiliary block, is required, the procedures listed in subsection 2.2.8, on page 2-110, "High Voltage Power - Turning Off and On (Fig. 2-64)" must be adhered to in order to remove all high voltage power from the equipment.

SECTION 1.4
PRINCIPLES OF OPERATION

This section contains a functional description of the equipment operation, where applicable.

NOTE:

Only the information pertaining to the locomotive crew is included. The descriptions are only to the extent necessary for an understanding by persons unfamiliar with the locomotive or its equipment.

1.4.1 CARBODY, INTERIOR FIXTURES, OPERATING CAB. This section includes the equipment described in the following subsections.

Refer to subsection 2.1.1, on page 2-1, "Carbody, Interior Fixtures, Operating Cab (Fig. 2-1 to 2-5)" for a description of the available controls and indicators.

1.4.1.1 Cab Seats. The engineer and the assistant seats are fully adjustable.

1.4.1.2 Windshield Heater. The heater is integrated into the windshield.

1.4.1.3 Wipers and Windshield Washer. Each cab is equipped with two windshields, with one wiper and one windshield washer spray nozzle for each windshield.

1.4.1.4 Sun Visors. The visors on the top part of the windshield protect the engineer and the assistant against glare.

1.4.1.5 Adjustable Footrest. The footrest under the engineer's console allows height adjustment of the floor-mounted equipment.

1.4.1.6 Mirrors. The retractable mirrors on each side of the locomotive allow the engineer vision to the rear of the locomotive cab.

1.4.1.7 Refrigerator. A refrigerator is installed at the bottom of the cab wall.

1.4.1.8 Emergency Escape Hatch. An emergency escape hatch is located on the cab ceiling, behind two hinged panels.

1.4.1.9 Toolbox. The toolbox on the cab wall contains an adjustable wrench, a hammer, a pinch bar, and a first aid kit.

1.4.1.10 Horn. An pneumatic horn is installed on the roof, at each end of the locomotive.

1.4.1.11 Bell. A pneumatic bell is located undercar, at each end of the locomotive.

1.4.1.12 Sanding System. Pneumatic sanders deposit sand in front of the wheels, only when the locomotive is at speed. They are located undercar near each truck front wheel, at both ends of the locomotive.

1.4.1.13 Fire Extinguishers. A fire extinguisher is located in the FIRE EXTINGUISHER locker on the cab wall. Two fire extinguishers are located in the equipment room, one on each side. All fire extinguishers are of the "C" type.

1.4.1.14 Ladder. The equipment room ladder can be used to access the roof, for maintenance purposes only.

WARNING:

TO PREVENT INJURY OR DEATH, NEVER ACCESS THE ROOF WITH THIS LADDER WHILE THE LOCOMOTIVE IS IN OPERATION.

1.4.2 TRUCK AND SUSPENSION. The functional description of the truck and suspension equipment operation includes the Integrated Truck Surveillance System (ITSS), and the locomotive onboard failure detection trainline architecture.

Refer to subsection 2.1.2, on page 2-7, "Truck and Suspension" for a description of the available controls and indicators.

In normal operation, the locomotive is equipped with gray service chains located between the truck frame and the locomotive carbody. Whenever the locomotive has to be lifted, red lifting chains are installed at theses locations.

WARNING:

THE LOCOMOTIVE MUST NOT BE OPERATED WHEN THE RED LIFTING CHAINS ARE INSTALLED. ALWAYS CHECK THAT THE SERVICE CHAINS ARE IN PLACE PRIOR TO LOCOMOTIVE OPERATION.

1.4.2.1 Integrated Truck Surveillance System. The Integrated Truck Surveillance System (ITSS) is composed of the following:

- Integrated Truck Surveillance Unit (ITSU)
- Truck hunting accelerometers (one per truck)
- Hot bearing temperature sensors (4 per truck).

The truck hunting accelerometers monitor truck instability by measuring the lateral acceleration of each truck. The hot bearing temperature sensors monitor the temperature of each truck journal bearing.

In normal operation, the ITSS monitors each hot bearing temperature sensor and truck hunting accelerometer. It provides information about each bearing temperature, condition, and operation outside normal operating range.

When a temperature sensor detects an abnormal bearing temperature, a hot bearing alarm (212 °F), is triggered. The appropriate ITSU front panel indicator illuminates, the "onboard failure" trainline becomes energized, and the ONBOARD FAILURE indicator on the engineer's overhead switch panel turns on. The ONBOARD FAILURE indicator may also be lit by a failure from a coupled car transmitted through the "Hot Journal" trainline.

When an accelerometer detects a truck hunting (acceleration above the specified rate), an alarm is triggered. The appropriate ITSU front panel indicator turns on, the "onboard failure" trainline becomes energized, and the ONBOARD FAILURE indicator on the engineer's overhead switch panel turns on.

When a hot journal or truck hunting is detected, the Multifunction Display No. 1 (MFD1) and the Primary Operating Display (POD) inform the engineer of the specified alarm. (Refer to subsection 2.2.7, on page 2-104, "En Route Procedures" for detailed operating procedures.)

1.4.2.2 Locomotive Onboard Failure Detection System. The Locomotive onboard failure detection system ensures compatibility between the high-speed electric locomotive and existing Amtrak rolling stock.

The "onboard failure" trainline is connected to the ITSS and the Fire Detection System. When a locomotive hot bearing, truck hunting, or fire is detected, the following occurs:

- The "onboard failure" trainline is energized.
- The ONBOARD FAILURE indicator turns on.
- The appropriate information is displayed on Multifunction Display No. 1 (MFD1) and Primary Operating Display (POD).

The "hot journal" trainline monitors the passenger car hot journal failures.

Pressing the SELF TEST and LAMP TEST buttons simultaneously on the ITSU front panel bypasses a faulty sensor (temperature sensor or accelerometer), in order to restore the trainline functionality.

The ITSU sealed CUTOUT switch is used to bypass a faulty ITSU. The ONBOARD TL bypass switch on the cab rear wall switch panel is used to bypass a faulty trainline.

1.4.3 COUPLER. The locomotive is equipped with two AAR Type H Tightlock automatic couplers, one at each end.

Refer to subsection 2.1.3, on page 2-13, "Coupler (Fig. 2-10)" for a description of the controls and indicators related to the operation of the coupler.

1.4.4 ELECTRICAL DISTRIBUTION SYSTEM. This subsection describes the operation of the following locomotive electrical distribution system major components:

- Low Voltage Battery Charger (LVBC)
- Battery and Battery Controls
- Circuit Breakers
- 120 Vac Receptacles.

Refer to subsection 2.1.4, on page 2-13, "Electrical Distribution System (Fig. 2-11 to 2-13)" for a description of the controls and indicators related to the operation of the electrical distribution system.

1.4.4.1 Low Voltage Battery Charger (LVBC). The LVBC components are the contactor assembly, the temperature monitors, and the input voltage monitor. The Head End Power (HEP) feeds the LVBC. The LVBC generates 72 Vdc for the battery and the low voltage distribution system and has its own microcontroller.

For protection, there are two redundant LVBCs tied to the same output, but only one is active at any time. The LVBCs are controlled by the Propulsion Electronic Control Unit (PECU).

1.4.4.2 Battery and Battery Controls. The nickel-cadmium battery consists of ten batteries, located in the two battery boxes, one on each side at the exterior of the locomotive. Each battery contains five cells.

The battery is the alternate source of 72 Vdc when it is unavailable from the LVBC. It supplies power for 15 minutes in Stage I, and for seven hours in Stage II.

The battery is protected by the battery main circuit breaker located near the battery box on the right side, towards the "F" End of the locomotive.

1.4.4.3 Load Shedding. If the high voltage supply from the pantograph, or the 480 Vac from the shop supply is lost, and if the reverser is set to OFF, complete load shedding occurs after 15 minutes. This condition removes all DC loads from the battery.

If the reverser is not in OFF, load shedding occurs in two stages. Stage 1 removes part of loads, and occurs after 15 minutes. Stage 2 removes the remaining DC loads, and occurs when the battery decreases below the "end of cell" voltage (50 Volts), or after the reverser is set to OFF. Only one DC circuit remains powered from the battery after complete DC power shut down. This circuit includes the step lighting, partial ceiling lighting in the cab and equipment room (one light near each entrance door and over the engineer station), the cab activate circuit, and the parking brake circuit. The radio battery charger is not included in the circuit, but the battery is fully charged and the radio available.

1.4.4.4 Circuit Breakers. All the locomotive circuit breakers are listed, and their location indicated, in subsection 2.1.4, on page 2-13, "Electrical Distribution System (Fig. 2-11 to 2-13)". They feed and protect different systems, as listed in the following table:

Table 1-1
Circuit Breaker Voltages for Each System

SYSTEM	480 Vac	120 Vac	72 Vdc
Truck and Suspension			X
Electrical Distribution System	X	X	X
Lighting and Indicators		X	X
HVAC	X	X	X
Communication Systems			X
Propulsion and Electric Braking	X		X
Friction Brake Equipment/Air Supply	X		X
Cab Signal and Automatic Train Control			X
Train Monitoring and Data Management			X
Water and Waste Retention System		X	X

1.4.4.5 120 Vac Receptacles. The 120 Vac receptacles located on each side of the locomotive are a provision for an external source of power for maintenance purposes. These receptacles power the following equipment only: 120 Vac outlets within the cabs (except the refrigerator outlets), 120 Vac outlets in the equipment room, maintenance lights. When the 120 Vac receptacles are supplied wayside power, the rest of the 120 Vac network is disconnected by the wayside contactors.

1.4.5 LIGHTING AND INDICATORS. The lighting system provides illumination to the cab, equipment room, and exterior of the locomotive as well as normal walkway lighting. It also provides lighting during maintenance, emergency, and for access to the locomotive.

Refer to subsection 2.1.5, on page 2-23, "Lighting and Indicators" for a description of the lighting system controls and indicators.

1.4.5.1 Exterior Lighting. Exterior lighting comprises the following equipment: headlights, marker lights, ditch lights, exterior ground lights.

1.4.5.2 Interior Lighting. Interior lighting comprises the following equipment: cab ceiling lights, timetable and console lights, cab step light, walkway lights, maintenance lights, toilet light.

1.4.6 DOORS, DOOR CONTROL AND SIGNAL SYSTEM. The locomotive is compatible with the door systems of all Amtrak cars operating on the Northeast Corridor.

Refer to subsection 2.1.6, on page 2-24, "Doors, Door Control and Signal System (Fig. 2-3)" for an explanation of the Door System operation.

1.4.7 HEATING, VENTILATION, AND AIR CONDITIONING. The locomotive HVAC system consists in two independent HVAC systems, one for each cab. Each HVAC system is fully automatic and depends on the various switches settings. The temperature for each cab is controlled by the temperature control unit of each cab HVAC unit.

Refer to subsection 2.1.7, on page 2-27, "Heating, Ventilation, and Air Conditioning" for a description of the HVAC system controls and indicators.

1.4.8 COMMUNICATION SYSTEMS. The communication systems provide Intercom (IC) and radio communication for the locomotive crew.

Refer to subsection 2.1.8, on page 2-29, "Communication Systems (Fig. 2-17 to 2-19)" for a description of the controls and indicators related to the operation of the communication systems.

1.4.8.1 Intercom. For IC communication, the engineer and assistant can use a headset or a microphone. Maintenance personnel can use one of the six remote stations located in the equipment room to communicate with the other remote stations, the engineer, or the assistant. Two remote stations can talk to each other at the same time. However, a remote station and a cab station cannot communicate at the same time. The IC voice transmission is heard from the cab ceiling speaker.

IC transmission with the headsets is VOX activated (there is no need to press on a PTT switch). IC transmission without the headsets requires that the PTT switch be pressed (communication footswitch for the engineer, and assistant's station PTT for the assistant).

Refer to subsection 2.1.8, on page 2-29, "Communication Systems (Fig. 2-17 to 2-19)" for a description of the IC controls and indicators.

1.4.8.2 Radio. For radio communication with the wayside on all AAR channels, the engineer can use the remote control head on the engineer's center console switch panel (the headset with the footswitch PTT, or the console microphone with the footswitch PTT). The assistant can use the assistant's headset station, with the station PTT or the station microphone with the station PTT. The radio voice reception is heard from the remote control head speaker.

Refer to subsection 2.1.8, on page 2-29, "Communication Systems (Fig. 2-17 to 2-19)" for a description of the radio controls and indicators.

1.4.9 PROPULSION AND ELECTRIC BRAKING. The propulsion system supplies electrical power to the traction motors, provides Head End Power (HEP), and controls electric braking power from the traction motors. The major components of the system are described in the following subsections.

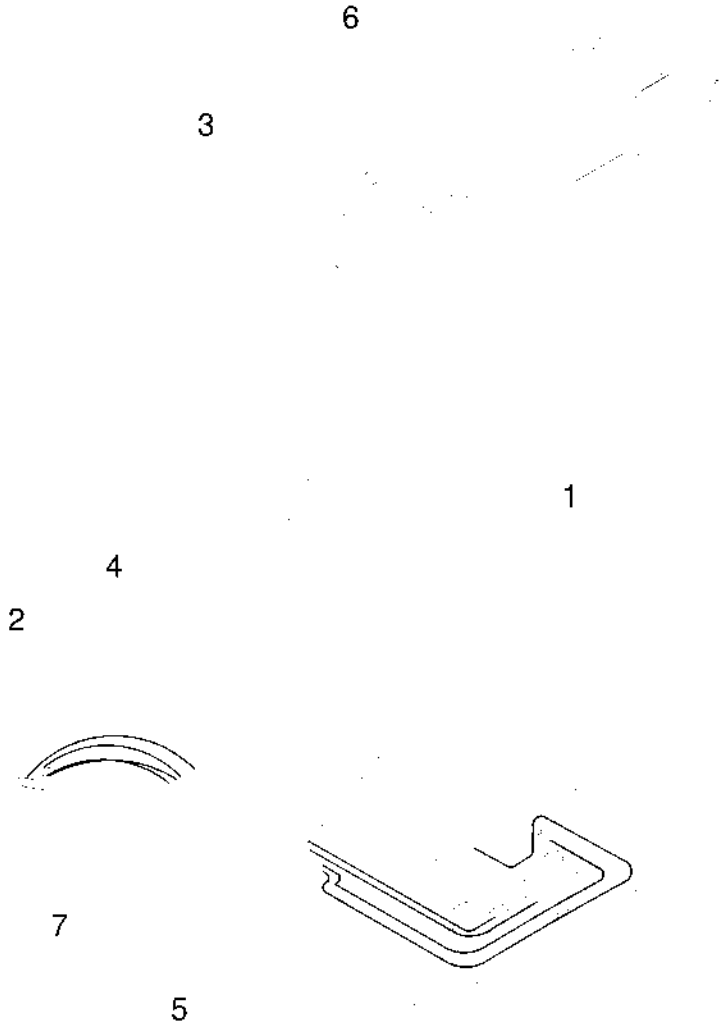
Refer to subsection 2.1.9, on page 2-34, "Propulsion and Electric Braking" for a description of the propulsion and electric braking controls and indicators.

1.4.9.1 Pantographs (Fig. 1-17). The two pantographs (Transtech of S.C. Inc.) are of the single-arm, direct air-operated type. The collector head consists of two carbon strips, with sealed air lines. With the pantograph in operation, the air line is pressurized. With the carbon broken or missing, the air to the raising cylinder is vented, causing the pantograph to drop.

1.4.9.2 Auxiliary Compressor (Fig. 1-7). When the main reservoir pressure is below 90 psi, the pantograph supply reservoir provides the air required to raise the pantograph. This reservoir is charged automatically by the auxiliary compressor when the CAB ACTIVATE button is pressed. If the pantograph is raised with insufficient pressure to close the main circuit breaker, the auxiliary compressor charges the system until the required pressure is reached.

1.4.9.3 Four-Function Unit. The four-function unit consists of the following equipment:

- Main Circuit Breaker: closes automatically at power-up.
- Catenary Voltage Sensing Transformer: indicates the state of the catenary voltage to the Propulsion Electronic Control Unit (PECU).
- Lightning Arrestor: protects the main circuit breaker, the main transformer and surrounding equipment, by providing lightning strikes a path to ground.
- Grounding Switch: ensures safety and allows maintenance activities by grounding both sides of the main circuit breaker.



1. High-Speed Pantograph
2. Air Lines to Carbon Strips
3. Horn
4. Raising Cylinder
5. Air Lines to Raising Cylinder
6. Carbon Strip
7. Air Control Equipment Box

Figure 1-17
High-Speed Pantograph

1.4.9.4 Main Transformer and Tap Changer. The main transformer is located under the locomotive carbody, between the trucks. The configuration of the transformer primary is adjustable by the tap changer mounted on top of the low voltage battery charger.

1.4.9.5 Propulsion Electronic Control Unit (PECU). The Propulsion Electronic Control Unit (PECU) controls the propulsion system. It controls the direction and amount of power flow from the catenary to the four motor inverters and the auxiliary inverter. In traction mode, it controls the power flow from the catenary to the traction motors. In braking mode, it controls the power flow to the catenary if receptive, or, if not, either to the auxiliary inverter or to brake resistors.

The PECU also controls the auxiliary inverter. The auxiliary inverter, fed by the DC-Link, produces a 1780 Vac, three-phase, 60 Hz output that the auxiliary transformer steps down to produce the Head End Power (HEP). HEP (480 Vac, three-phase, 60 Hz) feeds all locomotive and train consist equipment.

Two types of power converter, rectifier bridges and inverters, convert between ac and dc power. These power converters, and the rheostatic chopper, are all controlled by the PECU, and are based on gate turnoff thyristors (GTOs). The direction and amount of power flow is controlled by the timing and sequencing in the operation of the GTOs.

The PECU consist of the following equipment:

- Two main processing units, located in the propulsion electrical cubicle.
- Five control devices, four located in the central block, one in the auxiliary block.
- Six remote input/output modules, four located in the central block, two in the auxiliary block.

1.4.9.6 Traction Motors. There are four asynchronous ac traction motors on each locomotive, two per truck. They are 4-pole, squirrel-cage motors.

1.4.9.7 Auxiliary Transformer. The auxiliary transformer steps down the 1780 Vac, three-phase, 60 Hz auxiliary inverter output to provide the 480 Vac, three-phase, 60 Hz, HEP. It is located inside the main transformer assembly.

1.4.9.8 Grounding Equipment. High-voltage grounding is through carbon ground brushes, one on each side of an axle. Primary current from the main transformer (and auxiliary block) is returned to one side, and the other currents from the carbody, including those from the lighting arrestor, to the other side.

Low impedance resistors, placed between the carbody and the gearbox, are used as ground loss detectors.

1.4.9.9 Master Controller. The main components of the master controller are the reverser, throttle lever, and cruise control lever.

1.4.9.10 Key Card Reader. The key card reader consists of a card reading surface, a keypad, a green LED, a red LED, a beeper, and associated circuitry. There is one in each cab, used to provide cab authorization.

1.4.9.11 Key Card Reader Bypass Switch. One sealed bypass switch is provided, in the equipment room, for use exclusively when a key card reader has failed and the locomotive needs to be operated. It bypasses both key card readers.

1.4.9.12 Cab Display Unit. Each cab is equipped with three Cab Display Unit (CDU). The Primary Operating Display (POD) and Multifunction Display No.1 (MFD1) are on the engineer's console. The Multifunction Display No. 2 (MFD2) is on the assistant's console.

1.4.9.13 Cooling Equipment. Two water pumps circulate a water/glycol mixture through two radiators in the central block. Another circulates a water/glycol mixture through the radiator in the auxiliary block.

Four central block blowers circulate air through the two radiators, across the snubbers, and out through the roof hood. Another blower circulates air through the radiator in the auxiliary block.

Two main transformer oil pumps circulate oil through the transformer radiators in the central block. Two main transformer blowers circulate air through the radiators, through the rheostatic grids, and out through the roof hood.

Forced air cooling is provided by two traction motor blowers.

All pumps and blowers are powered by 480 Vac power.

1.4.9.14 EMI Limit Detector. The Electromagnetic Interference (EMI) limit detector is located in the electrical locker No. 3. Its sensor is located on the roof. It opens the main circuit breaker to remove catenary power when the level of electromagnetic interference reaches a threshold.

1.4.9.15 Fire Suppression System. The central element of the fire suppression system is the fire suppression control box, which controls the FE13 extinguishing agent stored in a high pressure container in the central block. The control box also sends signals to inhibit propulsion. The fire suppression control box is located in the propulsion electrical cubicle. The other components are spread throughout the central and the auxiliary blocks.

1.4.9.16 Auxiliary Block Key Switch. This key switch, located on the auxiliary block, is used for safety in power equipment maintenance. It inhibits access to power blocks unless the pantograph and main circuit breaker have been grounded. Refer to subsection 2.2.8, on page 2-110, "High Voltage Power - Turning Off and On (Fig. 2-64)" for a description of the high voltage equipment grounding.

1.4.10 FRICTION BRAKE EQUIPMENT (Fig. 1-18 and 1-19). The braking system for the locomotive is controlled by the automatic brake control lever and the independent brake control lever in the active cab. The braking system blends electrical (dynamic brakes) and electropneumatic braking. The friction brakes are applied by reduction of brake pipe pressure that results in application of brake cylinder pressure.

The friction brake system provides blended brake, pneumatic service brake, emergency brake, dead-in-tow feature by use of a tow locomotive, a snow brake feature, and spring-applied air release parking brake. An "end-of-train" device provides telemetry readings of the brake pipe pressure from the last car in the consist.

Refer to subsection 2.1.10, on page 2-46, "Friction Brake Equipment" for a description of the brake system controls and indicators.

1.4.10.1 Electrical Braking (Dynamic Braking). Electrical braking (dynamic braking) occurs when power is generated by the traction motors and sent into the catenary for regenerative braking, and into braking resistances for rheostatic braking. The Brake Control Computer (BCC) communicates with the propulsion system to establish the level of electric braking and friction brake required to produce the required brake level.

The engineer can also control electrical (dynamic) braking by using the cruise control lever in conjunction with the throttle lever. If the throttle lever is kept in an effort position while the cruise control speed setting is below the current train speed, the traction effort is negative (electric braking mode).

1.4.10.2 Electropneumatic Braking. The electropneumatic braking (pneumatic application of friction brakes controlled electrically) is controlled by the Brake Control Computer (BCC). It applies braking effort from a minimum service through emergency application. Friction brake effort is applied through wheel-mounted discs and by tread brake units on all wheels.

1.4.10.3 Parking Brake. The parking brake is spring applied, and air released. When no air is available, the parking brake can be manually released with the levers on both sides of the locomotive.

1.4.10.4 Snow Brake. The snow brake function prevents the buildup of snow and ice on the brake equipment of the locomotive. When energized, the snow brake function provides a friction brake application of 6 psi for 60 seconds at each of the disc and tread brake actuators.

1.4.10.5 Sanding. Sanding may be used when more adhesion between the wheel and rail is desired. Sand is deposited in front of the locomotive leading wheels. During an emergency brake application, sanding is automatic for 30 seconds or until the train stops, whichever is longer. Sanding is also used if wheelslip occurs in traction effort. Sanding is automatic, as requested by the propulsion system, this condition is indicated on MFD1 and MFD2.

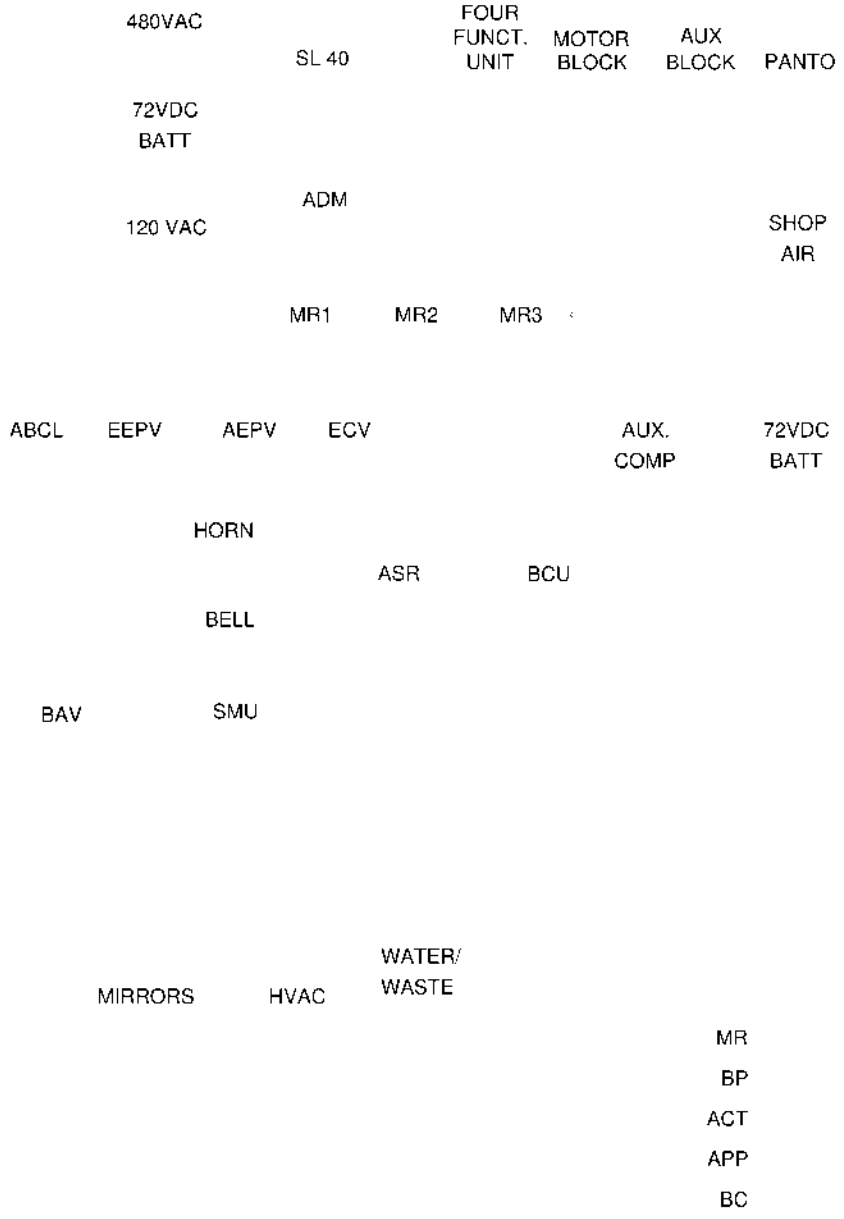
1.4.10.6 Independent Brake. The independent brake is a direct acting brake which acts on the locomotive(s) only. The independent brake is applied on all locomotives that are in a multiple unit consist by means of the application pipe.

Control of the independent brake is by the lead locomotive only, trailing locomotives respond to the application pipe pressure. Maximum brake cylinder pressure is typically 57 psi.

CAUTION:

Never use the independent brake as a parking brake when the locomotive is stopped. Always place the Independent Brake Control Lever in RELEASE position prior to cab deactivation. This ensures that no air is trapped in the system in order to prevent damage to the equipment.

The independent brake function is available only under computer control. A locomotive in trail is still able to respond to the independent brake trainline even without computer control.



ADM: Air Dryer Module
AEPV: Assistant Emergency Brake Valve
ASR: Auxiliary Supply Reservoir
BAV: Brake Application Valve
ECV: Conductor's Emergency Brake Valve
EEPV: Engineer Emergency Brake Valve
SMU: Sanding Metering Unit
SL 40: Air Compressor

Figure 1-18
Air Supply Block Diagram

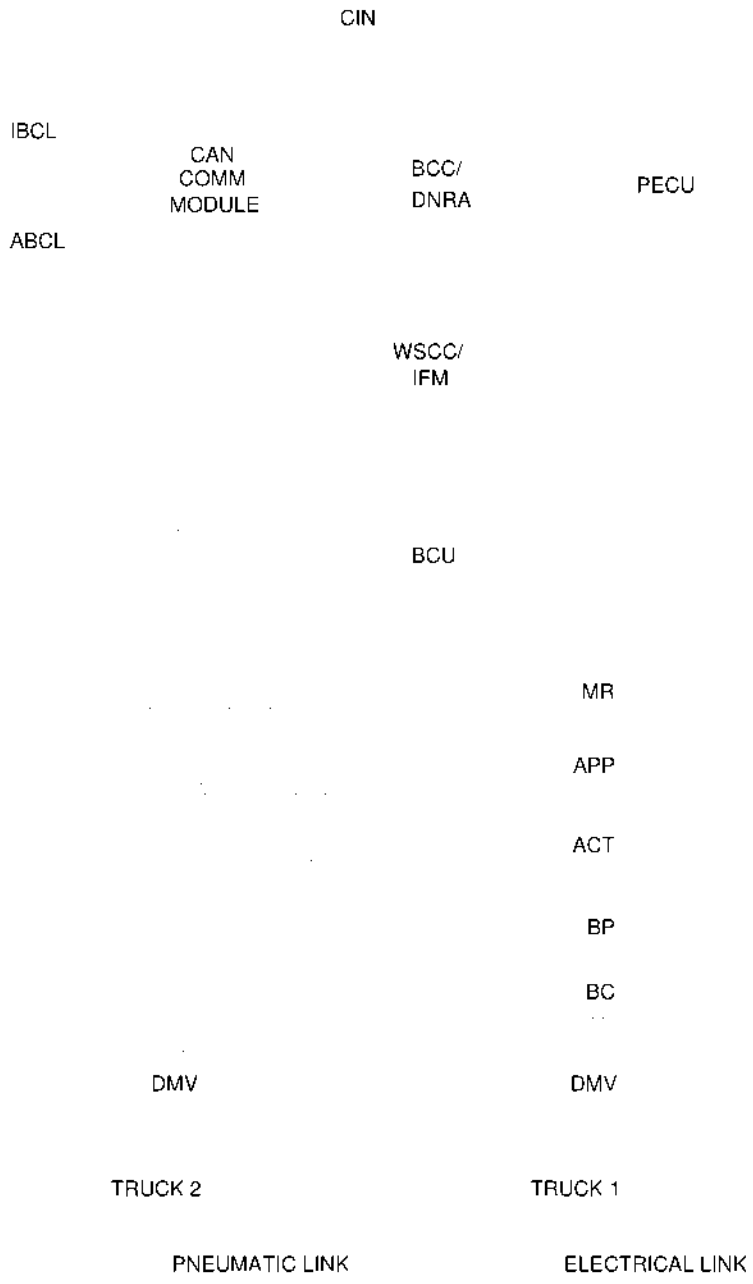


Figure 1-19
Air Brake System Block Diagram

1.4.10.7 Bail Off Function. The bail off function releases brake cylinder pressure from an automatic brake application on the locomotive (s) while keeping the brake applied on the cars in the consist.

1.4.10.8 Air Supply. The locomotive air supply system main components are the air compressor, main reservoir, brake supply reservoirs, and auxiliary reservoir.

1.4.10.9 Wheelslip/Slide System. The locomotive features a microprocessor controlled wheelslip/slide control system that detects and controls wheelslip on a per axle basis.

1.4.10.10 Truck-Mounted Brake System Components. The locomotive is equipped with four wheel-mounted cast steel brake discs units, and four tread brake units, with automatic slack adjuster, per truck. The discs provide approximately 85% of the braking effort, and the tread brakes 15%.

1.4.11 CAB SIGNAL AND AUTOMATIC TRAIN CONTROL SYSTEMS. This subsection describes the operation of all the subsystems related to the cab signal and automatic train control systems.

Refer to subsection 2.1.11, on page 2-55, "Cab Signal and Automatic Train Control Systems" for a description of the Automatic Train Supervision/Automatic Train Control/Speed Sensing (ATS/ATC/SS) system controls and indicators.

1.4.11.1 Automatic Train Supervision/Automatic Train Control/Speed Sensing and ACSES Systems. The Automatic Train Supervision/Automatic Train Control/Speed Sensing system is a microprocessor-based cab signaling system. It emulates existing cab signal equipment, with the addition of expanded aspects, Advanced Civil Speed Enforcement System (ACSES) interface, and penalty brake suppression.

The automatic train supervision/automatic train control system provides the following:

- A continuously controlled and constantly visible speed-aspect cab signal, reflecting the coded information transmitted through the rails by the signal system.
- Automatic brake application and locomotive power removal if the engineer acknowledges a downward signal change, but fails to manually initiate braking after a specified period of time, and if the train speed exceeds the limit required by the new cab signal aspect.
- Full stop (penalty) brake application and loss of propulsion within 5 seconds, if the engineer fails to acknowledge a more restrictive cab signal speed indication.
- Cancellation of the brake application order, delayed by ATC system, when the train speed is at or below the level indicated by the cab signal speed aspect displayed, provided proper actions are taken by the engineer.
- An audible warning when the cab signal aspect changes to a lower speed aspect regardless of train speed and whenever the train is in overspeed.

The speed sensing system is used to process speed signals from two speed sensors associated with axles No. 2 and No. 3 of the locomotive. It also provides a visible display of the train speed on the Primary Operating Display (POD).

1.4.11.2 Penalty Brake Suppression. An automatic penalty brake application from the ATC system is suppressed when the engineer performs the proper actions. Multifunction Display No. 1 (MFD1) indicates to the engineer if all the conditions are met, as follows:

- The SUPPRESSION indication flashes on the screen at deceleration between 0.9 to 1.2 mphps.
- When the ATC system penalty brake application is forestalled by the permanent suppression input (brake rate greater or equal to 1.2 mphps), the SUPPRESSION indication is on steady.

1.4.11.3 ATC Wheel Calibration. The ATC wheel size calibration must be activated from the ATC unit. Once the ATC is put in wheel wear mode, it lets the user adjust the new size of all 4 wheels of a specific truck. The system permits the new settings to be selected between 40 in. and 38 in. with a step of 0.5 in.

1.4.11.4 Alerter/Recorder. The locomotive is equipped with a microprocessor based alerter/recorder system. This equipment performs the two functions described in the following subsections.

1.4.11.4.1 Alerter Operation. The alerter/recorder system alerter operation consists of a vigilance task that verifies the presence of the engineer upon periodic sequence.

The alerter/recorder monitors the cab console inputs. If, after a 25-second period of time the system has detected no inputs, it activates a blinking visual alarm and an audio alarm. The audio alarm consists of a one-second beep every 15 seconds. If after 15 seconds there is no acknowledgement, the audio alarm remains at maximum sound level. The alarm increases in intensity until a reset is activated. The engineer can activate a reset by doing one of the following:

NOTE:

If the ATC is cutout, the alerter cannot be acknowledged by the acknowledge footswitch and acknowledge whisker switch. One of the other reset functions must then be used.

- Activating the acknowledge footswitch
- Activating the acknowledge whisker switch
- Operating the horn button
- Operating the horn footswitch
- Operating the bell button
- Switching on the headlight
- Moving the automatic brake control lever.
- Moving the throttle.

If the engineer does not activate a reset, the alerter/recorder activates a penalty brake combined with traction power removal. The engineer can reset the penalty brake condition by moving the brake handle to the suppression position. Once a penalty is initiated by the system, a full service brake application with power shutdown occurs.

1.4.11.4.2 Recorder Operation. The recorder task of the alerter/recorder system monitors and stores events over a 48-hour period. The recorder can also store up to ten minutes of cab background audio and radio audio activity.

The events recorded are:

- Speed
- Direction of motion
- Time
- Distance
- Throttle operation
- Brake application, and operation including electric (dynamic) brake
- Cab signal aspects and acknowledgment
- Civil speed enforcement display and acknowledgment
- Traction motor current
- Cutout (ITSU, ARU, ATC, ACSES, SS)
- Alerter system operation
- Horn-Bell-Headlights
- Loss of Traction Power
- Position/impact sensor operation
- Voice radio channel
- Cab background noise
- Out-of-limits of rail signal amplitude.
- End-of-train device.

Refer to subsection 2.1.11.7.1, on page 2-60, "Alerter/Recorder Equipment (Fig. 2-29)" for a description of the Alerter/Recorder System equipment.

1.4.12 TRAIN MONITORING AND DATA MANAGEMENT. The train monitoring system has two basic functions: assist the engineer in operating the locomotive, and help in the maintenance of the locomotive.

The Data Management System (DMS) is an onboard management computer acting as a gateway to a wireless radio network for exchange of various data and information with Amtrak wayside facilities.

Refer to subsection 2.1.12, on page 2-62, "Train Monitoring and Data Management" for a description of the train monitoring system and DMS controls and indicators.

1.4.12.1 Car Internal Network. The Car Internal Network (CIN) is used to carry monitoring and cab display information between subsystems in the locomotive. The CIN is used for subsystems-to-train monitoring system, and train monitoring system-to-DMS communications.

1.4.12.2 Propulsion and Brakes Internal Network. The propulsion and brakes internal network is used for communication between the propulsion and brake computers.

1.4.12.3 Car Internal Network Router. The car internal network router is the bridge that connects the propulsion and brakes internal network with the CIN to allow communication between the two networks.

1.4.12.4 Train Level Architecture. The train monitoring system monitors most locomotive subsystems by gathering information via the on-board CIN. It provides a user interface through display terminals in each cab. The train monitoring system interfaces with the DMS, which provides two-way radio communication with remote sites.

1.4.12.5 Train Configuration. One or two locomotives may be used in a train consist of up to 18 passenger cars requiring HEP. The locomotives should be located at the same end of the consist.

NOTE:

The HHP-8 (HSEL) locomotive has sufficient horsepower to provide continuous 125 mph operation when used in a train consist of one locomotive and 14 cars with an average weight of 115,000 lbs. each and 800 KW HEP load.

1.4.12.6 Locomotive Network. Two high-speed electric locomotives (HHP-8) in a train consist communicate together through two redundant data networks. This approach ensures proper message delivery even if one network becomes inoperative. A data network is a communication system between several computer based subsystems allowing them to share information in real time.

The network is also responsible for establishing the number of locomotives in the consist. The passenger cars and non-high-speed locomotives do not appear in this configuration. The location and orientation of the locomotives within the consist remains unknown.

1.4.12.7 Locomotive Level Architecture. The train monitoring system and DMS architecture is based on a Car Internal Network (CIN) that allows communications between the following components:

- Monitored subsystems equipped to communicate on the CIN
- Car monitoring unit
- Cab display unit
- CIN router
- Data management system computer.

1.4.12.8 Car Monitoring Unit. The Car Monitoring Unit (CMU) monitors the health and status of Microprocessor-Based Systems (MBS) by means of the on-board data network (car internal network). The CMU monitors nonMBSs through discrete input lines. The information is available to the locomotive crew and maintenance personnel through Cab Display Units in each cab.

The CMU performs the following functions:

- Maintains the locomotive network configuration
- Enables interlocomotive communication
- Sends and receives wayside information through the DMS
- Performs non-fail-safe control functions (horn sequencing, ditch light flashing, etc.).

1.4.12.9 Cab Display Units. Each locomotive cab is equipped with three Cab Display Units (CDU): Primary Operating Display (POD), and Multifunction Display No. 1 (MFD1) on the engineer's console; Multifunction Display No. 2 (MFD2) on the assistant's console.

The CDUs are used as the user interface to display operation/monitoring information to the crew/ maintenance personnel.

1.4.12.10 Data Management System Computer. The Data Management System (DMS) computer provides interface with two independent data radios. It also interfaces with the end-of-train device by means of serial link.

1.4.12.11 Data Radios. The transfer of information between the locomotive and wayside facilities is done through a pair of independent cellular data modems, or data radios (CDPD and RAM), each one using a different transmittal technique in order to minimize cost. The data radios use different transmittal rate, frequency band and interface protocol, allowing them to be used in different situations (locations). The cellular modems use the same type of communication system as a regular cellular phone network, but instead of transmitting voice information, they transmit (digital) data information.

1.4.12.12 Cab Printer. The CMU provides interface to the two cab printers (one in each cab) on which train orders and predeparture test results are printed. Refer to subsection 2.1.12.8, on page 2-72, "Cab Printer (Fig. 2-58)" for a description of the printer controls and indicator.

1.4.12.13 End Of Train Device (EOTD) System. The End Of Train Device (EOTD) system is used by the locomotive engineer to monitor the last car (end of train) brake pipe pressure.

Upon activation by the engineer of the EMERGENCY END-OF-TRAIN BRAKE switch on the engineer's left switch panel, a telemetry signal is sent from the locomotive Head Of Train Device (HOTD) to the EOTD in order to activate the brake valve actuator located in the last car.

Refer to subsection 2.1.12.9, on page 2-86, "End-of-Train System (Fig. 2-26 and 2-49)" for a description of the controls and indicators related to the operation of this system.

1.4.13 WATER AND WASTE RETENTION SYSTEMS. The water and waste retention systems are divided into two subsystems: water supply system and waste retention system.

- The water supply system delivers, holds, controls or drains all the fresh water supply available in the locomotive.
- The waste retention system includes all the components that retain, or move waste.

Refer to subsection 2.1.13, on page 2-86, "Water and Waste Retention Systems" for a description of the water and waste retention systems controls and indicators.

1.4.13.1 Water Supply System. The water supply system comprises the equipment described in the following subsections.

- Cold Water Tank
- Water Fill Stations and Fittings
- Water Raising Unit
- Water System Protection.

1.4.13.1.1 Cold Water Tank. The cold water tank located in the toilet module has a capacity of 7.5 gallons. The water is distributed by gravity to the toilet and sink.

1.4.13.1.2 Water Fill Stations and Fittings. The water tank can be filled from either side of the locomotive from an external source. The fill point consists of a box with a protected cover containing a hose fitting.

1.4.13.1.3 Water Raising Unit. The water raising unit is supplying the pressure required for efficient flushing cycle.

1.4.13.2 Waste Retention System. The waste retention system comprises the equipment described in the following subsections.

1.4.13.2.1 Toilet Assembly. The toilet assembly is designed as a self-contained unit. It comprises a flush control and isolation valve and a flush control unit.

1.4.13.2.2 Waste Tank Assembly. The waste tank has a capacity of 15 gallons, with approximately 6 gallons of retention capacity in the drainage piping system.

1.4.13.2.3 Water Pressurizer. A water pressurizer provides toilet rinsing water at required pressure to the toilet flushing system.

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CHAPTER 2
OPERATING INSTRUCTIONS

SECTION 2.1
CONTROLS AND INDICATORS

This section describes and explains how to use all the controls and indicators available to the crew for every system in the locomotive.

2.1.1 CARBODY, INTERIOR FIXTURES, OPERATING CAB (Fig. 2-1 to 2-5).
The following control and indicators are located in each cab:

- WIPER (PUSH TO WASH): This switch (Fig. 2-2), activates the wipers. It can be placed in four different positions: INT. (intermittent), OFF, LO, or HI. Washing liquid is sprayed on the windshield when the switch is pushed. The INT. WIPER DELAY knob (Fig. 2-2) controls the wipers delay when the WIPER (PUSH TO WASH) switch is in the INT. position.
- ADJUSTABLE FOOTREST: This switch, below the engineer's center console switch panel (Fig. 2-2), operates the adjustable footrest (up or down).

NOTE:

If the switch is defective, the adjustable footrest can be adjusted manually.

- MIRRORS (PUSH TO RETRACT): This switch (Fig. 2-3), spreads the corresponding mirror out when OUT LEFT or OUT RIGHT is selected. It retracts the mirrors when pushed. The mirrors retract automatically when the locomotive speed reaches 3 mph. When the locomotive is at speed, the mirrors can be extended momentarily by holding the switch in OUT position. When the switch is released, the mirrors retract automatically.

WARNING:

THE LOCOMOTIVE IS BEYOND NORMAL CLEARANCE WHEN THE MIRRORS ARE EXTENDED.

- HORN: These levers (Fig. 2-3 and 2-4), activate the horn. Two sound levels are provided: LOW and HIGH. When the horn is activated, the bell automatically starts ringing and can only be stopped by pressing the BELL pushbutton.

NOTE:

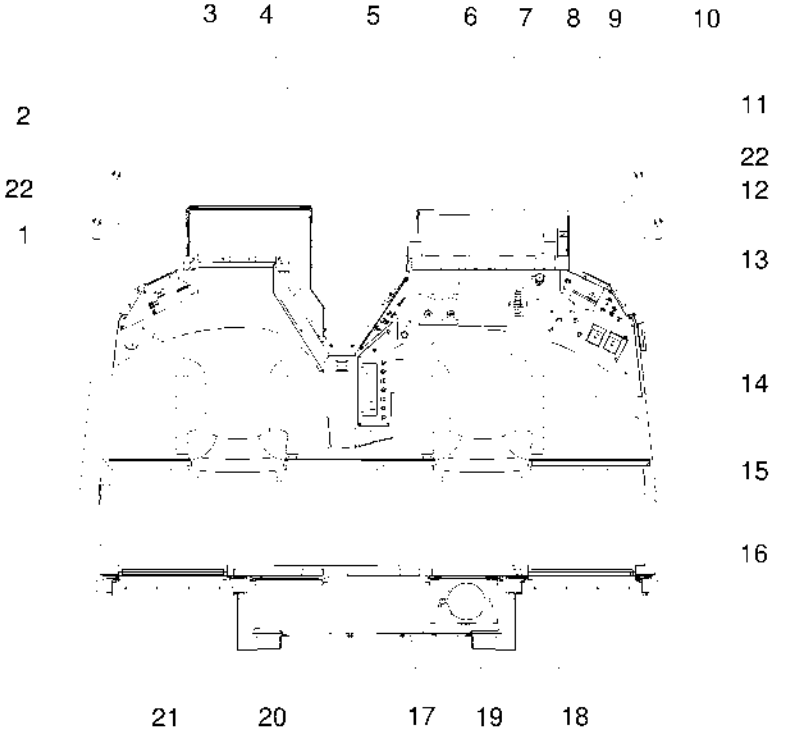
The horn can also be activated by using the horn footswitch if the locomotive speed is 3 mph or more. When the footswitch is pressed down, the horn starts an audible sequence, two long followed by one short and one long. It also starts the bell and flashing ditch lights.

- SAND: This pushbutton (Fig. 2-5) activates sanding. The sand is released as long as the pushbutton is kept pressed.

NOTE:

The SAND pushbutton activates sanding only when the locomotive is at speed.

- BELL: This pushbutton, (Fig. 2-5), activates the bell. When the bell ring is initiated by activation of the horn, the BELL pushbutton has to be pressed to stop the bell.



1. Assistant's Console, with Multifunction Display No. 2 (Fig. 2-36)
2. Assistant's Left Switch Panel (Fig. 2-4)
3. Locomotive Assistant's Headset Station (Fig. 2-19)
4. Engineer's Center Console Switch Panel (Fig. 2-2)
5. Engineer's Left Switch Panel (Fig. 2-15)
6. Reverser (Fig. 2-22)
7. Throttle Lever (Fig. 2-22)
8. Cruise Control Lever (Fig. 2-22)
9. Engineer's Console, with Primary Operating Display (Fig. 2-30) and Multifunction Display No. 1 (Fig. 2-32)
10. Engineer's Overhead Switch Panel (Fig. 2-9)
11. Automatic Brake Control Lever (Fig. 2-24)
12. Independent Brake Control Lever
13. Engineer's Right Switch Panel (Fig. 2-3)
14. Engineer's Desk Right Switch Panel (Fig. 2-5)
15. Adjustable Footrest
16. Engineer's Seat (Fig. 2-62)
17. Remote Control Head (Radio) (Fig. 2-17)
18. Cab Wall, with Cab Rear Wall Switch Panel (Fig. 2-8)
19. Fire Extinguisher
20. Cab Refuge
21. Assistant's Seat (Fig. 2-62)
22. Retractable Mirror

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Figure 2-1
General Cab Layout

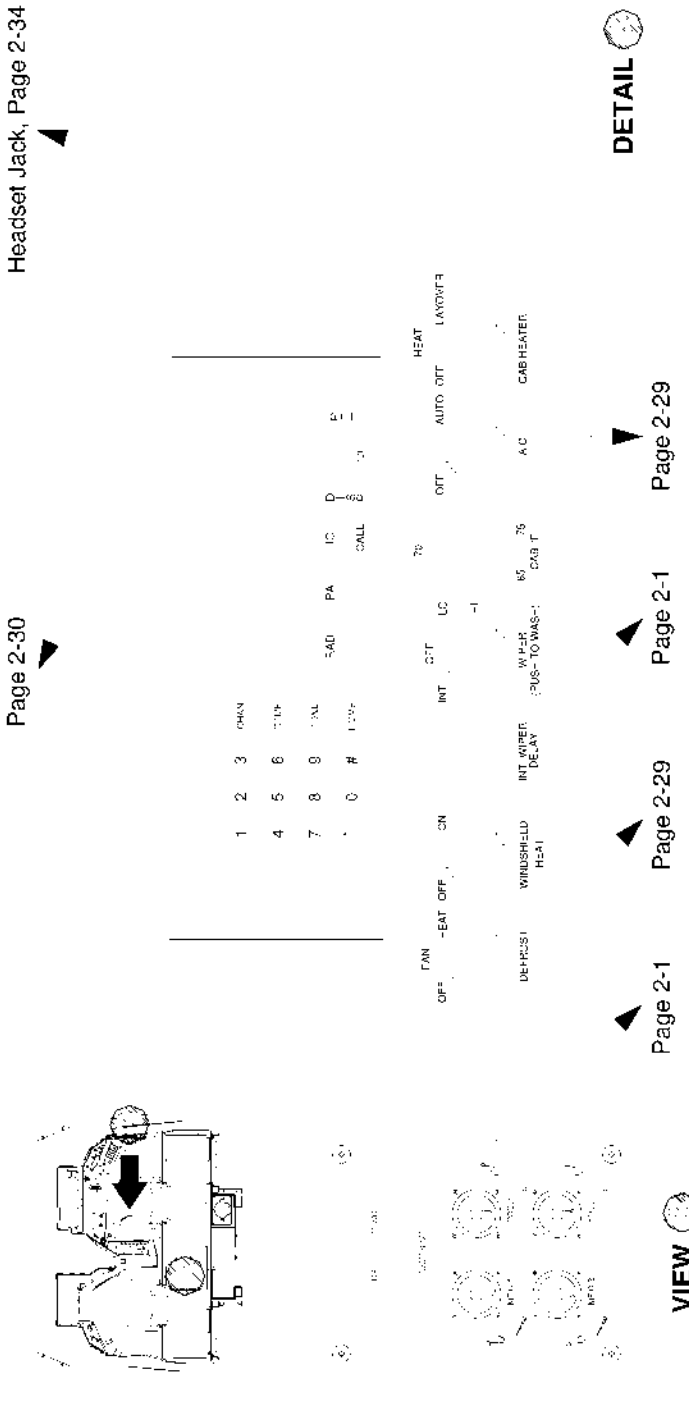

Figure 2-2
Engineer's Center Console Switch Panel and Adjustable Footrest Switch Panel

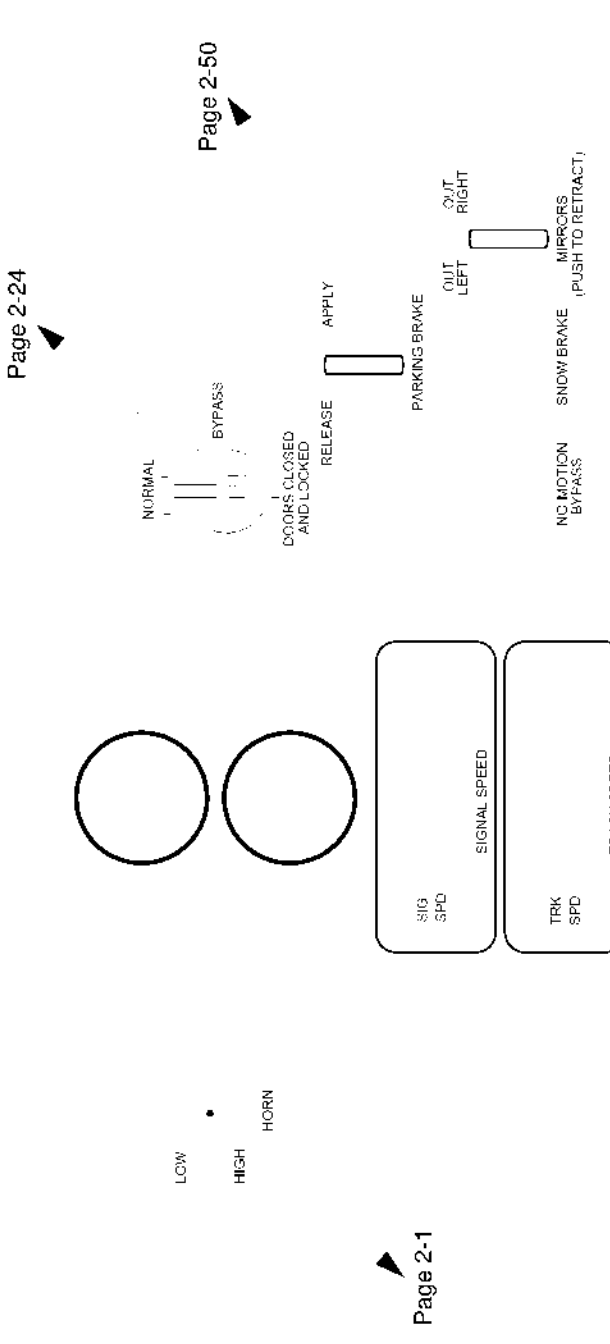

Figure 2-3
Engineer's Right Switch Panel

Figure 2-4
Assistant's Left Switch Panel

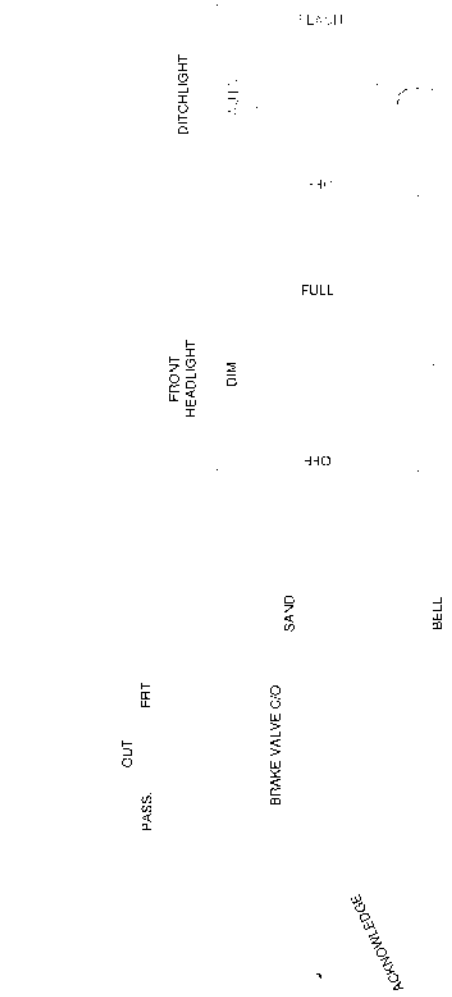

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Figure 2-5
Engineer's Desk Right Switch Panel

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2.1.2 TRUCK AND SUSPENSION. This section lists the main components of the truck assembly and describes the controls and indicators related to the Integrated Truck Surveillance System.

2.1.2.1 Truck Assembly (Fig. 2-6). The main components of the truck are:

- Truck frame
- Parking brake manual override lever
- Wheel-mounted brake disc
- Tread brake unit
- Traction motor (each with its own speed sensor)
- Gear unit (with ATC, or ACSES, and wheelslip/brakes speed sensor)
- Power coupling
- Traction bar assembly.

The figure also shows the location of the service chains and the red lifting chains that are used for lifting the locomotive only.

WARNING:

THE LOCOMOTIVE MUST NOT BE OPERATED WHEN THE RED LIFTING CHAINS ARE INSTALLED. ALWAYS CHECK THAT THE SERVICE CHAINS ARE IN PLACE PRIOR TO LOCOMOTIVE OPERATION.

The only controls available to the operating crew are the parking brake manual override levers located at each corner of the truck. To release the parking brake, each lever is operated as follows:

WARNING:

APPLY WHEEL CHOCKS OR ENSURE THAT THE LOCOMOTIVE IS PROPERLY RESTRAINED PRIOR TO RELEASING THE PARKING BRAKES.

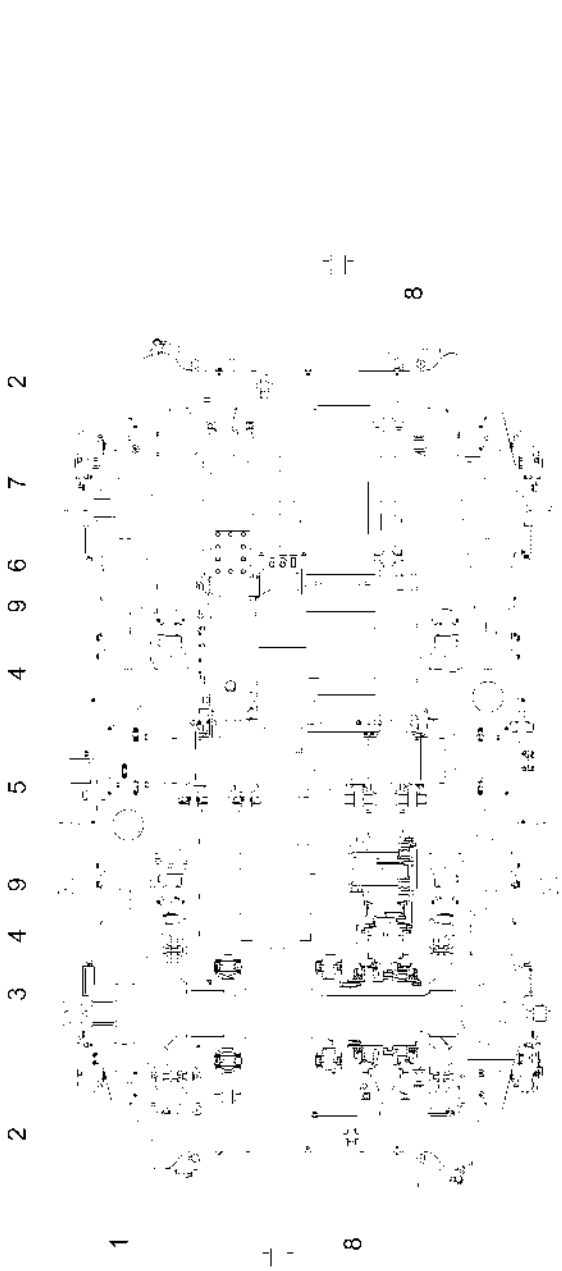
- Rotate the lever back and forth.
- Lock in spring plate.

WARNING:

A FALSE PARKING BRAKE APPLY INDICATION CAN OCCUR IF THE PARKING BRAKE IS APPLIED AND THE TRUCK MOUNTED PARKING BRAKE MANUAL OVERRIDE LEVER IS PULLED.

The various speed sensors mounted on both trucks are as follows:

- The traction motor speed sensors No. 1 to No. 4 are mounted on their respective traction motors.
- ACSES and wheelslip/brakes speed sensors are mounted on the gear units of axles No. 1 and No. 4.
- ATC and wheelslip/brakes speed sensors are mounted on the gear units of axles No. 2 and No. 3.



1. Truck Frame
2. Parking Brake Manual Override Lever
3. Wheel-Mounted Brake Disc
4. Tread Brake Unit
5. Traction Motor, with Speed Sensor
6. Gear Unit, with ATC/Brakes, or ACSES/Brakes Speed Sensor
7. Power Coupling
8. Traction Bar Assembly
9. Service Chain or Lifting Chain (Red)

Figure 2-6
Locomotive Truck Main Components

2.1.2.2 Integrated Truck Surveillance Unit (Fig. 2-7). The following control and indicators are located on the Integrated Truck Surveillance Unit (ITSU), mounted on electrical locker No. 1:

- HOT BEARING: These LEDs operate as follows for each wheel: green, normal operation; flashing red, hot bearing alarm; flashing amber, temperature sensor failure; steady amber, temperature sensor bypassed.

NOTE:

A hot bearing indication occurs when the bearing temperature reaches 212 °F. In case of hot bearing alarm, the proper way to verify the bearing temperature at the wheel is to place the Templstick on the bearing housing towards the end of the truck.

- TRUCK HUNTING: These LEDs operate as follows for each truck: green, normal operation; flashing red, truck hunting; flashing amber, accelerometer failure; steady amber, accelerometer bypassed.
- AIR BAG PRESSURE: These LEDs remain unlit, as there are no air bags on the locomotive trucks.
- CUTOUT Switch: This sealed switch cuts out the ITSU when activated.
- PTE Connector: This connector is used to connect the portable test equipment.
- ALARM: The red SYSTEM LED indicates a system failure. The amber SENSOR LED indicates a sensor failure.
- CIN: These LEDs indicate the Car Internal Network (CIN) port status, UNCONFIGURED in red, and ACTIVE in green.
- SYSTEM: The POWER, READY, and FAILURE LEDs indicate the system status.
- SELF TEST Switch: This pushbutton activates the self-diagnostic test.
- LAMP TEST Switch: This pushbutton activates a lamp test that verifies the proper functioning of all ITSU indicators.
- LOCAL ALARM ACKNOWLEDGMENT: A LED indicates if the system is in a degraded mode of operation (any sensor bypassed).

2.1.2.3 ONBOARD TL Switch (Fig. 2-8). The ONBOARD TL switch, on the cab rear wall switch panel, is used to recover locomotive operation when the ITSU sealed CUTOUT switch fails.

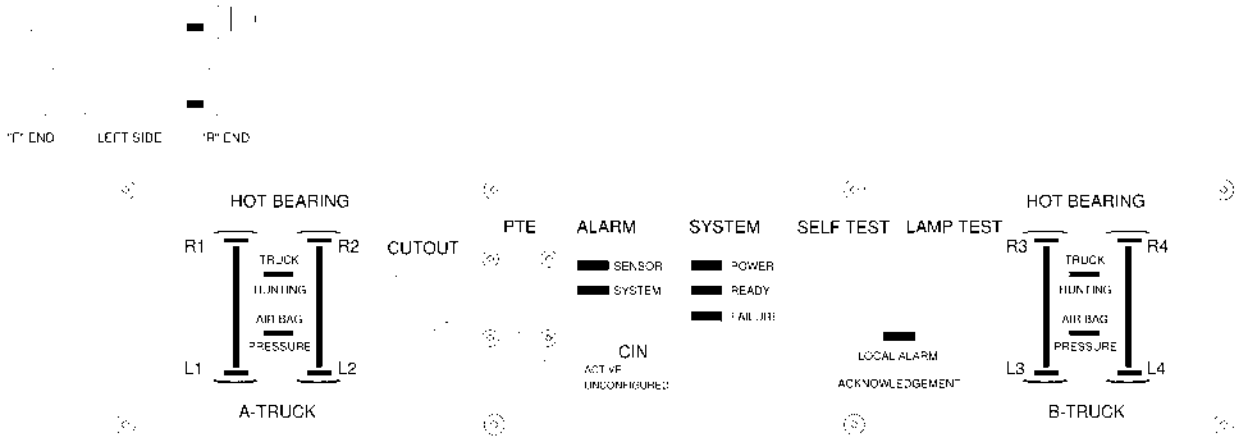
In BYPASS position, the switch deenergizes the on board failure trainline. This turns off the red ONBOARD FAILURE indicator and removes the alarm conditions.

NOTE:

The trainline identification is not related to the 480 Vac HEP trainlines.

2.1.2.4 ONBOARD FAILURE Indicator (Fig. 2-9). The ONBOARD FAILURE indicator, on the engineer's overhead switch panel, is a red indicator topped by a green indicator. These indicators provide the following information:

The red indicator turns on when a hot bearing, truck hunting, or fire is detected. The green indicator is on when there are no onboard failures. It must always be on in normal operating conditions.



HOT BEARING and TRUCK HUNTING LEDs: Green, normal operation; flashing red, hot bearing alarm; flashing amber, sensor failure; steady amber, sensor bypassed.

ALARM amber SENSOR LED indicates sensor failure, red SYSTEM LED indicates system failure.

CIN green ACTIVE LED and red UNCONFIGURED LED indicate Car Internal Network (CIN) port status.

SYSTEM POWER, READY, and FAILURE LEDs indicate system status.

LOCAL ALARM ACKNOWLEDGMENT LED indicates if system is in degraded mode of operation (any sensor bypassed).

NOTE:

To bypass a defective sensor, press simultaneously on the ITSU SELF TEST and LAMP TEST buttons. In case of multiple sensor failures, one activation of the degraded mode bypasses each defective sensor.

To cut out the ITSU, use the sealed CUTOUT Switch. If the ITSU sealed CUTOUT switch fails, use the ONBOARD TL switch (cab rear wall switch panel) to recover locomotive operation.

Figure 2-7
Integrated Truck Surveillance Unit

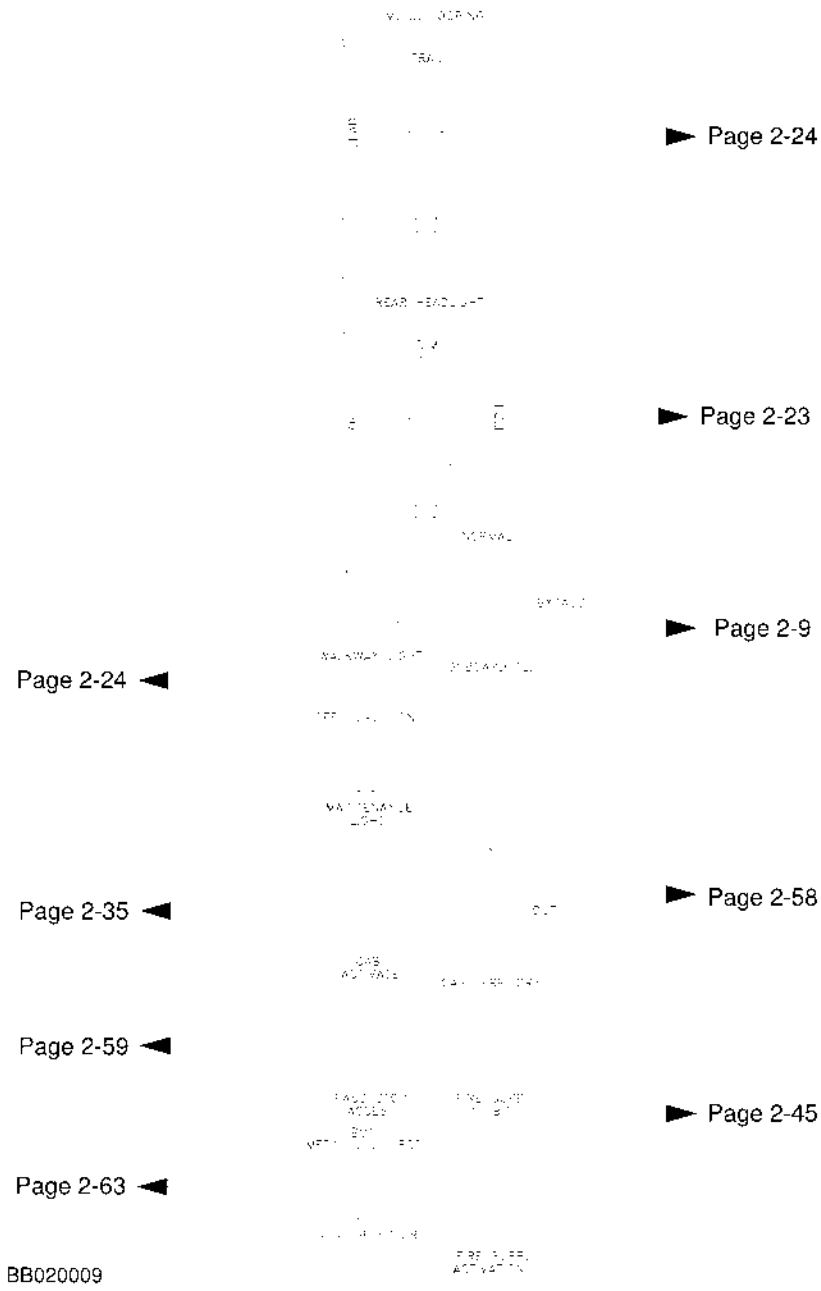


Figure 2-8
Cab Rear Wall Switch Panel

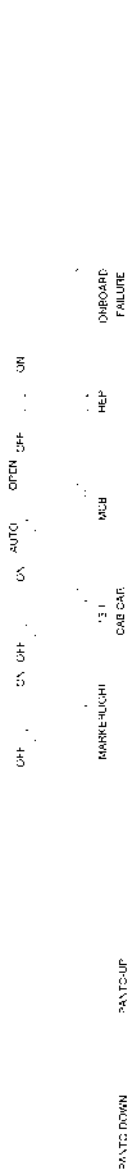


Figure 2-9
Engineer's Overhead Switch Panel

2.1.3 COUPLER (Fig. 2-10). The only controls and indicators available on the coupler are the telescopic uncoupling mechanism (cutting lever), and the shear indicators shown on figure 2-10 "Locomotive Coupler Main Components." The proper operation of the coupler is verified with the telltale recess shown on figure 2-63 "Properly Locked Coupler and Mechanical Head Exploded View." The coupler is attached to the locomotive by a bolted anchor. A shear ring release system is incorporated into the anchor. In the event of an overspeed coupling, the buffer bottoms out and the force in the coupler assembly increases. If the buff force is too high, the shear ring (holding the bracket and its support collar) fails, allowing the coupler assembly to move inboard through the anchor. The two red shear indication screws are then sheared off to indicate the deformation.

CAUTION:

The locomotive must coast into the mating vehicle during couple maneuver. Failure to do so may damage equipment. Couple at speed of 2.5 mph ± 1 mph. The speed limit must be adhered to in order to prevent damage to the equipment.

2.1.4 ELECTRICAL DISTRIBUTION SYSTEM (Fig. 2-11 to 2-13). This section lists all the circuit breakers that protect various systems and system functions on the locomotive. The section includes a description of the 120 Vac receptacles.

2.1.4.1 480 Vac Circuit Breakers (Fig. 2-11 and 2-12).

2.1.4.1.1 Electrical Distribution System Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB31	Battery Charger No. 1	Auxiliary Block
CB32	Battery Charger No. 2	Auxiliary Block
CB33	480/120 Vac Transformer	Auxiliary Block

2.1.4.1.2 HVAC Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB21	HVAC Unit "F" End	Auxiliary Block
CB22	HVAC Unit "R" End	Auxiliary Block
CB23	Toilet and Cab Heaters "F" End	Auxiliary Block
CB24	Cab Heaters "R" End	Auxiliary Block
CB25	Windshield Heater and Defogger "F" End	Auxiliary Block
CB26	Windshield Heater and Defogger "R" End	Auxiliary Block
CB34	Lower Drain Heater (For Future Use)	Auxiliary Block

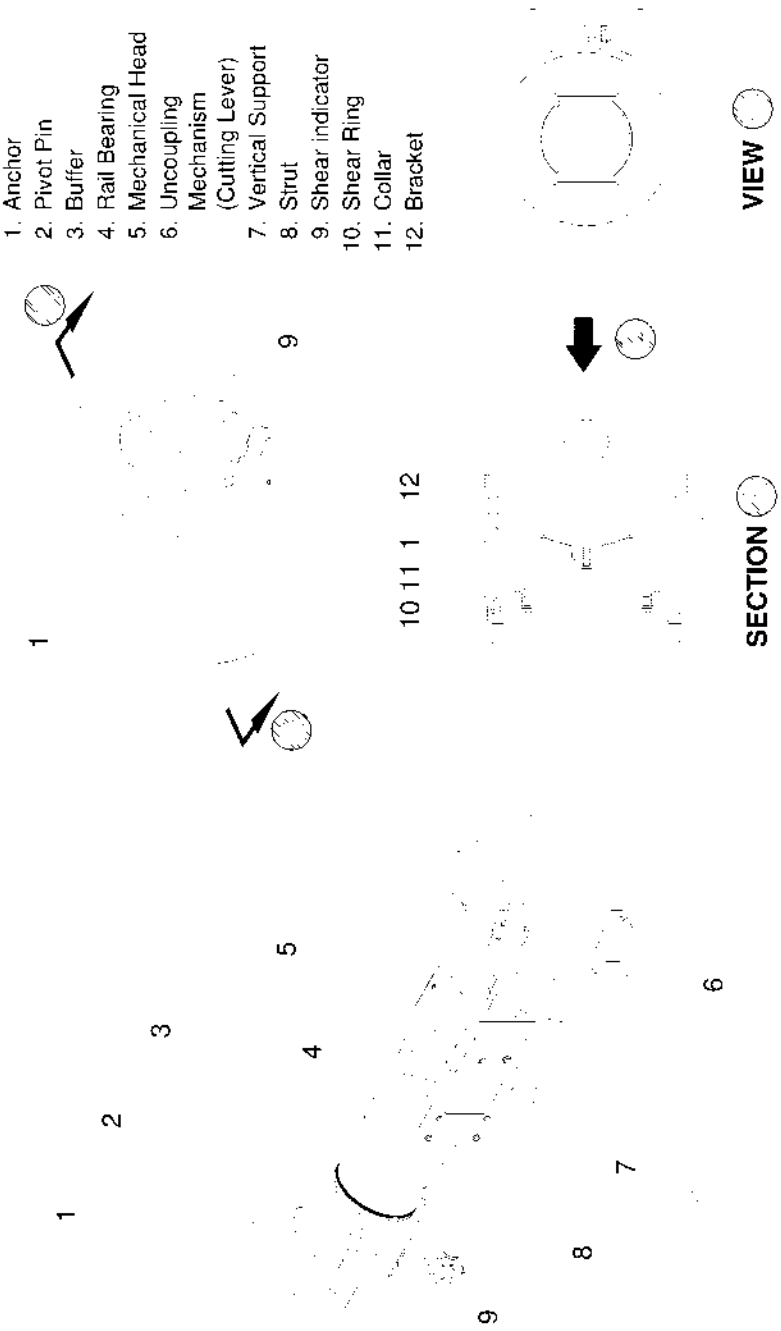
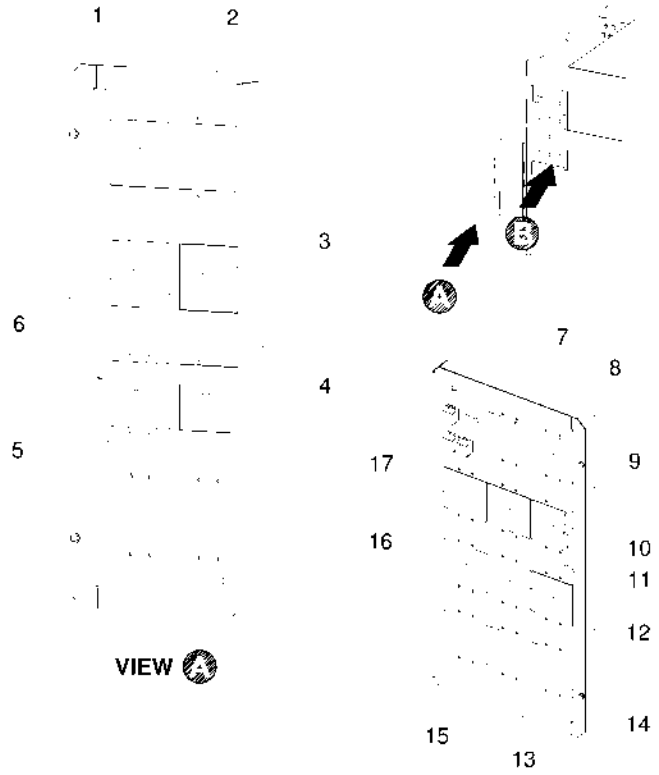
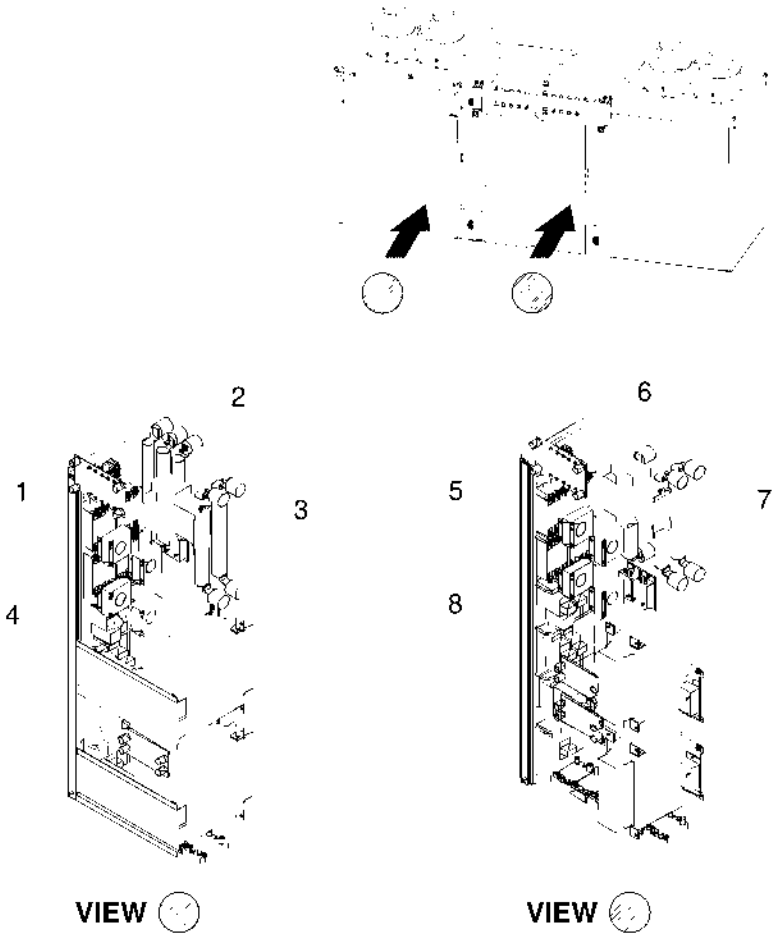


Figure 2-10
Locomotive Coupler Main Components



1. CB13, Main Transformer Oil Pump No. 1 (CB-M-OP-1)
2. CB14, Main Transformer Oil Pump No. 2 (CB-M-OP-2)
3. CB33, 480/120 Vac Transformer (CB-T-120)
4. CB34, Lower Drain Heater (Provision for Future use) (CB-HUE-1)
5. CB7, Auxiliary Block Blower (CB-MF-PCS-5)
6. CB12, Auxiliary Block Water Pump (CB-M-WP-3)
7. CB8, Traction Motor No. 1 and No. 2 Blowers (CB-MF-MTT-1)
8. CB9, Traction Motor No. 3 and No. 4 Blowers (CB-MF-MTT-2)
9. CB24, Cab Heaters "R" End (CB-CH-R)
10. CB25, Windshield Heater and Defogger "F" End (CB-HUE-F)
11. CB22, HVAC Unit "R" End (CB-HVAC-R)
12. CB26, Windshield Heater and Defogger "R" End (CB-HUE-R)
13. CB31, Battery Charger No. 1 (CB-BA-CH-1)
14. CB32, Battery Charger No. 2 (CB-BA-CH-2)
15. CB30, Master Air Compressor (CB-M-CP)
16. CB21, HVAC Unit "F" End (CB-HVAC-F)
17. CB23, Toilet and Cab Heaters "F" End (CB-CH-TH-F)

Figure 2-11
Auxiliary Block Circuit Breaker Panel



1. CB1, Rheostatic and Main Transformer Blower No. 1 (CB-MF-MT-1)
2. CB11, Motor Block Water Pump No. 2 (CB-M-WP-2)
3. CB3, Motor Block Blower No. 1 (CB-MF-PCS-1)
4. CB4, Motor Block Blower No. 2 (CB-MF-PCS-2)
5. CB2, Rheostatic and Main Transformer Blower No. 2 (CB-MF-MT-2)
6. CB10, Motor Block Water Pump No. 1 (CB-M-WP-1)
7. CB5, Motor Block Blower No. 3 (CB-MF-PCS-3)
8. CB6, Motor Block Blower No. 4 (CB-MF-PCS-4)

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Figure 2-12
Central Block Circuit Breakers

2.1.4.1.3 Propulsion and Electric Braking Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB1	Rheostatic and Main Transformer Blower No. 1	Central Block
CB2	Rheostatic and Main Transformer Blower No. 2	Central Block
CB3	Motor Block Blower No. 1	Central Block
CB4	Motor Block Blower No. 2	Central Block
CB5	Motor Block Blower No. 3	Central Block
CB6	Motor Block Blower No. 4	Central Block
CB7	Auxiliary Block Blower	Auxiliary Block
CB8	Traction Motor No. 1 and No. 2 Blowers	Auxiliary Block
CB9	Traction Motor No. 3 and No. 4 Blowers	Auxiliary Block
CB10	Motor Block Water Pump No. 1	Central Block
CB11	Motor Block Water Pump No. 2	Central Block
CB12	Auxiliary Block Water Pump	Auxiliary Block
CB13	Main Transformer Oil Pump No. 1	Auxiliary Block
CB14	Main Transformer Oil Pump No. 2	Auxiliary Block

2.1.4.1.4 Friction Brake Equipment Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB30	Master Air Compressor	Auxiliary Block

2.1.4.2 120 Vac Circuit Breakers (Fig. 2-13).

2.1.4.2.1 Operating Cab Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB42	Refrigerator	120 Vac CB Panel
CB45	Foot Platform	120 Vac CB Panel

2.1.4.2.2 Electrical Distribution System Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB46	120 Vac Receptacles	120 Vac CB Panel

2.1.4.2.3 Lighting and Indicators Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB47	Maintenance Lighting	120 Vac CB Panel

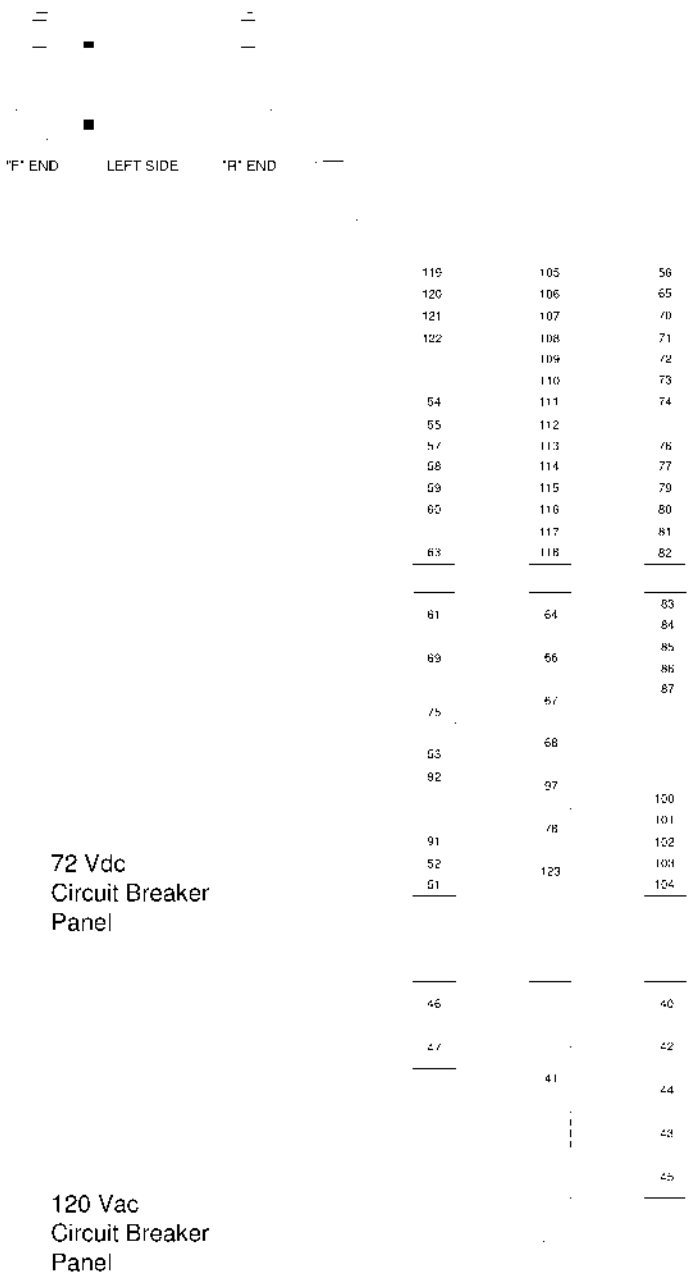


Figure 2-13
72 Vdc and 120 Vac Circuit Breaker Panels - Electrical Locker No. 3

Legend for Figure 2-13

120 Vac CIRCUIT BREAKER PANEL

CB NO.	SYSTEM	CB NO.	SYSTEM
CB40	HVAC Control	CB44	Defroster and Defogger Controls
CB41	Freeze Protection	CB45	Foot Platform
CB42	Refrigerator	CB46	120 Vac Receptacles
CB43	Waste Collection and Retention	CB47	Maintenance Lighting

72 Vdc CIRCUIT BREAKER PANEL

CB NO.	SYSTEM	CB NO.	SYSTEM
CB51	Aux. Air Compressor & Control Rear Panto	CB84	Multifunction Displays No. 1
CB52	Access Lighting	CB85	Multifunction Displays No. 2
CB53	Local Control	CB86	Printers
CB54	Cab Control F End	CB87	DMS/Data Radio
CB55	Cab Control R End	CB91	Snow Brake/Parking/Sanding
CB56	General Control	CB92	Diesel Engine Run
CB57	Cab Lighting	CB97	ACSES Cutout
CB58	Walkway Lights	CB100	AGATE Control 1
CB59	Marker Lights	CB101	AGATE Control 2
CB60	Headlights	CB102	AGATE Control 3
CB61	Alerter Event Recorder	CB103	AGATE Control 4
CB63	Communication Control/Radio	CB104	AGATE Control 5
CB64	Trainline Controls	CB105	Power Supply Gate Drive System 1
CB65	Temperature Controllers	CB106	Power Supply Gate Drive System 2
CB66	ATC	CB107	Power Supply Gate Drive System 3
CB67	ACSES	CB108	Power Supply Gate Drive System 4
CB68	ADU	CB109	Power Supply Gate Drive System 5
CB69	Speed Sensing	CB110	RIOM 1
CB70	WSCC / IFM	CB111	RIOM 2
CB71	BCC / DNRA	CB112	RIOM 3
CB72	Pneumatic Brake	CB113	RIOM 4
CB73	Air Supply Unit Control	CB114	RIOM 5
CB74	EP Assist	CB115	RIOM 6
CB75	EP3	CB116	MPU1
CB76	Ditch Lights	CB117	MPU2
CB77	Integrated Truck Surveillance	CB118	I / O MPU1
CB78	EMI Limit Detection	CB119	I / O MPU2
CB79	Toilet Control	CB120	Fire Suppression System
CB80	Car Monitoring Unit	CB121	Control Tap Changer
CB81	Monitoring Input / Output	CB122	Control Pantograph Front
CB82	CIN Router	CB123	HEP Controls and Contactors
CB83	Primary Operating Displays		

2.1.4.2.4 HVAC Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB40	HVAC Control	120 Vac CB Panel
CB41	Freeze Protection	120 Vac CB Panel
CB44	Defroster and Defogger Controls	120 Vac CB Panel

2.1.4.2.5 Water and Waste Retention Systems Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB43	Waste Collection and Retention	120 Vac CB Panel

2.1.4.3 72 Vdc Circuit Breakers (Fig. 2-13).

2.1.4.3.1 Electrical Distribution System Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB50	72 Vdc Battery Main Breaker	Battery Box
CB123	HEP Controls and Contactors	72 Vdc CB Panel

2.1.4.3.2 Lighting and Indicators Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB52	Access Lighting	72 Vdc CB Panel
CB57	Cab Lighting	72 Vdc CB Panel
CB58	Walkway Lights	72 Vdc CB Panel
CB59	Marker Lights	72 Vdc CB Panel
CB60	Headlights	72 Vdc CB Panel
CB76	Ditch Light	72 Vdc CB Panel

2.1.4.3.3 HVAC Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB65	Temperature Controllers	72 Vdc CB Panel

2.1.4.3.4 Communication Systems Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB63	Communication Control/Radio	72 Vdc CB Panel

2.1.4.3.5 Propulsion and Electric Braking Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB51	Auxiliary Air Compressor and Control Rear Panto	72 Vdc CB Panel
CB53	Local Control	72 Vdc CB Panel
CB54	Cab Control F End	72 Vdc CB Panel
CB55	Cab Control R End	72 Vdc CB Panel
CB56	General Control	72 Vdc CB Panel
CB64	Trainline Controls	72 Vdc CB Panel
CB92	Diesel Engine Run	72 Vdc CB Panel
CB100	AGATE Control 1	72 Vdc CB Panel
CB101	AGATE Control 2	72 Vdc CB Panel
CB102	AGATE Control 3	72 Vdc CB Panel
CB103	AGATE Control 4	72 Vdc CB Panel
CB104	AGATE Control 5	72 Vdc CB Panel
CB105	Power Supply Gate Drive System 1	72 Vdc CB Panel
CB106	Power Supply Gate Drive System 2	72 Vdc CB Panel
CB107	Power Supply Gate Drive System 3	72 Vdc CB Panel
CB108	Power Supply Gate Drive System 4	72 Vdc CB Panel
CB109	Power Supply Gate Drive System 5	72 Vdc CB Panel
CB110	RIOM 1	72 Vdc CB Panel
CB111	RIOM 2	72 Vdc CB Panel
CB112	RIOM 3	72 Vdc CB Panel
CB113	RIOM 4	72 Vdc CB Panel
CB114	RIOM 5	72 Vdc CB Panel
CB115	RIOM 6	72 Vdc CB Panel
CB116	MPU1	72 Vdc CB Panel
CB117	MPU2	72 Vdc CB Panel
CB118	I / O MPU1	72 Vdc CB Panel
CB119	I / O MPU2	72 Vdc CB Panel
CB120	Fire Suppression System	72 Vdc CB Panel
CB121	Control Tap Changer	72 Vdc CB Panel
CB122	Control Pantograph Front	72 Vdc CB Panel

2.1.4.3.6 Friction Brake Equipment Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB70	WSCC / IFM	72 Vdc CB Panel
CB71	BCC / DNRA	72 Vdc CB Panel
CB72	Pneumatic Brake	72 Vdc CB Panel
CB73	Air Supply Unit Control	72 Vdc CB Panel
CB74	EP Assist	72 Vdc CB Panel
CB75	EP3	72 Vdc CB Panel
CB91	Snow Brake/Parking Brake/Sanding	72 Vdc CB Panel

2.1.4.3.7 Cab Signal and Automatic Train Control Systems Circuit Breakers - Safety Related Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB61	Alerter Event Recorder	72 Vdc CB Panel
CB66	ATC	72 Vdc CB Panel
CB67	ACSES	72 Vdc CB Panel
CB68	ADU	72 Vdc CB Panel
CB69	Speed Sensing	72 Vdc CB Panel
CB77	Integrated Truck Surveillance	72 Vdc CB Panel
CB78	EMI Limit Detection	72 Vdc CB Panel

2.1.4.3.8 Train Monitoring and Data Management Systems Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB80	Car Monitoring Unit	72 Vdc CB Panel
CB81	Monitoring Input / Output	72 Vdc CB Panel
CB82	CIN Router	72 Vdc CB Panel
CB83	Primary Operating Displays	72 Vdc CB Panel
CB84	Multifunction Displays No. 1	72 Vdc CB Panel
CB85	Multifunction Displays No. 2	72 Vdc CB Panel
CB86	Printers	72 Vdc CB Panel
CB87	DMS/Data Radios	72 Vdc CB Panel

2.1.4.3.9 Water and Waste Retention Systems Circuit Breakers.

CIRCUIT BREAKER	FEEDS AND PROTECTS	LOCATION
CB79	Toilet Control	72 Vdc CB Panel

2.1.4.4 120 Vac Receptacles. The 120 Vac receptacles located on each side of the locomotive power the 120 Vac outlets within the cabs (except the refrigerator outlets), the 120 Vac outlets in the equipment room, and the maintenance lights.

2.1.5 LIGHTING AND INDICATORS. The following subsections describe the exterior and interior lighting controls and indicators.

2.1.5.1 Access Lighting (Fig. 2-5). The access lighting, including ground lights and all incandescent lights (near door entrances and in the cab ceiling) is controlled by the following switches:

- Exterior switches, near the ladders,
- Interior switches, near the door entrances,
- CAB CEILING LIGHT switches (engineer's left switch panels), in EXIT position.

All these switches turn on, for one minute, all the access lighting.

2.1.5.2 Headlights (Fig. 2-5 and 2-8). There are two headlight switches in each cab, FRONT HEADLIGHT on the engineer's desk right switch panel, and REAR HEADLIGHT on the cab rear wall switch panel. The front headlight switch turns on the front headlights in DIM or FULL position. The rear headlight switch turns on the rear headlights in DIM or FULL position.

NOTE:
When the M.U. LOOPING switch is in TRAIL position, the cab headlights are not functional. Place the switch in TRAIL position in both coupled cabs in multiple unit operation. Leave the M.U. LOOPING switch in LEAD position in any cab not coupled to another cab.

2.1.5.3 Ditch Lights (Fig. 2-5). The ditch lights are controlled by the DITCH LIGHT switch on the engineer's desk right switch panel. They operate only when the headlights are on in FULL position, when the FRONT HEADLIGHT switch is in DIM position, the ditch lights are inoperative. The switch positions allow the following modes of operation:

- ON: Ditch lights continuously operative.
- AUTO: Ditch lights flash alternately when the horn is blown (by footswitch or hand switch). They continue to flash until the bell is silenced with the BELL button on the engineer's desk right switch panel, or until the switch is set to OFF.
- FLASH: Ditch lights flash alternately.
- OFF: Ditch lights inoperative.

2.1.5.4 M.U. Looping Switch (Fig. 2-8 and 2-14). The M.U. LOOPING switch on the cab rear wall switch panel activates the front headlights in LEAD position. In TRAIL position, the cab headlights are not functional.

To enable multiple unit operation of two HHP-8 (HSEL) locomotives, the M.U. LOOPING switch must be set on TRAIL position in both coupled cabs.

2.1.5.5 Marker Lights (Fig. 2-9). The MARKER LIGHT switch on the engineer's overhead switch panel turns on the marker lights when set to ON.

2.1.5.6 Exterior Ground Lights. The exterior ground lights are turned on for a one-minute period when any of the following switches is activated:

- Exterior switches, near the ladders,
- Interior switches, near the door entrances,
- CAB CEILING LIGHT switches (engineer's left switch panels), in EXIT position.

2.1.5.7 Cab Ceiling Lights (Fig. 2-15). The CAB CEILING LIGHT switch on the engineer's left switch panel turns on the cab ceiling lights when set to ON. In EXIT position, the access lights listed above turn on for one minute.

2.1.5.8 Timetable and Console Lights (Fig. 2-4 and 2-15). The TIMETABLE switches on the engineer's left switch panel and the assistant's left switch panel turn on their respective timetable light when set to ON.

The CONSOLE DIMMER switch on the engineer's left switch panel controls the intensity of console lighting.

2.1.5.9 Cab Step Light. The cab step light is operative in all modes.

2.1.5.10 Walkway Lights (Fig. 2-8). The WALKWAY LIGHT switch on the cab rear wall switch panel turns on the walkway lights in alternate position.

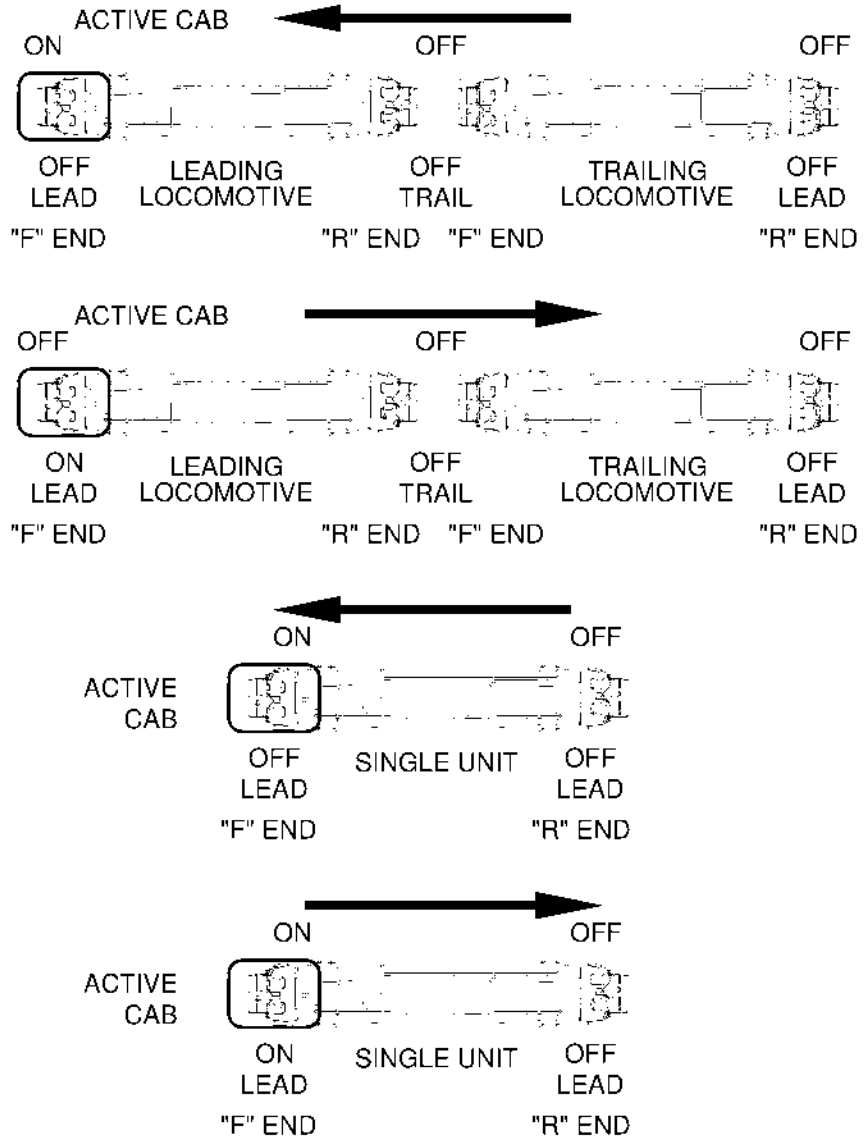
2.1.5.11 Maintenance Lights (Fig. 2-8). The MAINTENANCE LIGHT switch on the cab rear wall switch panel turns on the maintenance lights and the cab ceiling lights for one hour when set to the alternate position.

2.1.5.12 Toilet Light. A toilet timer switch, located on the toilet wall, turns on the toilet light and activates the toilet exhaust fan for ten minutes when activated.

2.1.6 DOORS, DOOR CONTROL AND SIGNAL SYSTEM (Fig. 2-3). The status of all the doors in the train consist is indicated on the Multifunction Display No. 1 (MFD1). When all the doors are effectively closed, the "CLOSED&LOCKED" indicator of the train status section is highlighted in green. When any door in the consist is open, the gray indicator is not illuminated. A wrong "Doors Closed and Locked" signal from a car causes a loss of traction power. This signal can be bypassed by setting the DOORS CLOSED AND LOCKED sealed switch on the engineer's right switch panel to the BYPASS position to recover normal operation.

NOTE:

The DOORS CLOSED AND LOCKED switch is sealed.



NOTE:

When the M.U. LOOPING switch is in TRAIL position, the cab headlights are not functional.

Place the switch in TRAIL position in both coupled cabs in multiple unit operation.

Leave the M.U. LOOPING switch in LEAD position in any cab not coupled to another cab.

Figure 2-14
Multiple Unit Operation

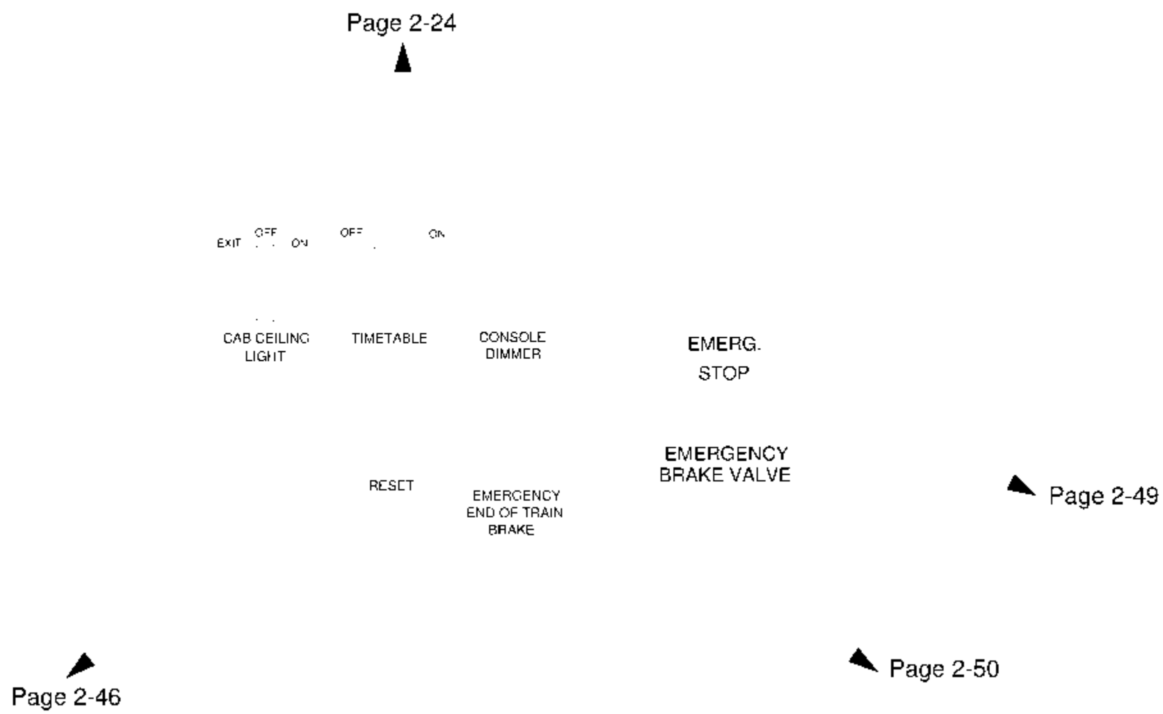


Figure 2-15
Engineer's Left Switch Panel

2.1.7 HEATING, VENTILATION, AND AIR CONDITIONING. The following subsections describe the Heating, Ventilation, and Air Conditioning (HVAC) system controls and indicators.

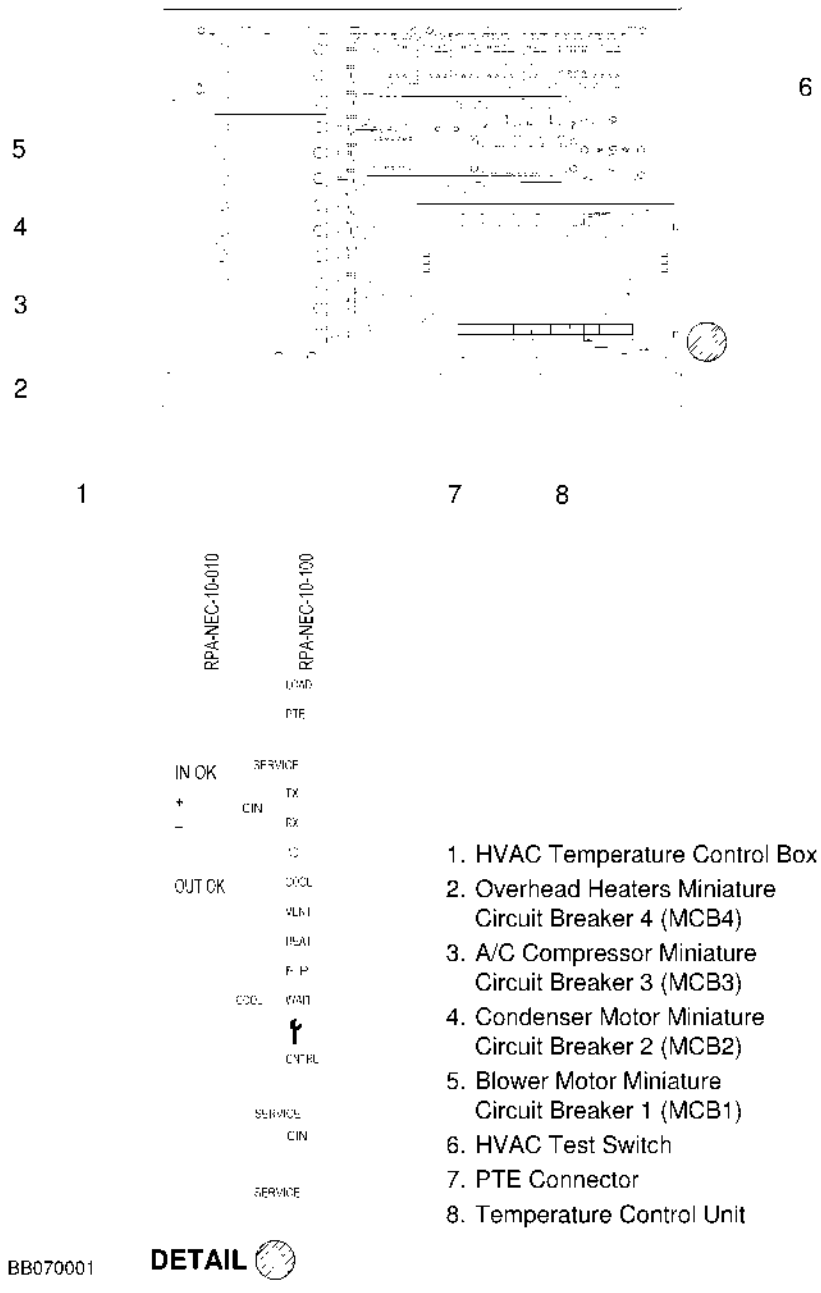
2.1.7.1 Temperature Control Unit (Fig. 2-16). Each locomotive cab HVAC is controlled by a dedicated temperature control unit (TCU) located inside the HVAC Unit. The TCU, energized whenever the 120 Vac is available in the locomotive, controls all the subsystems in the HVAC system.

The TCU is equipped with LEDs that provide indications on the HVAC system operation. The following LEDs provide the most important indications to enable a quick diagnostic of the system status:

LOAD:	Green, on when the TCU outputs are enabled.
CNTRL:	Red, on when the Central Processing Unit (CPU) requires service.
TX:	Yellow, on when the TCU transmits to the car internal network.
RX:	Yellow, changes state periodically (5 seconds). Steady state indicates TCU not communicating with the monitoring system.
COOL:	Green, on in air conditioning mode.
VENT:	Green, on in ventilation mode.
HEAT:	Green, on in layover or in heating mode.
F.P.:	Green, on when the freeze protection is activated.
COOL WAIT:	Red, on when the compressor is inhibited.
MAINT:	Red, on when the TCU or HVAC is in an abnormal condition.
CIN:	Red, on when the network interface requires servicing.
72 Vac:	Green, on when the TCU is receiving 72 Vac.
120 Vac:	Green, on when the TCU is receiving 120 Vac.
IN:	Green, on when input power is in range.
OUT:	Green, on when output power is in range.

2.1.7.2 A/C Switch. The A/C switch, on the engineer's center console switch panel, controls the air conditioning in the cab. Switch settings are as follows:

- OFF: The air conditioning unit is not operational and no air conditioning, blower and overhead heating is available. Cab heaters are functional if the cab heater switch is set to HEAT.
- AUTO: All functions can operate, depending on other switches positions and ambient and return air temperatures. The HVAC test switch must be set to AUTO. Cab heaters are also functional if the cab heater switch is set to HEAT.



1. HVAC Temperature Control Box
2. Overhead Heaters Miniature Circuit Breaker 4 (MCB4)
3. A/C Compressor Miniature Circuit Breaker 3 (MCB3)
4. Condenser Motor Miniature Circuit Breaker 2 (MCB2)
5. Blower Motor Miniature Circuit Breaker 1 (MCB1)
6. HVAC Test Switch
7. PTE Connector
8. Temperature Control Unit

Figure 2-16
HVAC Temperature Control Box, with Temperature Control Unit

2.1.7.3 CAB HEATER Switch. The CAB HEATER switch, on the engineer's center console switch panel, controls both cab heaters located under the console in the cab side walls. Switch settings are as follows:

- OFF: Cab heaters are not available.
- HEAT: Cab heaters are functional regardless of the A/C test switch position. The return air sensor (located inside the return air grille) controls the operation of cab heaters if the A/C test switch is set to AUTO and the cab heat sensor (on the cab wall) controls the operation of cab heaters if the A/C test switch is set to OFF.
- LAYOVER: The air conditioning unit turns OFF automatically and both cab heaters remains operational to provide an interior temperature of 45 °F.

2.1.7.4 DEFROST Switch. The DEFROST switch, on the engineer's center console switch panel, controls windshield defrosting with the following settings:

- OFF: No defrost available.
- FAN: Fan blows air on the windshield interior side.
- HEAT: Fan blows heater air on the windshield interior side.

2.1.7.5 WINDSHIELD HEAT Switch. The windshield heat switch, on the engineer's center console switch panel, turns the windshield heater on or off.

2.1.7.6 Cab Temperature Selector. The cab temperature selector, labelled CAB °F, on the engineer's center console switch panel, adjusts the cab temperature from 65 °F to 75 °F. It is inoperative if the CAB HEATER and A/C switches are off.

2.1.7.7 HVAC Test Switch (Fig. 2-16). This switch is located inside the HVAC electrical control box, above the TCU. Switch settings are as follows:

- OFF: When set to this position (for maintenance purpose only), no air conditioning is available.
- AUTO: This is the normal position for this switch. The air conditioning unit is enabled.
- TEST: When the switch is held on this position (for maintenance purpose only), both the refrigerant compressor and the condenser fan motor are running. When released, the switch returns automatically to AUTO.

2.1.7.8 Freeze Protection. Freeze protection is controlled automatically by the TCU and enabled whenever the ambient temperature falls below 45 °F.

2.1.7.9 Toilet Thermostat. In the toilet module, the toilet forced air heater is controlled by a local thermostat.

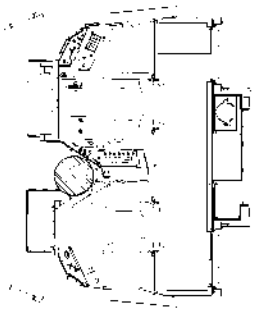
2.1.8 COMMUNICATION SYSTEMS (Fig. 2-17 to 2-19). The communication systems controls and indicators available to the locomotive crew are detailed in the following subsections.

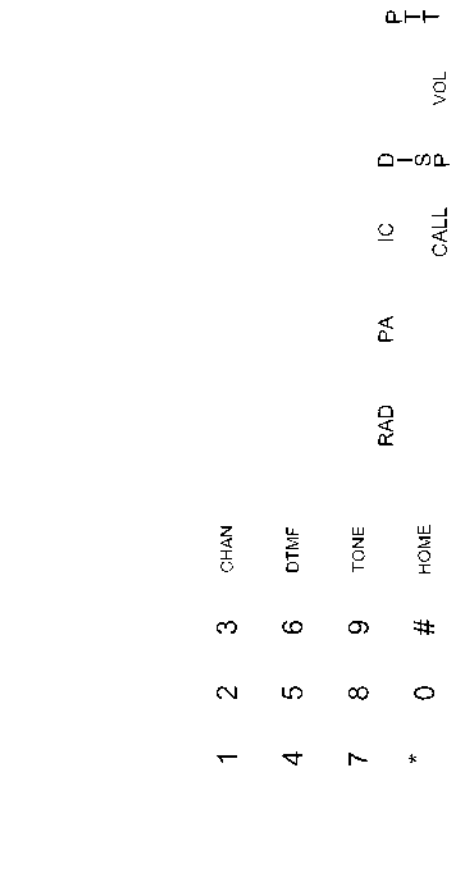
2.1.8.1 Remote Control Head (Fig. 2-17). The remote control head, located on the engineer's center console switch panel, is the radio extension. It includes the following controls and features:

- Numeric keypad: 12-digit (numeric) keypad normally used to transmit DTMF dispatch call tones. Also used to enter channel, home, or tone numbers when in the corresponding select mode.
- CHAN button: Initiates the channel select mode for entry of TX and RX channels from the numeric keypad.
- DTMF button: Initiates the dispatch DTMF select mode to select and transmit a DTMF dispatch tone via the numeric keypad.
- TONE button: Initiates the dispatch tone select mode to select and transmit a singletone dispatch tone via the numeric keypad.
- HOME button: Initiates the home channel select prompt for entry of a programmed home channel from the numeric keypad.
- RAD button: Used to select radio mode of operation.
- PA button: PA mode is not enabled in the locomotive.
- IC button: Used to select IC mode of operation.
- CALL button: IC call feature is not enabled in the locomotive.
- DISP button: Retransmits the preselected tone (DTMF or singletone) indicated in the DISP T/D display.
- VOL control: This rocker switch controls remote control head speaker radio volume level.
- PTT button: When held pressed, enables the remote control head microphone to transmit voice messages.
- Microphone: Used to transmit voice radio messages.
- Speaker: Used for received radio messages only (always enabled)

The remote control head also provides the following indicators and displays:

- TX indicator: Comes on yellow whenever transmission occurs (PTT or dispatch calls).
- VOLUME display: Indicates relative volume level within a 0 (minimum) to 10 (maximum) range.
- DISP T/D display: Indicates the selected dispatch tone ("T" for singletone and "D" for DTMF) with the chosen tone number.
- TX display: Indicates the current transmitter channel selection.
- RX display: Indicates the current receiver channel display.
- HOME display: Indicates the current home channel selection (left blank if no home channel is selected).





Refer to Page 2-30 for Switches Description

Figure 2-17
Remote Control Head

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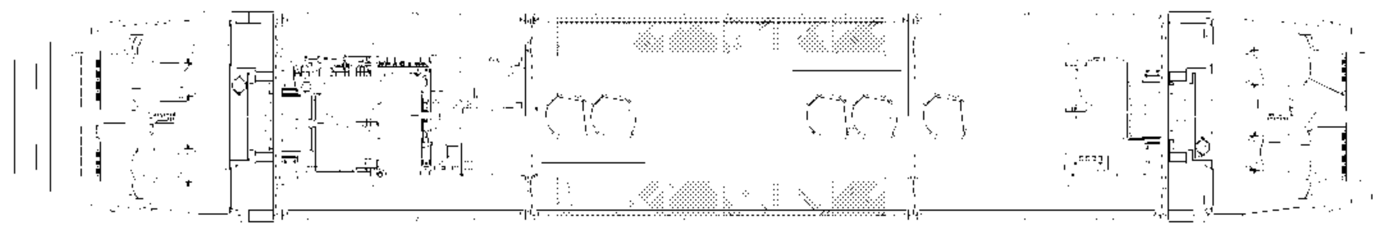
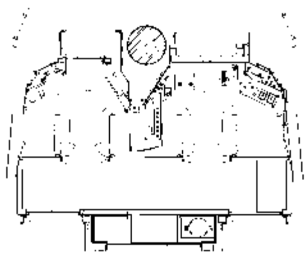


1. Communication Footswitch
2. Remote Control Head
3. Locomotive Engineer Junction Module
4. Remote Station Switch Box
5. Locomotive Radio
6. Remote Station
7. Assistant's Headset Station
8. Cab Speaker
9. Radio Battery Box, Radio Battery Charger
10. Voice Radio Antenna (On the Roof)

Figure 2-18
Communication Systems Component Location



Refer to Page 2-34 for Switches Description

Figure 2-19
Locomotive Assistant's Headset Station

2.1.8.2 Assistant's Headset Station (Fig. 2-19). The assistant's headset station includes the following features:

- Headset jack. Provides a jack access to the assistant's headset.
- PTT button for IC and radio modes of operation
- Microphone for IC and radio modes of operation
- LEDs for mode monitoring
- Volume control knob for the cab speaker.
- Mode selector button for IC and radio modes of operation.

2.1.8.3 Remote Stations. Six remote stations are located in the locomotive equipment room. They allow IC communication between maintenance personnel in the equipment room and crew members in the cab during maintenance activities. Their enclosures provide an access for the headset jack. (See figure 2-18 for the exact locations.)

2.1.8.4 Engineer's Microphone. The engineer's microphone is mounted inside the cab console, between Multifunction Display No. 1 (MFD1) and Primary Operating Display (POD). It is used for IC and radio transmission. It is activated with the communication footswitch.

2.1.8.5 Engineer's Headset Jack. The engineer's headset jack is mounted on the engineer's center console switch panel, to the right of the remote control head, and is used to plug in a headset.

2.1.8.6 Communication Footswitch. The communication footswitch located under the cab console is a PTT used by the engineer for IC and radio mode of operation.

2.1.9 PROPULSION AND ELECTRIC BRAKING. The propulsion and electric braking controls and indicators are detailed in the following subsections.

2.1.9.1 Pantograph Controls (Fig. 2-20 and 2-21). Manual pantograph control is achieved from the cab console in concurrence with the setting on the PANTOGRAPH LOCAL SELECTOR on the propulsion electrical cubicle in the equipment room. The engineer's overhead switch panel PANTO-UP pushbutton switch provides a momentary UP Trainline command. The resulting action is determined by the setting on the PANTOGRAPH LOCAL SELECTOR. The engineer's overhead switch panel two-position PANTO-DOWN pushbutton switch, in the pressed down position, energizes the "pantograph down" trainline. This deenergizes the locomotive pantograph magnet valves. At the end of a manual pantograph control operation involving the DOWN pushbutton, the control system must be reset for reuse. Resetting the manual pantograph control, consists of making sure that the PANTO-DOWN pushbutton is in the pulled up position in both cabs.

NOTE:

The pantograph is raised from the active cab and lowered from either cab whether active or not.

The PANTOGRAPH LOCAL SELECTOR switch settings affect the locomotive pantograph configuration as follows:

- OFF: both pantographs remain down or are lowered.
- FRONT: enables the raising of the locomotive front pantograph regardless of active cab location.
- REAR: enables the raising of the locomotive rear pantograph regardless of active cab location.
- BOTH: enables the raising of both locomotive pantographs regardless of active cab location.

The Main Circuit Breaker (MCB) can close only after the pantograph is raised.

CAUTION:

The locomotive must not be moved from electrified to nonelectrified tracks or from nonelectrified to electrified tracks unless the pantographs are down and grounding switch closed.

NOTE:

The main circuit breaker closes only after the pantograph is raised.

The pantograph local control switch, on the propulsion electrical cubicle, allows rear pantograph raising, when the grounding switch of the four-function unit is activated, to ground the catenary. The use of the access hatch to the roof is not possible when the switch is in GROUND position.

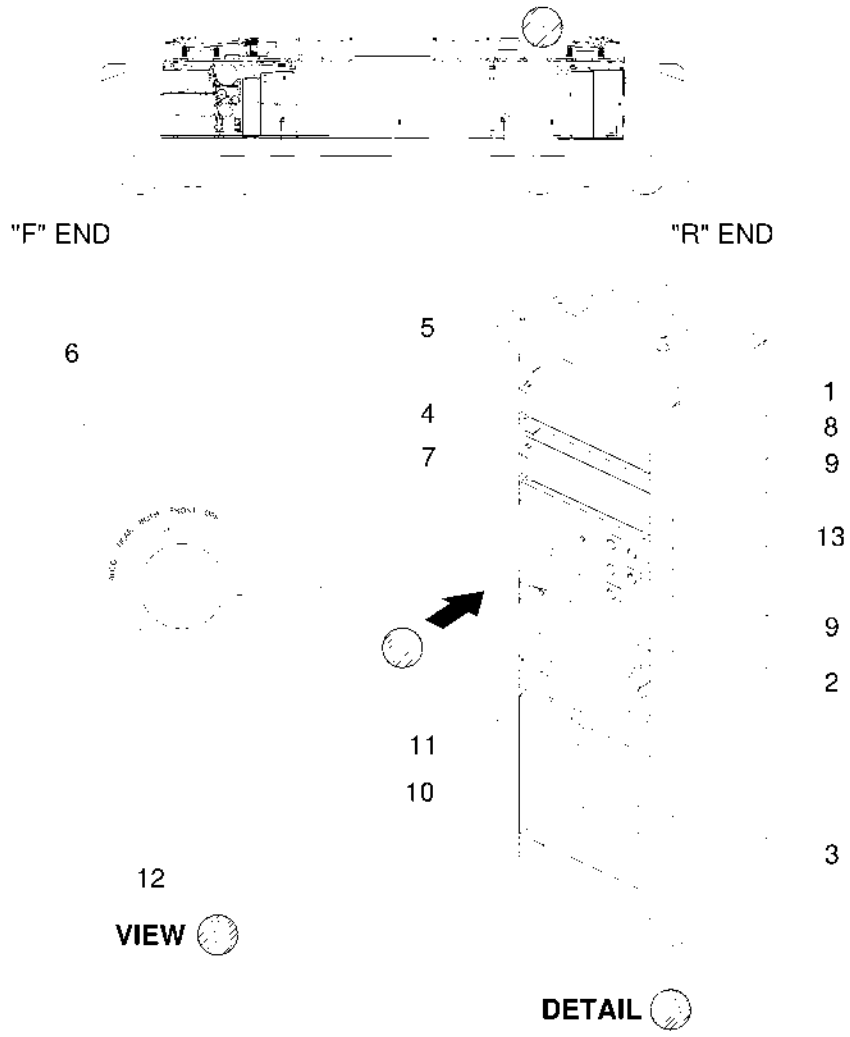
The pantograph pneumatic control panel cutout handles allow the isolation of each pantograph air supply.

2.1.9.2 CAB ACTIVATE button. The CAB ACTIVATE button, on the cab rear wall switch panel, is used to activate the monitoring system, key card reader, propulsion control, and the auxiliary compressor.

2.1.9.3 Key Card Reader. Each cab of the locomotive is equipped with a key card reader that includes a keypad for entering a Personnel Identification Number (PIN). The reader beeps only when a key is pressed and a valid key card has been swiped. The key card must be applied against the reading surface to read the coded data. The data is processed by the monitoring and propulsion systems. The monitoring system logs the data and authorizes different access levels to the monitoring information. The propulsion system authorizes setting the reverser to N (Neutral), FWD (Forward), REV (Reverse), but traction effort depends on the key card authorization level.

The key card reader incorporates two LEDs and a beeper providing the following operation status:

- Green LED: Illuminates steady when the key card reader is ready to accept a key card. It also blinks/beeps for a period to indicate that a valid key card with the appropriate PIN number has been accepted. The LED comes back steady on to indicate that the key card reader is ready to accept another key card.
- Red LED: Normally turned off, it starts blinking/beeping for a period if an invalid PIN number is entered. It stays on if the key card reader is powered but an internal fault is detected.



1. Propulsion Electrical Cubicle
2. Fire Control Unit
3. Trainline Relay Panel
4. Main Processing Unit No. 2 (MPU2)
5. Main Processing Unit No. 1 (MPU1)
6. Pantograph Local Selector
7. Pantograph Local Control Switch
8. Oil Level Detector Bypass Switch
9. PTE Connector
10. Fire Control Unit Bypass Switch
11. Key Card Reader Bypass Switch
12. Pantograph Switch/Key
13. Multiple-Unit HEP Bypass Switch

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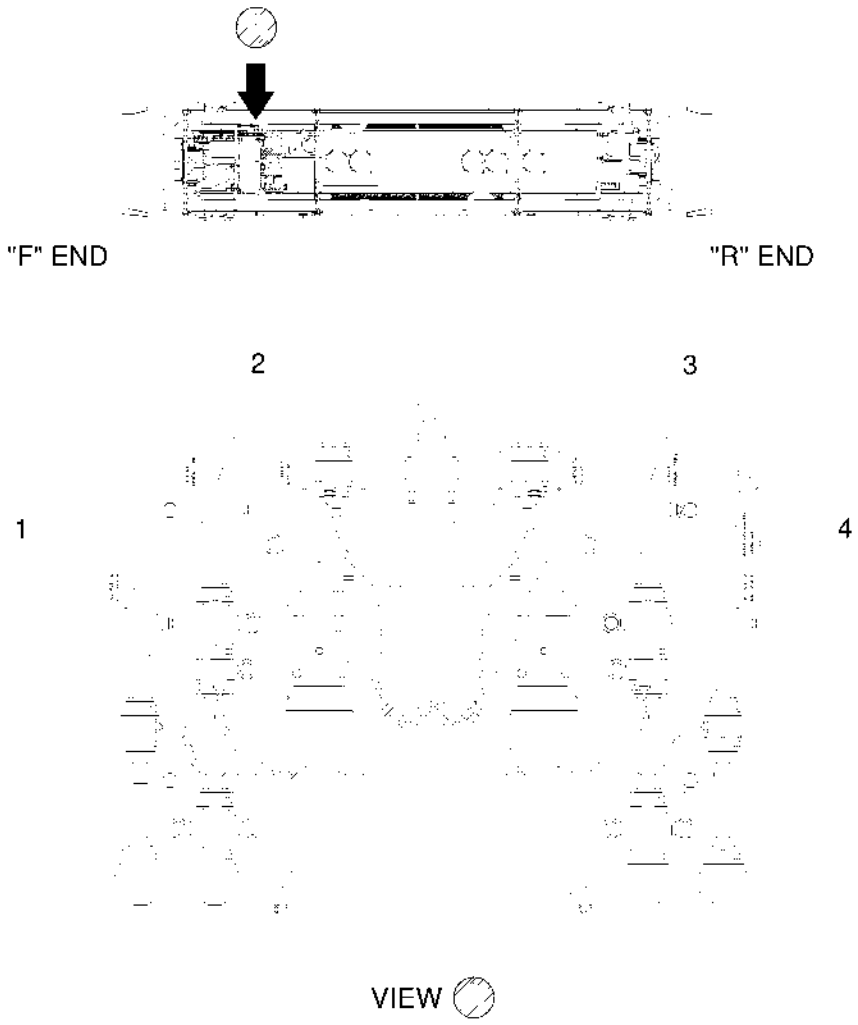
Figure 2-20
Propulsion Electrical Cubicle



1. Rear Pantograph Output to Maximum Reach Cutout Handle
2. Rear Pantograph Output to Carbon Strip Cutout Handle
3. Front Pantograph Output to Maximum Reach Cutout Handle
4. Front Pantograph Output to Carbon Strip Cutout Handle

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Figure 2-21
Pantograph Pneumatic Control Panel

The key card reader gives access to different services in each cab of a train consist. The authorization is limited to the cab where the key card has been entered. The highest level authorized for the local cab is displayed on Multifunction Display No. 1 (MFD1) and Multifunction Display No. 2 (MFD2), and logged (level, user ID, time stamp) by the monitoring system. The different levels of authorization are explained in the following subsections.

2.1.9.3.1 Leading Cab Authorization (Table 2-1). Any valid key card and associated PIN turns on MFD2 screen. Level 1 to 3 access authorizes the reverser setting to the N, FWD, or REV position. When the reverser is set, it enables certain cab equipment and controls. The Primary Operating Display (POD), MFD1, Aspect Display Unit (ADU), and other console indicators turn on as required. It also enables pantograph raising. This action also locks out the opposite cab of the locomotive.

Table 2-1
Leading Cab Access Levels

LEVEL	DESCRIPTION	REVERSER POSITION ALLOWED	MONITORING DISPLAYS
1	Train movement (revenue service) with full access to maintenance data.	FWD, REV, N, OFF	POD, MFD1, MFD2
2	Yard movement with speed limitation by propulsion system; full access to maintenance data.	FWD, REV, N, OFF	POD, MFD1, MFD2
3	Full access to maintenance data, and static motoring test.	FWD, REV, N, OFF	POD, MFD1, MFD2
4	Limited access to maintenance data (manual fault entry).	NONE	MFD2

2.1.9.3.2 Multiple Access Levels. Up to three users per cab may be authorized in the system if the key card being read is followed by its associated PIN. If the key card is read but the PIN is not entered and another key card is presented, the original key card data is discarded, and replaced by data of the second card. After validation of the key card, it is possible to manipulate the reverser only if all reversers are in OFF position. If the opposite cab reverser has been left in another position (condition announced by MFD2), the problem must be corrected first. Correcting the problem automatically unlocks the reverser since the authorization level has already been entered.

NOTE:
If the cab is authorized with the reverser in another position than OFF, and the throttle is in a power position, the throttle must be cycled to "0" and back to power positions to reactivate the propulsion system, and to enable propulsion controls.

2.1.9.3.3 Trailing Cab Authorization (Table 2-2). If a cab has already been selected as leading cab, the key card reader gives access to the monitoring system with MFD2, but the reverser remains locked. In a trailing cab, any valid key cards and associated PIN turn on MFD2, but do not authorize reverser operation. Once MFD2 is illuminated, it remains in this condition until the authorization is logged out.

Table 2-2
Trailing Cab Access Levels

LEVEL	DESCRIPTION	REVERSER POSITION ALLOWED	MONITORING DISPLAYS
1	Full access to maintenance data.	NONE	MFD2
2	Full access to maintenance data.	NONE	MFD2
3	Full access to maintenance data.	NONE	MFD2
4	Limited access to maintenance data (manual fault entry).	NONE	MFD2

2.1.9.3.4 Simultaneous Cab Operation. If the two cabs are occupied in operation, the engineers log their key cards in their respective key card readers, and both reversers are unlocked simultaneously until the first one is set to N, FWD, or REV position. If one cab has the reverser set out of the OFF position, it locks out the opposite cab reverser. When the initial reverser is set back to OFF position, the opposite one becomes unlocked.

Once a cab has been deauthorized (10 seconds after the reverser is moved to OFF), it is necessary to reenter the key card.

WARNING:
IF THE KEY CARD READER BYPASS SWITCH IS ACTUATED, BOTH CAB REVERSERS OF THE LOCOMOTIVE ARE AUTHORIZED SIMULTANEOUSLY.

2.1.9.4 Key Card Reader Bypass Switch. A key card reader sealed bypass switch is located on the propulsion electrical cubicle in the equipment room. This bypass switch must be used only in case of failure of the key card reader preventing cab activation and train operation. This two-position, sealed switch provides a level 1 authorization to both cabs of the locomotive. This condition also causes the illumination of both MFD2 displays. Setting the reverser out of the OFF position results in the illumination of Multifunction Display No. 1 (MFD1), Primary Operating Display (POD), and Aspect Display Unit (ADU), and configures the trainlines. The setting of one reverser to N, FWD, or REV position automatically locks out the opposite cab.

NOTE:

If the key card reader bypass sealed switch is set to BYPASS position while the throttle is in a power position, no power is applied to the traction motors unless the throttle is cycled from "0" to a power position.

2.1.9.5 Main Circuit Breaker Switch (Fig. 2-9). The main circuit breaker is controlled by the MCB switch on the engineer's overhead switch panel. In AUTO position, the switch allows for future automatic reconfiguration of high-power hardware, such as the main transformer primary, when there is catenary nominal voltage transition. The OPEN position allows the manual reconfiguration of high-power hardware by opening the main circuit breaker.

NOTE:

The main circuit breaker closes automatically at power-up.

2.1.9.6 Pantograph Pressures. The pressures related to the operation of the pantograph are as follows:

- Air pressure going to the pantograph: 150 psi
- Minimum pressure: 65 to 70 psi
- Pressure required to close the Main Circuit Breaker: 95 psi
- Regulator to carbon strip pressure: 43. 5 psi.

2.1.9.7 Main Circuit Breaker - Opening/Not Closing. The following conditions either prevent closure or open the circuit breaker if closed:

- Main circuit breaker manual selector in OPEN position.
- Overcurrent detected in main transformer primary.
- No current return to ground.
- Inverter or rectifier bridge failure.
- Overtemperature detected in main transformer.
- Fire detected.
- EMI limit exceeded.
- Pantograph DOWN command detected.
- Insufficient air pressure.
- Propulsion (PECU) main circuit breaker close command not present.

2.1.9.8 Master Controller (Fig. 2-22). The master controller comprises the equipment described in the following subsections.

2.1.9.8.1 Reverser. The master controller reverser is locked when placed in OFF position. When the reverser is unlocked from OFF position, by moving it to the right, it goes from inactive to auxiliary power on, in N position. The FWD and REV positions are then available.

NOTE:

Position change from forward to reverse is not authorized with locomotive at speed. When the locomotive is in movement, the change of direction (REV to FWD, or vice-versa) is effective once below 3 mph.

In order to select a direction of travel, the engineer must verify that THE TRAIN IS STOPPED, the "NO MOTION" indication is shown on the POD, and that the parking brakes are applied prior to moving the master controller reverser handle to the "FWD" or "REV" position.

WARNING:

THE PARKING BRAKE STATUS INDICATION ON THE MULTIFUNCTION DISPLAY NO. 1 IS LOCAL ONLY. ALWAYS VERIFY INDIVIDUALLY IF THE PARKING BRAKE, AND/OR THE HANDBRAKE, IS APPLIED ON ANY HHP-8, OR OTHER LOCOMOTIVES, IN THE CONSIST.

2.1.9.8.2 Throttle Lever. The throttle lever (also called effort lever) provides a traction power range from 0% to + 100% (full effort). The indications provided to the right of the lever are:

(1) 0: No traction effort, the lever has to be cycled back to this position whenever traction power is lost. This position is also used for a running recovery of a penalty brake application. When the lever is in this position it locks and it only unlocks if the button on the handle is pressed. When the lever is moved from 0 position, it locks the reverser in the selected travel direction.

NOTE:

The throttle lever must be cycled back to the "0" position to restart traction after a service brake application (after moving the ABCL to the "REL" position).

(2) READY: Prior to proceeding, the throttle must be placed in READY to activate propulsion in order to ensure that the locomotive responds immediately when traction is requested. When the locomotive is in motion the READY position provides no tractive effort.

NOTE:

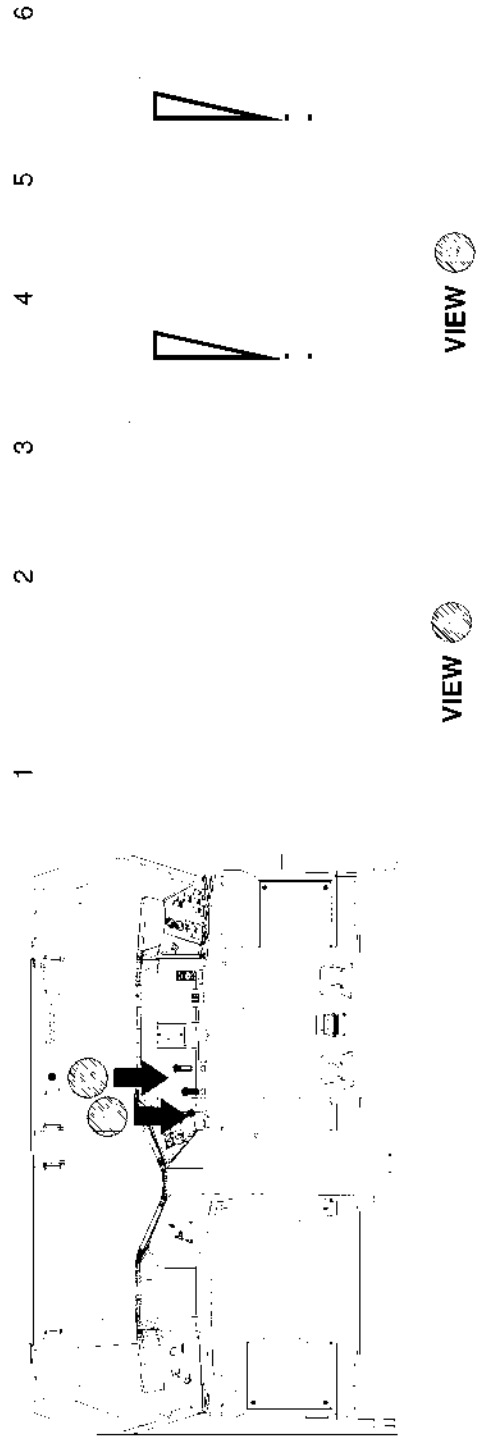
When the throttle lever is moved from "0" towards the "EFFORT" position, the traction effort increases progressively.

(3) EFFORT Zone: The amount of effort provided by the propulsion equipment is related to the lever position in the EFFORT zone. The lever is pushed in to achieve more effort, and pulled back to reduce it. The total effort achieved is indicated on the cab display units. (The current effort is displayed on the MFD1 and MFD2.)

The traction effort is limited by the position of the throttle lever, in traction mode only.

NOTE:

The current effort value is always displayed on the MFD1 and MFD2 displays.



1. Reverser
2. Reverser Handle
3. Throttle Lever (Effort Lever)
4. Effort Range Indicator
5. Cruise Control Lever
6. Speed Range Indicator

Figure 2-22
Propulsion Master Controller

2.1.9.8.3 Cruise Control Lever. The cruise control lever provides a speed range. The range is from 0 to maximum speed. Speed control is imposed by the Main Processing Unit (MPU). The indications provided to the right of the lever are:

(1) 0: No speed set, in this position, the locomotive speed is dependent on the amount of effort required.

(2) SLOW: In this position, a direction of travel must be selected, the train can be already running, and the cruise speed mode is activated. The POD displays the "Cruise Slow" indication and the speed value is set at 3 mph.

(3) SPEED Zone: The speed achieved by the locomotive is related to the lever position in the SPEED zone. The lever is pushed in to gain more speed, and pulled back to reduce the speed. The speed setting on the primary operating display in analog and digital formats increases according to the handle position. A maximum value of 135 mph can be set when the handle is placed fully forward in the SPEED zone.

To allow the propulsion system to regulate the preset speed, the throttle lever is moved forward to the EFFORT position.

If the cruise speed selected is at or above the current train speed, the traction effort is positive (traction mode). If the cruise speed selected is below the current train speed, the traction effort is negative (electric braking mode).

NOTE:

Switching between traction mode and electric braking mode is automatic.

2.1.9.9 Power Unit/Head End Power (Fig. 2-9). The power unit in the central block of the locomotive starts when high voltage is present, and auxiliary inverters become ready. Head End Power (HEP) is available only if the 480 Vac jumpers are looped at both ends, or when 480 Vac trainlines are looped through all the train consist. If the 480 Vac trainline loop integrity is lost when the locomotive speed is higher than 5 mph, the HEP is still supplied. The lead locomotive is by default selected as HEP supply.

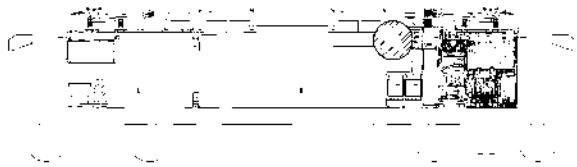
The HEP switch on the engineer's overhead switch panel energizes and deenergizes the HEP power to passenger cars. HEP power is energized, from an active cab only, by placing the switch in ON position. The switch returns to center once a position is selected. The OFF position of the switch is operational all the time in either cab. For more details, refer to subsection 2.2.1, on page 2-90, "HEP Operation".

2.1.9.10 Multiple-Unit HEP Bypass Switch. The multiple-unit HEP bypass switch, on the propulsion electrical cubicle, is used to bypass the HEP power supply from a locomotive in a multiple unit.

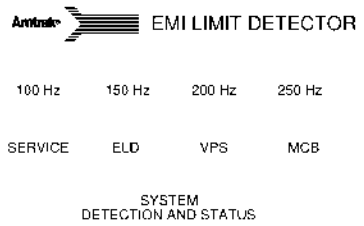
2.1.9.11 EMI Limit Detector (Fig. 2-23). When the harmonic current level reaches a threshold, the EMI limit detector opens the main circuit breaker.

The following control and indicators are located on the EMI Limit Detector (ELD), mounted on electrical locker No. 3:

- 100, 150, 200, 250 Hz status indicators: Continuously illuminated red LED indicates that harmonic interference is detected. Flashing red LED indicates MCB has been opened but interference is below threshold.



"R" END "F" END



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DETAIL

Figure 2-23
EMI Limit Detector

- Red SERVICE LED illuminated: Indicates communication node is not functioning normally.
- Green ELD LED continuously illuminated: Indicates ELD is functioning properly. Flashing LED indicates ELD operating properly but lockout condition exists.
- Green VPS LED illuminated: Indicates ELD Vital Power Supply (controls opening of MCB) is functioning normally.
- Green MCB LED illuminated: Indicates MCB output is on (holds MCB closed).
- PTE connectors: Provide PTE access to the ELD.

2.1.9.12 Fire Suppression System (Fig. 2-8). In case of fire, an audio alarm and a visual alarm displayed on the Primary Operating Display (POD) and Multifunction Display No. 1 (MFD1) warn the engineer, the ONBOARD FAILURE red indicator, on the engineer's overhead switch panel, also turns on. The engineer can respond in the following manner:

(1) Allow the automatic fire suppression system to activate, which occurs after a two minute delay from initial alarm.

(2) Acknowledge the alarm and deactivate fire suppression, after confirming no fire exist, with the MFD1, or the FIRE SUPP. INHIBIT pushbutton on the cab rear wall switch panel.

NOTE:

Once the fire suppression system has been deactivated, the fire control unit (FCU) must be reset to get back the detection mode.

(3) Manually activate the fire suppression system, after confirming a fire exists, with the FIRE SUPP. ACTIVATION pushbutton, on the cab rear wall switch panel.

The fire control unit bypass switch, on the propulsion electrical cubicle, is used to bypass the fire suppression system when it triggers a false fire alarm. It must be used only when it is confirmed that no fire exists.

WARNING:

THE AUTOMATIC FIRE SUPPRESSION SYSTEM IS DEACTIVATED WHEN THE FIRE CONTROL UNIT IS BYPASSED.

2.1.9.13 Low Voltage Battery Charger. The HEP feeds the Low Voltage Battery Charger (LVBC), which generates 72 Vdc for the battery and the low voltage distribution system. There are two battery chargers with only one active at a time. Both are controlled by the PECU.

2.1.9.14 Wheelslip/Slide Control. The propulsion system has its own wheelslip/slide control. A slight slip is corrected by an electric brake effort reduction. The computers used to prevent wheelslip protection operate axle by axle. They use the speed signals of the four axles to define a reference speed and detect slip.

2.1.9.15 Braking Setup. When catenary voltage is lost, traction inverters automatically switch to braking mode. In this mode, the available power is used to satisfy braking requests. The locomotive and trailer car subsystems fed by the auxiliary power are also supplied.

The following are the causes and resulting forms of braking setup:

- A catenary phase change, indicated by phase break signals or signs (or ACSES), results in braking setup without interruption and without opening the main circuit breaker.
- A catenary voltage change in a dead section, indicated by signs (or ACSES), results in auxiliary power interruption, with braking setup, and with main circuit breaker openings and closings controlled by the PECU.
- A loss of catenary voltage, not indicated by phase break signals, dead section signs, or voltage change signs, results in the main circuit breaker opening and in a change to the best level of braking setup possible.

2.1.9.16 RESET Pushbutton. The RESET pushbutton, on the engineer's left switch panel, is compatible with the AEM-7 propulsion reset pushbutton through the white train control trainline.

2.1.9.17 13 T CAB CAR Switch. The 13 T CAB CAR switch, on the engineer's overhead switch panel, is used only when a cab car leads the train consist. It allows control of the locomotive propulsion and brake system by the cab car through the 13 T trainline.

2.1.9.18 Oil Level Detector Bypass Switch. The oil level detector bypass switch, on the propulsion electrical cubicle, is used to bypass a defective main transformer oil level detector. It must be used only when a visual inspection indicates normal oil level. To check the oil level, the central block has to be opened. Do not operate the locomotive and refer to maintenance personnel in order to determine if the oil level is low.

CAUTION:

When the oil level detector bypass switch is activated, the main transformer is not protected against a low oil level that could result in damage to the equipment.

2.1.10 FRICTION BRAKE EQUIPMENT. The brake system components mounted within the cab console consist of the Automatic Brake Control Lever (ABCL), the Independent Brake Control Lever (IBCL), the ABCL/IBCL CAN (Controller Area Network) communication module, the emergency brake valves, the BRAKE VALVE C/O switch, the PARKING BRAKE switch, the SNOW BRAKE pushbutton, and the EMERGENCY END-OF-TRAIN BRAKE switch.

The brake system components located in the equipment room consist of the brake control unit, brake control computer, detection of nonrotating axles, wheelslide control computer, independent failure monitor, conductor's emergency brake valve, and emergency magnet valve cutout cock.

The brake system and air supply components outside the locomotive include the exterior brake indicators, truck brake cutout cocks, parking brake release handles, and pneumatic trainline cutout cocks.

The air gauges are part of the information provided by the cab display units (MFD1 and MFD2). The following table lists the brake system air pressures indicated on the air gauges under normal operating conditions:

Table 2-3
Air Gauges Indications

GAUGE	ABCL POSITION	INDICATION
Brake Pipe/ Equalizing Reservoir	Release	110 ± 1 psi
	Minimum	102 ± 2 psi
	Suppression	92 ± 2 psi
	Full Service	85 ± 3 psi
	Handle Off	0 psi
	Emergency	0 psi
Brake Cylinder	Release	0 psi
	Minimum	16 ± 2 psi
	Suppression	40 ± 2 psi
	Full Service	57 ± 2 psi
	Handle Off	69 ± 2 psi
	Emergency	69 ± 2 psi
NOTE: When the independent brake control lever is used, brake cylinder pressure indications vary from 0 psi (MIN) to 57 psi (MAX).		
Main Reservoir		125 to 140 psi

2.1.10.1 Automatic Brake Control Lever (Fig. 2-24). The Automatic Brake Control Lever (ABCL), on the engineer's console, provides the interface between the engineer and the brake system. Movement of the ABCL causes the increase or decrease of automatic brake effort.

The ABCL interfaces electronically with the brake control computer, independent failure monitor, PECU, alerter, ACSES, and the ATS/ATC systems, and pneumatically, as an operational backup, directly with the brake pipe equalizing reservoir volume to control the brake pipe pressure.

The ABCL positions are: REL (release), MIN (minimum), SUPP (suppression), FS (full service), HO (handle off), and EM (emergency). Switches signal the handle positions to the various systems: release to the PECU, handle off to the alerter system, suppression to the ACSES, alerter, and the ATC systems.

NOTE:
The ABCL positions are: REL, MIN, SUPP, FS, HO, EM.
The letter "K" between MIN and SUP positions is not a brake lever position.

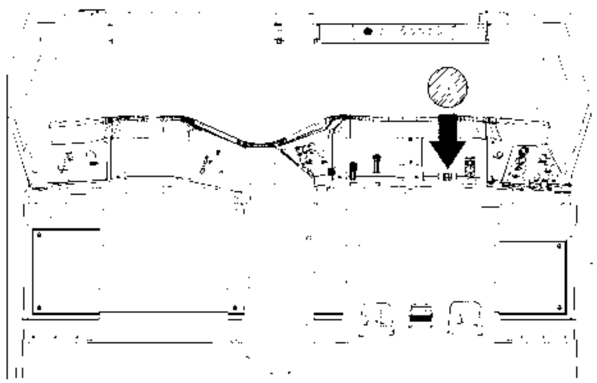

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Figure 2-24
Automatic Brake Control Lever

Movement of the handle to the EM position pilots an E-3 application valve to provide rapid venting of the brake pipe that creates emergency brake cylinder pressure.

When the engineer performs a service brake application by placing the ABCL on a position between "MIN" and "FS", the following happens:

(1) The traction effort is automatically canceled, regardless of the traction mode (manual or cruise).

(2) The propulsion system is switched to electric braking mode.

(3) The traction efforts displayed on the MFD1 and MFD2 are negative.

(4) Brake cylinder pressure is added to the electric brake effort in order to meet the total brake demand defined by the position of the ABCL.

NOTE:

To restart traction after a service brake application, the ABCL must be moved to the "REL" position and the effort lever cycled back to the "0" position.

NOTE:

Ensure the ABCL is in HO position and cut out in the opposite cab in order to prevent any penalty brake application (at emergency brake rate) when operating from the leading cab.

2.1.10.2 Independent Brake Control Lever. The independent brake (locomotive only) applies and releases the friction brakes on the locomotive. The Independent Brake Control Lever (IBCL) is self-lapping and has a bail off feature.

CAUTION:

Never use the independent brake control lever as a parking brake when the locomotive is stopped. Always place the independent brake control lever in RELEASE position prior to cab deactivation. This ensures that no air is trapped in the system in order to prevent damage to the equipment.

NOTE:

The independent brake control lever is controlled by the brake control computer. If the cab is deactivated with the independent brake applied, some air is trapped in the application trainline. This will prevent brake release with the brake pipe while the locomotive is being towed if the application trainline is not connected.

2.1.10.3 ABCL/IBCL CAN Communication Module. The ABCL/IBCL CAN (Controller Area Network) communication module is an electronic interface between ABCL/IBCL operation and the brake control computer/independent failure monitor.

This device provides the communication signals for the brake control computer and independent failure monitor in response to the analog signals received from the ABCL and the IBCL.

2.1.10.4 Emergency Brake Valve (Fig. 2-4 and 2-5). The EMERGENCY BRAKE VALVE pushbutton on the engineer's left switch panel, and the assistant's left switch panel, enables the operator to initiate an emergency brake application.

2.1.10.5 BRAKE VALVE C/O Switch (Fig. 2-5). The BRAKE VALVE C/O switch on the engineer's desk right switch panel is used as follows:

- PASS. position is used when towing a train consist set-up in graduated release.
- FRT. position is used when towing a train consist set-up in direct release.
- OUT position is used to cut out the ABCL and IBCL.

2.1.10.6 PARKING BRAKE Switch (Fig. 2-3). The PARKING BRAKE switch on the engineer's right switch panel is used to apply or release the parking brakes of the locomotive.

WARNING:

A FALSE PARKING BRAKE APPLY INDICATION CAN OCCUR IF THE PARKING BRAKE IS APPLIED (USING THE PARKING BRAKE SWITCH ON THE ENGINEER'S RIGHT SWITCH PANEL OR THE PARKING BRAKE CUTOUT COCK ON THE BRAKE CONTROL UNIT) AND THE TRUCK MOUNTED PARKING BRAKE MANUAL OVERRIDE LEVER IS PULLED.

2.1.10.7 SNOW BRAKE Pushbutton (Fig. 2-3). The SNOW BRAKE pushbutton on the engineer's right switch panel initiates a friction brake application of 6 psi for 60 seconds at each of the disc and tread brake actuators.

NOTE:

During blended brake when electric brake provides all the braking effort (no friction brake applied), the snow brake pressure is completely released through blending magnet valves on the locomotive.

2.1.10.8 EMERGENCY END-OF-TRAIN BRAKE Switch (Fig. 2-15). The EMERGENCY END-OF-TRAIN BRAKE switch on the engineer's left switch panel allows the engineer to propagate an emergency brake application from the rear of the consist.

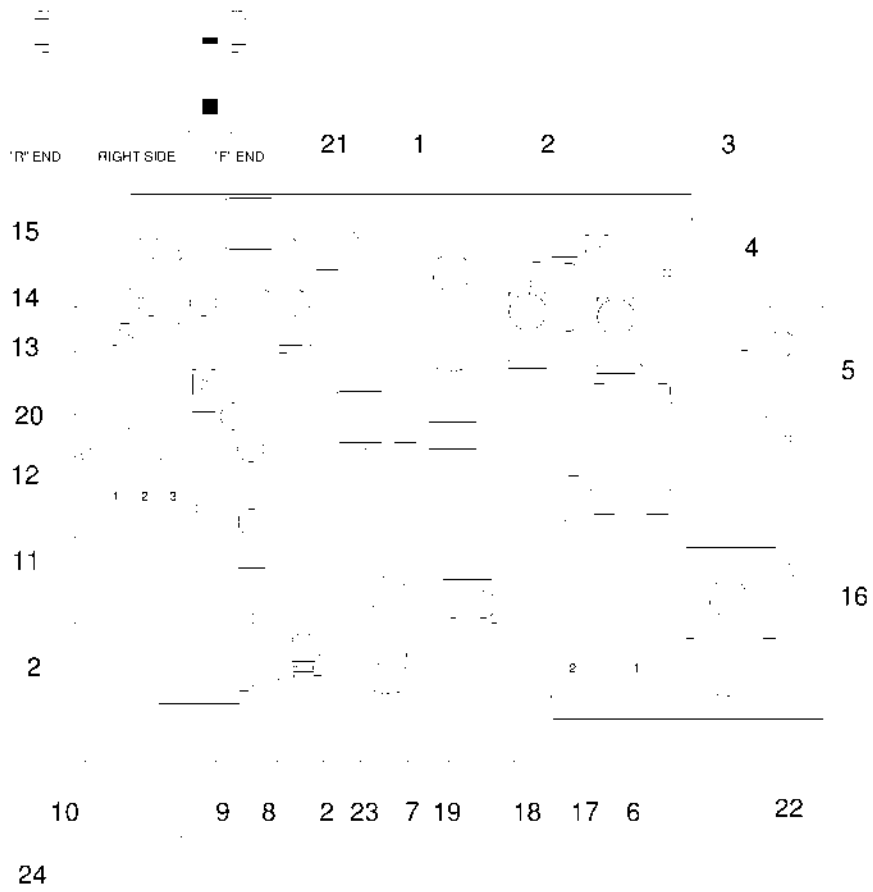
2.1.10.9 Brake Control Unit (Fig. 2-25). The Brake Control Unit (BCU) allows both electropneumatic and full pneumatic control of brake pipe pressure. It provides the following:

- Penalty application of service brake in response to the ATS/ATC, alerter, and ACSES systems, as well as low main reservoir pressure

NOTE:

Low main reservoir pressure is set at 115 psi, using the low main pressure valve. If the valve is defective, the brake control computer, acting as a backup, detects low main reservoir pressure at 110 psi.

- Independent brake function
- Bail off function
- Auxiliary air supply for sanding, bell, and horn
- Snow brake function



1. Independent Brake Relay Valve
2. Air Filter
3. Governor
4. Auxiliary Reservoir Pressure Gauge
5. Valve KE3.9, with Manual Quick-Release Handle
6. Parking Brake Impulse Valve
7. Snow Brake Cutout Cock
8. KM-2 Vent Valve
9. Relay Valve RH4
10. Main Reservoir Cutout Cock
11. Analog Converter AW4. 1A
12. Conductor's Emergency Brake Valve
13. ATC Sealed Cutout Cock (Red)
14. Alerter Sealed Cutout Cock (Yellow)
15. ACSES Sealed Cutout Cock (Blue)
16. Brake Cylinder 2 Pressure Gauge
17. Parking Brake Cutout Cock
18. Main Reservoir Pressure Gauge
19. Brake Cylinder 1 Pressure Gauge
20. Brake Pipe Pressure Gauge
21. Dead Engine Feature Cutout Cock
22. Brake Cylinder 2 Relay Valve
23. Brake Cylinder 1 Relay Valve
24. Emergency Magnet Valve Cutout Cock

Figure 2-25
Pneumatic Brake Control Unit

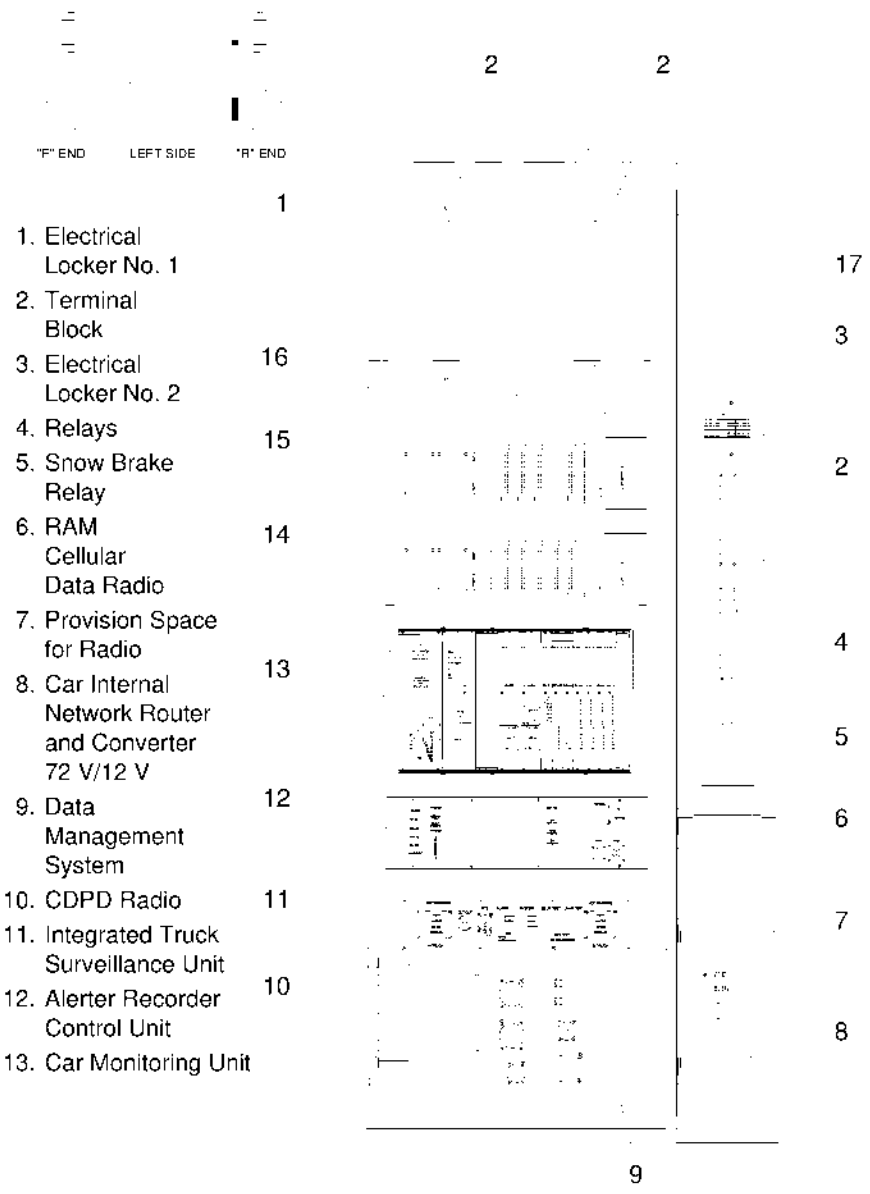
- Blending with the electric brake
- Brake cylinder pressure in response to brake pipe pressure
- Parking brake function.

The brake control unit is equipped with the following cutout cocks:

- Dead engine feature: Allows the charging of main reservoir with brake pipe air.
- ATC Penalty Magnet Valve: Isolates the ATC penalty brake magnet valve if it fails or if the ATC fails. Use this cutout cock whenever the electrical cutout mounted on the ATC equipment cabinet is used and the penalty cannot be recovered.
- Alerter Penalty Magnet Valve: Isolates the alerter penalty brake magnet valve if it fails or if the alerter fails. Use this cutout cock whenever the electrical cutout mounted on the alerter/recorder control unit is used and the penalty cannot be recovered.
- ACSES Penalty Magnet Valve: Isolates the ACSES penalty brake magnet valve if it fails or if the ACSES fails. Use this cutout cock whenever the electrical cutout mounted on the ACSES equipment cabinet is used and the penalty cannot be recovered.
- MR: Isolates the BCU from the MR supply and vents the BCU of MR air pressure. It purges air from the manifold and is to be used for maintenance purposes only.
- Truck Equipment: Isolates the brake equipment on a per truck basis.
- Snow Brake: Isolates and vents the snow brake reducing valve and magnet valve from the MR supply.
- Parking Brake: enable the isolation of the parking brake circuit from the brake cylinders in order to vent the parking brake system.
- Auxiliary Systems: Enables the isolation of the auxiliary circuit from the MR supply and to vent the auxiliary system.

2.1.10.10 Brake Control Computer (Fig. 2-26). The Brake Control Computer (BCC), located on electrical locker No. 1 in the equipment room (combined with detection of nonrotating axles), is the main control element of the brake system. The BCC is responsible for the following major functions within the brake system:

- Control of brake pipe
- Blending calculations
- Electric brake control
- BP pressure calculation from brake demand
- EP assist control
- Control of independent brake
- Control of bail off
- Calculation of percentage of friction brake operative
- Diagnostics/maintenance event annunciation.



1. Electrical Locker No. 1
2. Terminal Block
3. Electrical Locker No. 2
4. Relays
5. Snow Brake Relay
6. RAM Cellular Data Radio
7. Provision Space for Radio
8. Car Internal Network Router and Converter 72 V/12 V
9. Data Management System
10. CDPD Radio
11. Integrated Truck Surveillance Unit
12. Alerter Recorder Control Unit
13. Car Monitoring Unit
14. Brake Control Computer with Detection of Nonrotating Axle
15. Wheelslide Control Computer with Independent Failure Monitor
16. Fan
17. Locomotive Control Unit (HOTD)

Figure 2-26
Electrical Locker No. 1 and No. 2 Equipment Arrangement

2.1.10.11 Detection of Nonrotating Axles (Fig. 2-26). The Detection of Nonrotating Axles (DNRA), located on electrical locker No. 1 in the equipment room (combined with BCC) is a secondary control element of the brake system. The DNRA is responsible for the following major functions within the brake system:

- Detection and annunciation of locked axles
- Release of locked axles by complete venting of Brake Cylinder pressure
- Diagnostics/maintenance event annunciation.

2.1.10.12 Wheelslide Control Computer (Fig. 2-26). The Wheelslide Control Computer (WSCC) is located on electrical locker No. 1 in the equipment room (combined with the independent failure monitoring system). The WSCC is responsible for the following major functions within the brake system:

- Friction brake wheelslide/slip control
- Monitoring of truck equipment for cutout
- Electric brake reduction
- Sanding control
- Manual cutout of brakes through the dump valves
- Detection and annunciation of locked axles
- Diagnostics/maintenance event annunciation.

The WSCC maximizes the wheel to rail adhesion level through reduction of brake cylinder pressure, or reduction of electric brake effort. Control of the electric brake is accomplished through the PECU until the level of slip is too great, when the WSCC takes over the reduction of electric brake.

2.1.10.13 Independent Failure Monitoring System (Fig. 2-26). The Independent Failure Monitoring System (IFM), located on electrical locker No. 1 in the equipment room (combined with WSCC) is an independent system by which the total requested brake demand from the ABCL is compared with the pressure of the brake pipe and propulsion computer. The calculated friction brake effort determined from BP reduction added to the propulsion computer signal should equal the total brake demand. Any discrepancy is reported over the data management system/car internal network, and an alarm is generated to the cab display unit.

2.1.10.14 Conductor's Emergency Brake Valve (Fig. 2-25). The conductor's emergency brake valve, located on the Pneumatic Brake Control Unit, in the equipment room, initiates an emergency brake application when the valve handle is pulled down.

2.1.10.15 Emergency Magnet Valve Cutout Cock (Fig. 2-25). The Emergency Magnet Valve Cutout Cock (EMVCC), located on the Pneumatic Brake Control Unit, in the equipment room is used to cutout the Emergency Magnet Valve (EMV) in case of power loss. The EMV must be energized in operation to prevent any unrequested emergency brake.

CAUTION:

For any towing operation, the EMV must be cutout to prevent any emergency brake application due to loss of battery power.

2.1.10.16 Brake Indicators (Fig. 1-2 and 1-3). The pneumatic brake indicators provide a positive indication, per axle, of the status of brake cylinders and parking brake. The red indicator in the fully out position indicates that the brake cylinders are pressurized at that truck. The gold indicator in the fully out position indicates that the parking brake is applied at that truck.

2.1.10.17 Exterior Truck Brake Cutout Cocks (Fig. 1-2 and 1-3). The exterior truck brake cutout cocks are mounted in-line with the brake cylinder supply line to a particular truck. Electrical contacts are provided on the cock to provide a warning signal to the engineer that the truck brake equipment has been isolated.

2.1.10.18 Parking Brake Manual Override Levers (Fig. 2-6). A manually operated lever allows manual release of the parking brake on each axle, for a truck, from either side of the locomotive truck.

2.1.10.19 Pneumatic Cutout Cocks (Fig. 1-2 and 1-3). The following pneumatic cutout cocks are located at each end of the locomotive: Application Pipe, Actuating Pipe, Main Reservoir/Equalizing Pipe, Brake Pipe. The cutout cocks are accessed by opening the associated pneumatic cutout cocks access panel located at each corner of the locomotive.

2.1.11 CAB SIGNAL AND AUTOMATIC TRAIN CONTROL SYSTEMS. The cab signal and automatic train control systems controls and indicators are detailed in the following subsections.

NOTE:

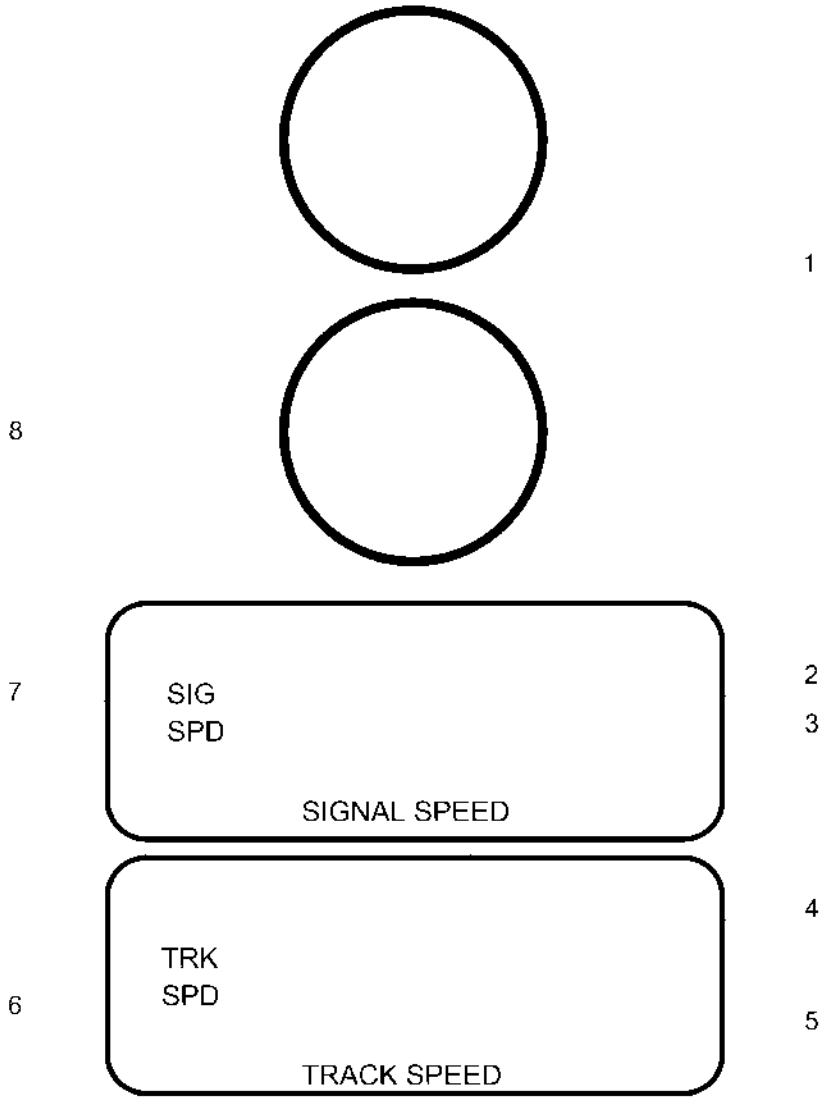
Operating rules on the subject prevail.

2.1.11.1 Aspect Display Unit (Fig. 2-27 and 2-28). An Aspect Display Unit (ADU) is mounted on the engineer's right switch panel. It contains a color position display, used to display the current wayside signals. The ADU also incorporates two orange digital displays. The top display, identified SIGNAL SPEED, is used in conjunction with the aspects to display the current wayside aspects. The bottom display, identified TRACK SPEED, is used to display track speeds from the ACSES system. (See Figure 2-28 "Aspect Display Unit Indications" for a description of the nine aspects, with their speed limitations, displayed on the ADU.)

When the cab signal-authorized speed is equal to or lower than the ACSES authorized speed, the cab signal-authorized speed is indicated by the SIG SPD indicator to the left of the cab signal-authorized speed. When the ACSES-authorized speed is lower than the cab signal-authorized speed, the ACSES-authorized speed is indicated by the TRK SPD indicator to the left of the ACSES-authorized speed.

If the ACSES speed is received as unknown or invalid, the ADU displays three horizontal bars as the ACSES speed, and the maximum ACSES authorized speed is 125 mph.

The ADU houses a sonalert for each system: Steady tone for ATS/ATC, pulsed tone for ACSES.



1. Color Position Display
2. Top Display for Wayside Aspects
3. Signal Speed Display (Cab Signal Authorized Speed)
4. Bottom Display for ACSES Track Speed
5. Track Speed Display (ACSES Authorized Speed)
6. TRK SPD Indicator (ACSES Speed Most Restrictive)
7. SIG SPD Indicator (Cab Signal Speed Most Restrictive)

Figure 2-27
Aspect Display Unit

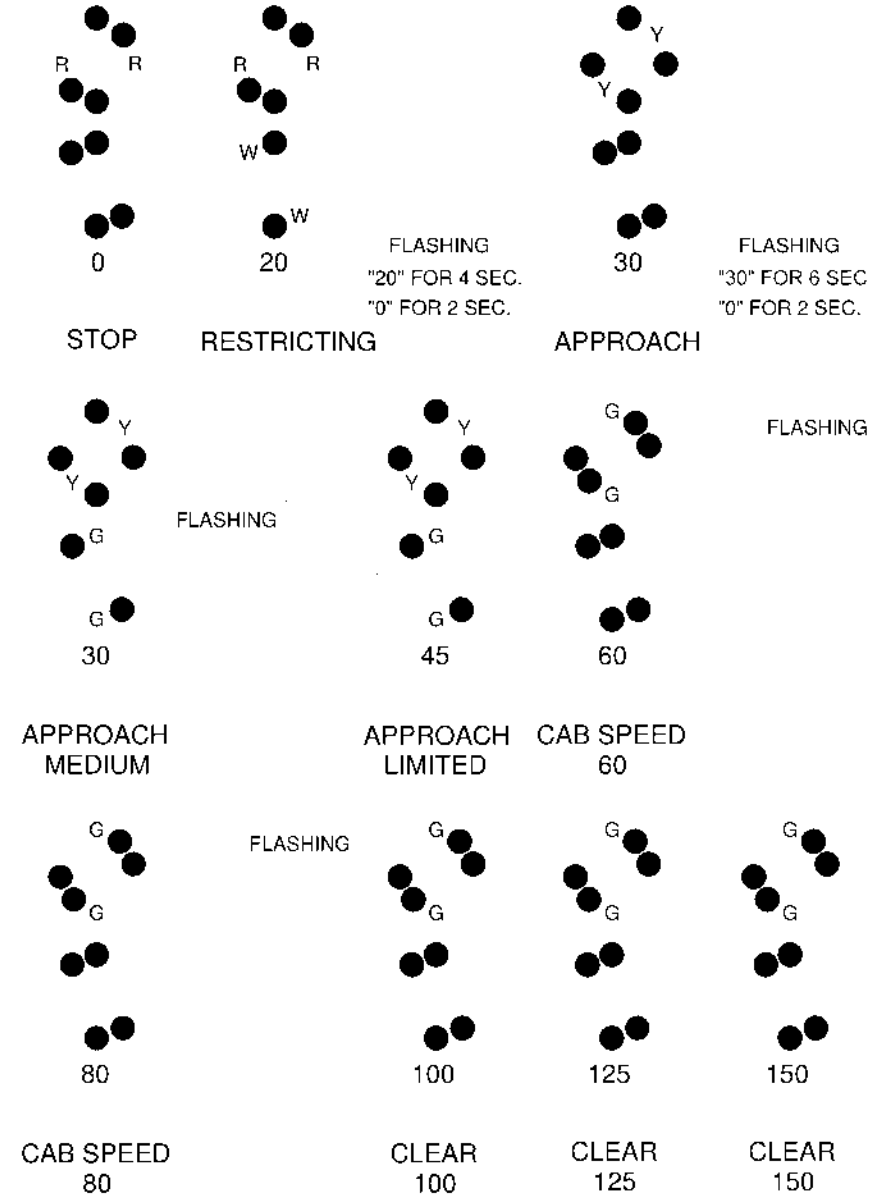


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Figure 2-28
Aspect Display Unit Indications

When the CAB TERRITORY switch on the cab rear wall switch panel is in OUT position, the ADU darkens the ATS/ATC aspects and displays a "79" in the signal speed display. The 79 mph limit is enforced by the ATS/ATC system.

When the ADU is not in the active cab, no sonalert sounds, but the displays remain active.

Additional nonvital indications are displayed on POD, MFD1, and MFD2. The indications included on these displays are shown in Table 2-4.

Table 2-4
Cab Signal and Automatic Train Control Cab Display Unit Indications

INDICATION	DISPLAY	FUNCTIONS
NO-MOTION (YELLOW)	POD	On when speed sensing system detects zero velocity.
OVERSPEED (RED)	POD	On steady in overspeed flashing in penalty.
NON-CAB TERRITORY (YELLOW)	POD	On steady when CAB TERRITORY switch is in OUT position.
ATS/ATC CUT-OUT (WHITE)	MFD1 MFD2	On steady when automatic train supervision switch (ATSCO) is in CUTOUT position.
SPEED SYSTEM CUTOUT (WHITE)	MFD1 MFD2	On steady when speed system switch (SSCO) is in CUTOUT position.
APPLICATION (WHITE)	POD	On steady when there is confirmation of loss of traction power.
SUPPRESSION (YELLOW)	POD	Flashes at deceleration between 0.9 to 1.2 mphps. On steady when the ATC system is being forestalled by the permanent suppression input or a brake rate greater or equal to 1.2 mphps.

2.1.11.2 CAB TERRITORY Switch (Fig. 2-8). The CAB TERRITORY switch on the cab rear wall switch panel, must be maintained in the IN position whenever the locomotive is operating in cab signal territory. When the locomotive is in noncoded territory and this switch is moved to the OUT position, the overspeed detection point changes from 20 mph to 79 mph. Transition to noncoded operation can only be accomplished when no cab signal code is being received and the locomotive speed is less than 20 mph.

2.1.11.3 Cab Signal Acknowledgment Switches (Fig. 1-11 and 2-5). Two separate acknowledgment are provided. The first is from the ACKNOWLEDGE switch on the engineer's desk right switch panel. The second is from the acknowledge footswitch mounted between the horn footswitch and the radio footswitch.

2.1.11.4 PASS STOP ACSES Pushbutton. The PASS STOP ACSES pushbutton, on the cab rear wall switch panel, is used to release a positive stop brake application when the train comes to a complete stop short of a home signal. Use of the PASS STOP pushbutton changes the aspect back to RESTRICTING, and allows the train to move at restrictive speed.

WARNING:

OPERATION OF THE PASS STOP ACSES PUSHBUTTON MUST BE IN ACCORDANCE WITH RAILROAD OPERATING RULES.

2.1.11.5 NO-MOTION BYPASS Switch (Fig. 2-3). The engineer can bypass the speed sensing system by pressing on the NO-MOTION BYPASS switch on the engineer's right switch panel in case of failure.

When the switch is used to bypass a defective speed sensing system, the engineer can:

(1) Charge the brake pipe after an emergency brake.

(2) Reset, or close, the MCB after an emergency brake.

(3) Apply the parking brake.

(4) Extend the mirrors momentarily, if the MIRRORS (PUSH TO RETRACT) switch is held in OUT position.

2.1.11.6 ACSES Cutout Switch. With the ACSES cutout switch in cutout position, the ADU darkens the ACSES speed limit information and deactivates the ACSES sonalert. The ATS/ATC system enforces 125 mph as the maximum speed. The switch is located on the ACSES equipment rack.

2.1.11.7 ATS and Speed Sensing Cutout Switches (Fig. 2-65). Two sealed cutout switches, labeled ATSCO and SSCO, are mounted on the ATS/ATC equipment cabinet in the equipment room.

The Automatic Train Supervision Cutout switch (ATSCO) bypasses the ATS system. It is to be used when an ATS or ATC failure cannot be cleared. With the ATSCO in cutout position, the ADU darkens the ATS/ATC aspects and the signal speed display, and deactivates the ATS/ATC sonalert. The ACSES display shows 79 as maximum speed limit information.

The Speed Sensing Cutout switch (SSCO) cuts out the speed sensing system, by shutting down the speed sensing CPU (all related functions are lost, including the speed displayed on the POD). It allows ATS operation with no overspeed enforcement.

NOTE:

When the speed sensing has been cut out, the NO-MOTION BYPASS switch is used to intentionally bypass the no-motion signal provided by the speed sensing system.

2.1.11.7.1 Alerter/Recorder Equipment (Fig. 2-29). The alerter/recorder system includes the following items: Alerter/Recorder Control Unit (ARU), alerter alarm unit, cab microphone.

The alerter/recorder control unit, located on electrical locker No. 1 in the equipment room, performs all major control and recording tasks. The ARU front face plate is equipped with the control and indicators described below:

The download module provides high speed data extraction to a memory card (PCMCIA) that can be easily downloaded to computer for future analysis. To download the recorded information on a memory card, press on the DWL button once a PCMCIA card has been inserted in the card slot. The LEDs on the PCMCIA card provide the following information:

- DWL.: Yellow, lit when the recorder information is being downloaded to the memory card.
- SYS. FLT.: Red, on when the ARU is defective.
- PCM. FLT.: Red, on when the recorder is not able to download information on the memory card due to a card failure.

The two-position (NORMAL, BYPASS) sealed cutout switch can be used to clear a penalty brake application due to a system failure. The switch cuts out the alerter magnet valve circuitry only. The two PTE connectors are used to connect the portable test equipment.

The CPU card, is equipped with the following LEDs:

- CIN ACTIVITY: Green, on when the ARU is communicating with the car internal network
- CPU FAILURE: Red, on when the central processing unit has failed.
- CIN SERVICE: Yellow, on when the network interface requires servicing.

The other indicators on the ARU, in the power supply card consist of LEDs that provide information on the different voltages supplied to the unit, and on the output from the penalty magnet valve. In normal operating conditions they should be on.

The ARU is connected to an alerter alarm unit in each cab. The alarm unit generates a progressive audible alarm tone for the alerter function.

The cab microphone is located between the engineer station and the assistant station in each cab. It allows the system to transform background audio in the cab into analog signals transmitted to the recorder.

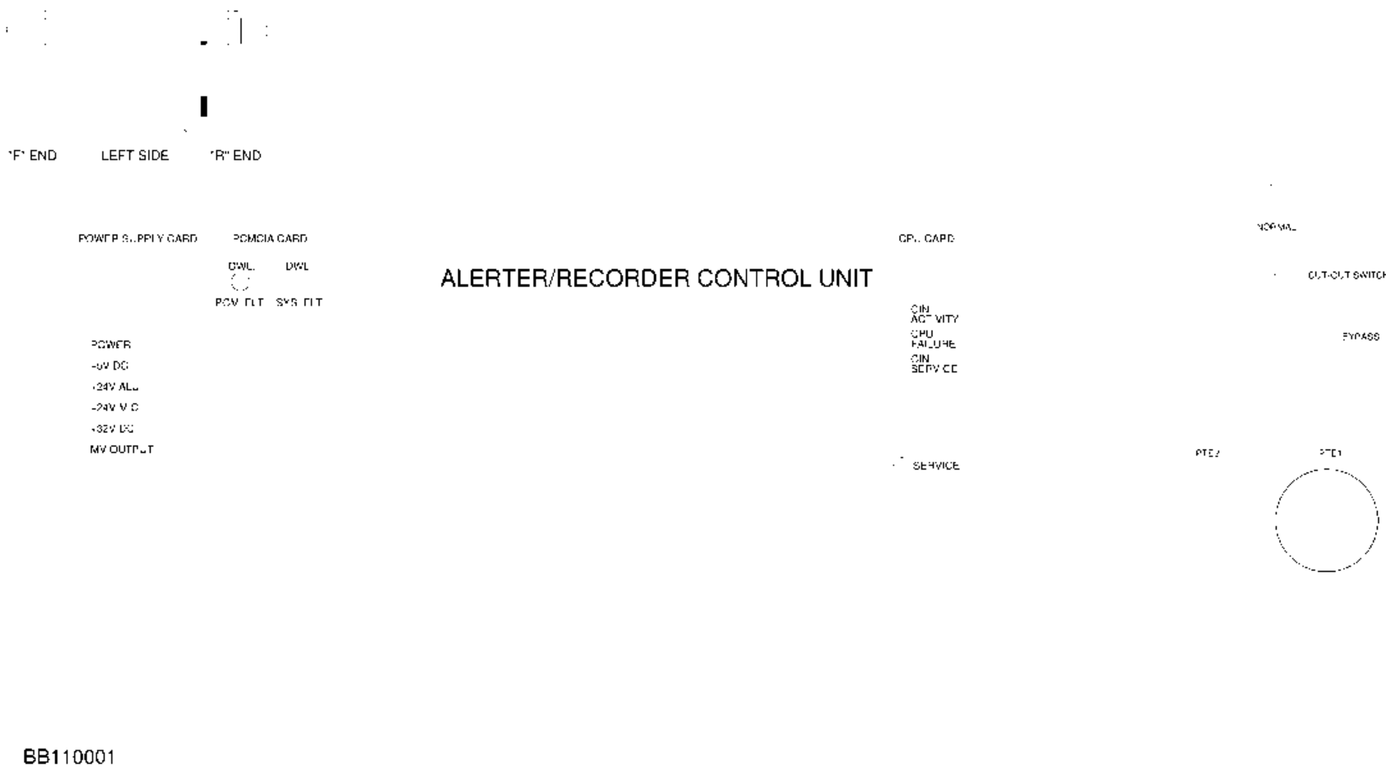


Figure 2-29
Alerter/Recorder Control Unit

2.1.11.8 Alerter Operation and Timing. The alerter system monitors operator movements through various console equipment over a period of 25 seconds. This time base is fixed and does not vary with the train speed. If no activity has been detected, the audible and visual alarms in POD start beeping/blinking over an additional 15-second period. The audible alarm intensity is progressive and the beeping is done at a fixed frequency. The visual alarm on POD increases in size. If no reset is actuated, a penalty brake with loss of traction power is initiated, while the audible alarm stays steady on for 5 more seconds and then shuts off. When the system initiates a penalty, a full service brake application with loss of traction power occurs. To reset the penalty condition, the brake handle has to be placed into the suppression position and it is not necessary to stop the train.

The resets available to the engineer are:

- Acknowledge footswitch activation
- Acknowledge whisker switch activation
- Horn button utilization
- Horn footswitch utilization
- Bell button utilization
- Headlight activation
- Automatic brake control lever operation
- Throttle lever operation.

NOTE:

If the ATC is cutout, the alerter cannot be acknowledged by the acknowledge footswitch and acknowledge whisker switch. One of the other reset functions must then be used.

2.1.12 TRAIN MONITORING AND DATA MANAGEMENT. The following subsections describe the train monitoring and data management systems equipment.

The cab display units are installed in each cab console. The thermal printer and the CDU SELECTOR switch are located on the cab wall.

The following equipment is located on electrical locker No. 1 and No. 2 in the equipment room:

- Car Monitoring Unit (CMU)
- Car Internal Network (CIN) router unit
- Data Management System (DMS) computer
- DMS RAM (brand name) modem radio
- DMS CDPD (Cellular Digital Packet Data) modem radio
- Head of Train Device (HOTD), Locomotive Control Unit
- Power converters.

2.1.12.1 CDU Selector Switch. The CDU SELECTOR switch, located on the cab rear wall switch panel, has three positions: BOTH, POD and MFD1. BOTH is the normal operating position. In degraded mode, when one of the screens has failed, the other one can be manually selected in order to display both screens indications at the same time.

2.1.12.2 Entry Control. All the Cab Display Units (CDUs) processors and network controllers are always online and running. The CDU operating pages are protected through the use of the card reader and master controller. Control is provided to:

- Protect against unauthorized entry and data manipulation
- Increase LCD backlight life expectancy
- Decrease global power requirements
- Decrease network traffic.

2.1.12.3 Cab Display Units (Fig. 2-30 to 2-56). The Cab Display Units (CDUs) (processors and screens) are the primary interface to the train and its subsystems, for the engineer and maintenance personnel. Each cab is equipped with three CDUs. Refer to Table 2-1, on page 2-38, "Leading Cab Access Levels" and to Table 2-2, on page 2-39, "Trailing Cab Access Levels", for the authorization level required for each screen.

Two screens are located on the engineer's console: Primary Operating Display (POD), and Multifunction Display No. 1 (MFD1).

Multifunction Display No. 2 (MFD2) is located in the assistant's console.

- POD displays speed, speed limits, time, cruise control setting, indications, and the reasons for the speed limitation. (See Figure 2-30 "Primary Operating Display in Normal Mode".)
- MFD1 displays pneumatic pressures, traction effort, abnormal subsystem states, and alarms. It provides access to the train operations and alarm handling functions. It is also used to initiate predeparture tests and speed check.
- MFD2 displays subsystem status, maintenance events, and manual fault entry. Inserting an ID card and a valid PIN number in the key card reader, results in the main operations page appearing on this screen. This screen can be activated in nonactive cabs.

2.1.12.4 Primary Operating Display (Fig. 2-30 and 2-31). The Primary Operating Display (POD) is an intelligent active speedometer that provides all necessary speed related information in analog and digital readout formats. It displays the information listed in the following subsections.

2.1.12.4.1 Speed Related Information. The speed related information shown on the POD is as follows:

- Actual analog train speed
- Actual digital train speed
- Cruise set indication

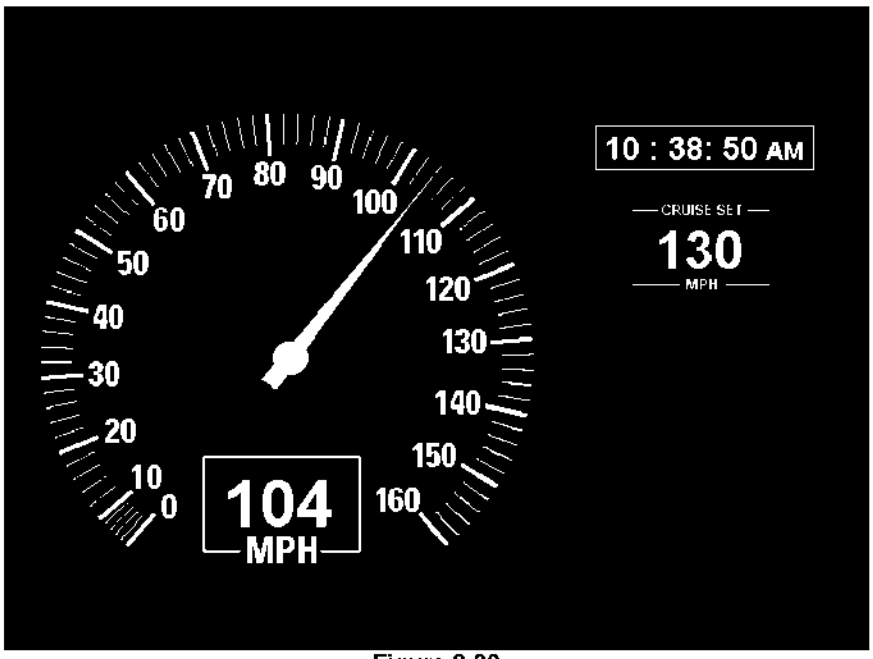


Figure 2-30
Primary Operating Display in Normal Mode

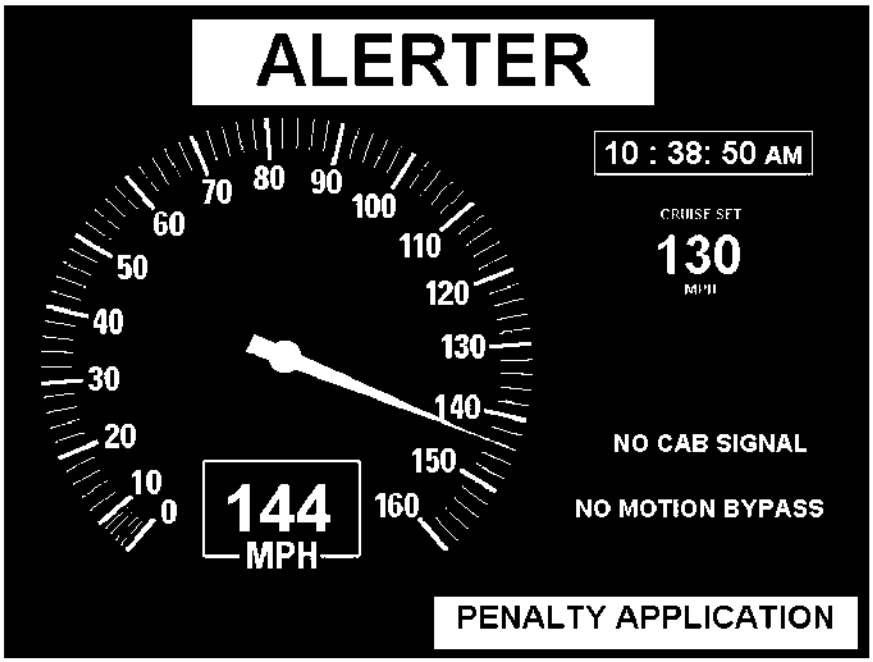


Figure 2-31
Primary Operating Display with Indications Displayed

- Analog cruise speed
- Digital cruise speed
- Maximum authorized speed.

2.1.12.4.2 Indications. The POD also provides the following indications:

- Alerter
- Overspeed warning
- Brake suppression
- Penalty brake application
- Time of day
- Fire detected
- Hot journal
- Truck hunting
- No cab signal
- No motion bypass or no motion
- Unknown speed restriction.

2.1.12.4.3 Alertness Indication. POD integrates the crew alertness indication. When a command is received from the alerter, POD displays a flashing warning simultaneously with the alerter audible tone. Following the alerter warning sequence, the flashing warning changes from a small indicator to a large one, 5 seconds before the penalty brake application. Once the alerter signal is acknowledged by the engineer, the alerter command is discontinued and the display returns to normal.

2.1.12.5 Multifunction Display No. 1 (Fig. 2-32 to 2-35). Multifunction Display No. 1 (MFD1) is dedicated to train operations. It displays operational values and statuses. The data of the main operation page cannot be removed from view, although some function keys can introduce pop-up windows.

2.1.12.5.1 Main Operation Page. The main operation page is used by the engineer to view critical information at a glance. The page is split into three sections.

The ALARMS section provides a scrolling list of existing system alarms, sorted by criticality. The list shows the ten most critical alarms. As an alarm cause is cleared, the list scrolls to the next most critical item. In the event of more than ten alarms, a "next page" button becomes available. (Refer to tables 2-5, 2-6, and 2-7 for a list of all the alarms that can be displayed on the screen.)

The train operational values section provides the actual values in analog readouts of various operational parameters. The number of parameters to be displayed is a compromise between obtaining critical data and keeping the page uncluttered to enable viewing the information at a glance. MFD1 displayed data is limited to the following information:

- Brake pipe and brake cylinder pressure (same analog gauge)

- Main reservoir and equalizing reservoir pressure (same analog gauge)
- Electrical traction/braking effort.

The TRAIN STATUS section provides the following train status information:

- Friction Brakes: All released, all applied
- Parking Brake: Released, applied

WARNING:

THE PARKING BRAKE STATUS INDICATION ON THE MULTIFUNCTION DISPLAY NO. 1 IS LOCAL ONLY. ALWAYS VERIFY INDIVIDUALLY IF THE PARKING BRAKE, AND/OR THE HANDBRAKE, IS APPLIED ON ANY HHP-8, OR OTHER LOCOMOTIVES, IN THE CONSIST.

- Pantographs: Up/down (depending on actual state of each pantograph)
- Doors: Closed and locked, open
- Wheelslip: Slip/spin (yellow), no slip/spin (gray)
- Authorization level.

2.1.12.5.2 Alarms. The following tables lists all the alarms that can be displayed on MFD1 and MFD2. All levels of alarms are listed. Refer to subsection 3.2, on page 3-1, "Alarms" for a detailed explanation of the alarm levels. Refer to the troubleshooting tables sections in chapter 3 for more details on the actions to perform in case of alarm.

NOTE:

For some alarms, the locomotive number is indicated after the alarm text.

Table 2-5
Level 1 Alarms

ALARM TEXT	ALARM TEXT
ACSES FAULT	ALERTER FAULT
ATS/ATC FAULT	BRAKE CONTROL FAULT
COACH HOT JOURNAL	CONDUCTOR VALVE APPL
EMI LIMIT EXCEEDED	FIRE DETECTED
HOT JOURNAL (L1 to L4, R1 to R4)	LOCKED AXLE (#1 to #4)
LOW TRANSFORMER OIL	SPEED SENSING FAULT
UNKNOWN SPEED RESTRICTION	

Table 2-6
Level 2 Alarms

ALARM TEXT	ALARM TEXT
BATTERY CB OPEN	BATTERY CHARGERS FLT
BOTH BRAKE LEVERS ACTIVE	BRG SENSOR FAULT (L1 to L4, R1 to R4)
CAT VOLTAGE BELOW 8.4KV	CAT VOLTAGE BELOW 8.7KV
CAT VOLTAGE BELOW 17.5KV	ELD FAULT/LOCKED OUT
ELECT BRAKE LOSS 25%	ELECT BRAKE LOSS 50%
ELECT BRAKE LOSS 75%	ELECT BRAKE LOSS 100%
EOT BATTERY LOW/DEAD	EOT COMMUNICATION LOSS
EVENT RECORDER FAULT	HEP FAULT
INCOMING TRAIN ORDER	INDEPENDENT BRAKE FAULT
MAIN CB LOCKED OUT	NO WHEEL SLIP PROTECT
PANTO F BROKEN	PANTO F TOO HIGH
PANTO R BROKEN	PANTO R TOO HIGH
TRACTION LOSS 25%	TRACTION LOSS 50%
TRACTION LOSS 75%	TRACTION LOSS 100%
TRUCK HUNT FAULT (F or R)	TRUCK HUNTING (F or R)
TRUCK SURVEIL FAULT	

Table 2-7
Level 3 Alarms

ALARM TEXT	ALARM TEXT
ACSES C/O	ACSES DATA NOT AVAILABLE
ACSES MAGN VALVE C/O	ALARMS NOT AVAILABLE
ALERTER C/O	ALERTER MAGN VALVE C/O
ATS C/O	ATS/ATC DATA NOT AVAILABLE
ATS/ATC MAGN VALVE C/O	AUTO POWER LIMIT
BRG SENSOR BYPASS (L1 to L4, R1 to R4)	CARD READER C/O
CAT VOLTAGE BELOW 10.8KV	CAT VOLTAGE BELOW 11.2KV
CAT VOLTAGE BELOW 22.5KV	DOORS C & L BYPASS
DYNAMIC BRAKE WARNING	EMERG C/O COCK

Table 2-7
Level 3 Alarms (Cont'd)

ALARM TEXT	ALARM TEXT
END OF TRAIN NOT ARMED	EXCESSIVE MOTOR CURRENT
FAULT TRAILING UNIT	FIRE OUTPUTS C/O
FIRE SUPP CYL BYPASS	FIRE SUPP INHIBITED
HEP OUTPUT OFF	HOT JOURNAL WARNING (L1 to L4, R1 to R4)
MAIN CB OPEN	NO 480V LEFT T/L CONT.
NO 480V RIGHT T/L CONT.	NO POWER BRAKES
NO-MOTION BYPASS	ON BOARD RESTRICTION C/O
PANTO PB F ACTIVATED	PANTO PB R ACTIVATED
PNEUMATIC BACKUP ACTIVE	SANDING
SNOW BRAKE APPLIED	SPEED SENSING C/O
TRANSFORMER OIL C/O	TRUCK EQ C/O #1
TRUCK EQ C/O #2	TRUCK HUNT BYPASS F
TRUCK HUNT BYPASS R	TRUCK SURVEIL C/O

2.1.12.5.3 Alarm Help Procedures Page. The alarm help procedures window provides the information for taking action following train and subsystem alarms. This window is accessed using the function keys on the main operations page. The alarm handling window repeats the reported alarms of the operations page. It displays the online help procedure for level 1 and level 2 alarms. The engineer can scroll through the alarm list using the function keys.

2.1.12.5.4 Train Operations Page. The train functions ease the operation of the train. They present specific information and controls on various train operations. They are accessed using the function keys, as a pop-up window on the main operations page. The first page shows the dates and time of the last predeparture tests.

The train operations page presents step by step procedures for the following predeparture tests: alerter test, brake test, ATC test, and ITSU test. The results can be printed out in order to be signed by maintenance personnel.

2.1.12.5.5 Incoming Train Order. When a train order is sent from the wayside operations centers to the train, it is received by the DMS. Upon reception, an incoming train order alarm is generated, requiring acknowledgment by the engineer on MFD1.

The train order is then printed out in the cab. Confirmation of the train order printout is required by the engineer (in case of a paper jam). A reprint command is also available. No additional incoming train order can be received until printout has been confirmed.

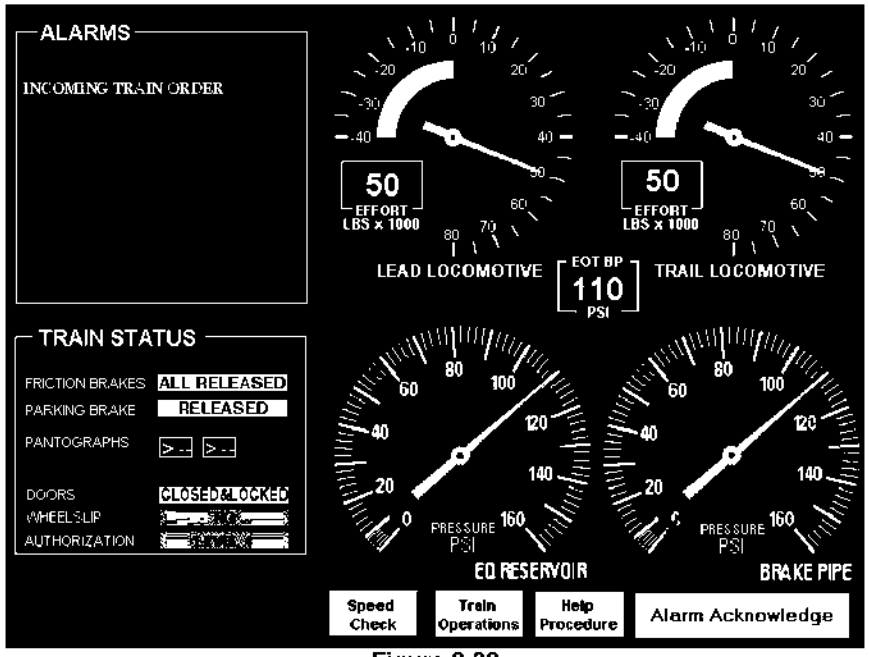


Figure 2-32
Multifunction Display No. 1 Main Operation Page

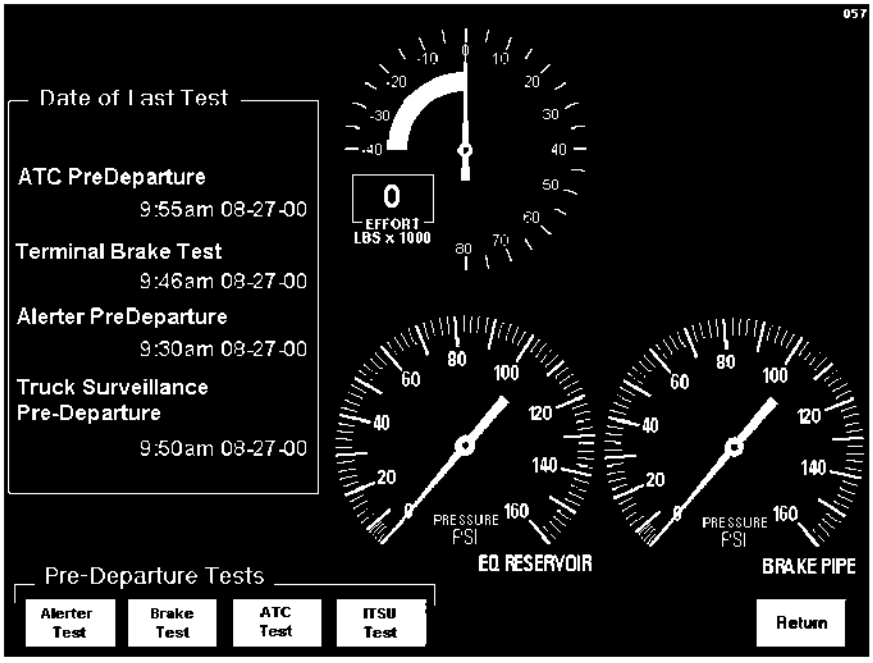


Figure 2-33
Multifunction Display No. 1 Train Operations Page

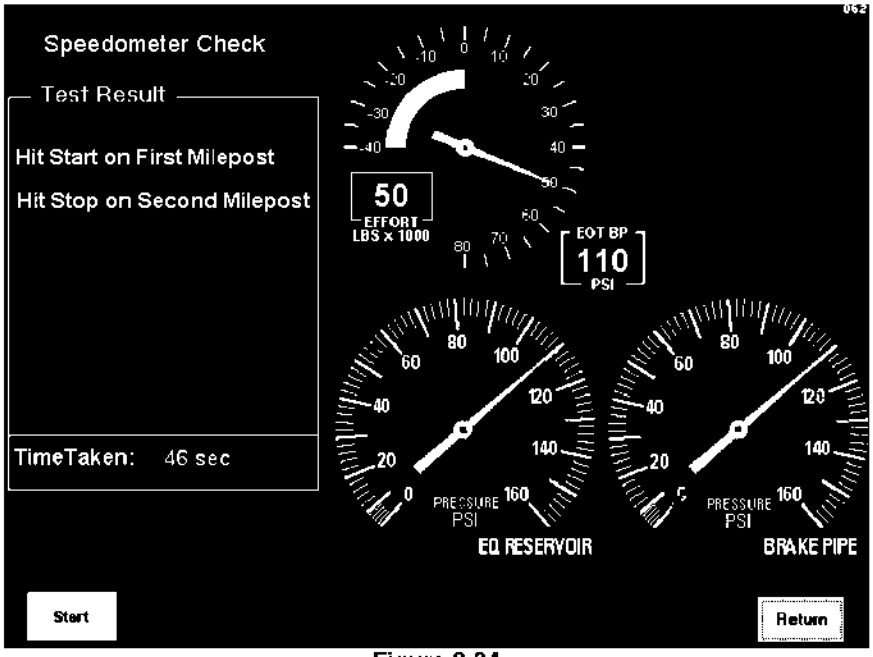


Figure 2-34
Multifunction Display No. 1 Speed Check Page

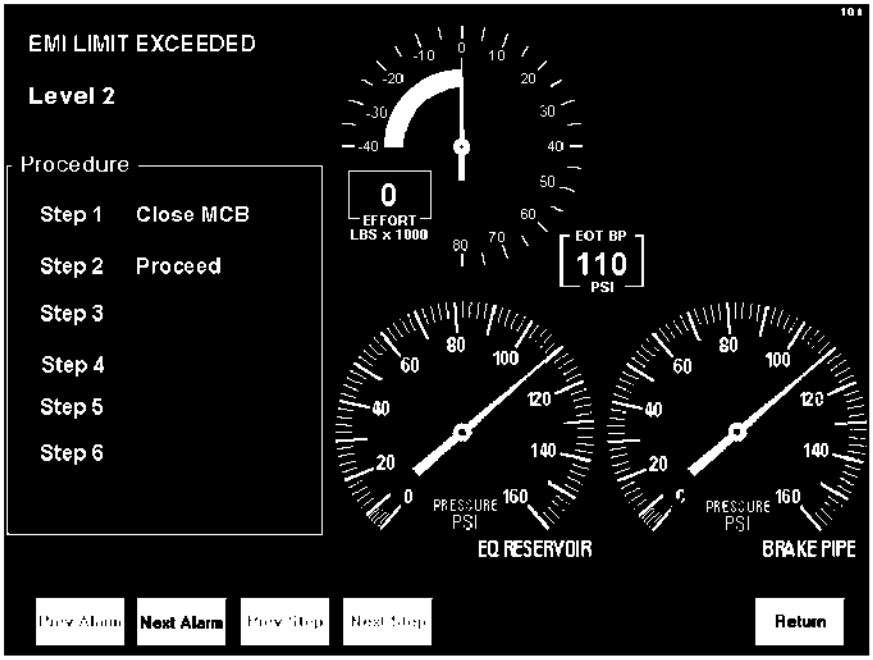


Figure 2-35
Multifunction Display No. 1 Alarm Help Page

2.1.12.6 Multifunction Display No. 2 (Fig. 2-36 to 2-56). Multifunction Display No. 2 (MFD2) is used by the assistant or maintenance personnel. It provides some of the information displayed on MFD1 main operations page. (No alarm help procedures, train operations, or train order information is provided.) It also displays the top level menu for all auxiliary maintenance functions.

The main operations page provides access to the subsystem statuses, maintenance events pages, and manual fault entry pages.

MFD2 main operations page displays the following information:

(1) An ALARMS section, identical to MFD1. (Refer to tables 2-5, 2-6, and 2-7 for a list of all the alarms that can appear on the display.)

(2) A train operational values section that displays the following operational parameters in analog readouts:

- Brake pipe and brake cylinder pressure (same analog gauge)
- Main reservoir and equalizing reservoir pressure (same analog gauge)
- Total electrical traction/braking effort
- Actual speed digital readout.

(3) A TRAIN STATUS section, identical to MFD1.

2.1.12.6.1 Subsystem Status Pages. The subsystem status pages provide information on subsystem health. The top level subsystem status selection page allows the user to get an overall view of the locomotive physical configuration.

NOTE:

If an abnormal status is detected, the corresponding subsystem identification is shown in red.

The subsystem statuses are selected and displayed on a per subsystem group basis. When useful, a button is available presenting a more detailed view.

Most subsystems provide detailed analog parameters as well as discrete statuses. Typical information consists in pressures, temperatures, positions (open, closed), and states (normal/fault, active/inactive, self-test, online/offline).

2.1.12.6.2 Subsystems Maintenance Events Page. The monitoring system uses a daily log to manage the maintenance events generated by all subsystems.

All subsystems track the state (set and reset) of every maintenance event they send to the CMU. The CMU takes all maintenance events that remain in the set state at the end of a day, and transfers them to the beginning of the new day.

This ensures that today's log contains the events that occurred within the last 24 hours, and all events that are still set (even if they were set several days before). Each event describes at least the following:

- Unique descriptive message caption (28 characters)
- Fault code
- Affected subsystem
- Time and date of last occurrence (stamped by the CMU)

- Maintenance event category
- Maintenance event type (set/reset, pulse)
- Geographical position, in mileposts, where the fault occurred (from ACSES)
- Index of the extraordinary report file (if applicable).

The maintenance events selection page is accessed from the main maintenance menu. The maintenance event page gives access to a variety of sorting and filtering options to better isolate the desired data. All events in a specific subsystem group are displayed. The following information can also be displayed:

- Today's events
- Events from a specified date, from today back to a maximum of 5 days (although there is a backlog up to 30 days)
- Events category (faults, information, maintenance forecasting, manual faults, all categories)
- A choice as to whether or not to view the milepost
- Extraordinary Data Report (EDR) information (it indicates if EDR files are available by specific subsystem)
- Explode multiple event count. (Instead of showing the number of time each event has occurred, it shows one entry for each occurrence of this event.)

Default query (summary button): This option generates a default maintenance event query to the CMU with the criteria that are desired most of the time.

The manual fault entry gives the opportunity to register an event that is not covered in the automatic portion of the monitoring system.

2.1.12.7 Car Monitoring Unit (Fig. 2-57). The Car Monitoring Unit (CMU) startup sequence is initiated by the availability of the main 72 Vdc power source. On startup, the CMU performs self-tests, detects hardware configuration, and reads the locomotive number.

The LEDs located at the top of each card of the CMU indicate the status of the card: if the LED is ON, the card is defective. The BYPASSED LED at the bottom of the card indicates if this card is in fault and has been bypassed.

2.1.12.8 Cab Printer (Fig. 2-58). The cab printer is equipped with the following controls and indicators:

- The LINE/LOCAL button is used to set the printer online or offline.
- The PAPER ADVANCE button is used to advance the paper.
- The green ONLINE LED indicates the printer status.
- The red ERROR LED indicates an internal error. It also turns on to indicate a self-test is initiated.
- The yellow POWER LED is on when the printer is powered.

Refer to subsection 2.2.6, on page 2-102, "Cab Printer Operation (Fig. 2-58)" for the operating description of the cab printer.

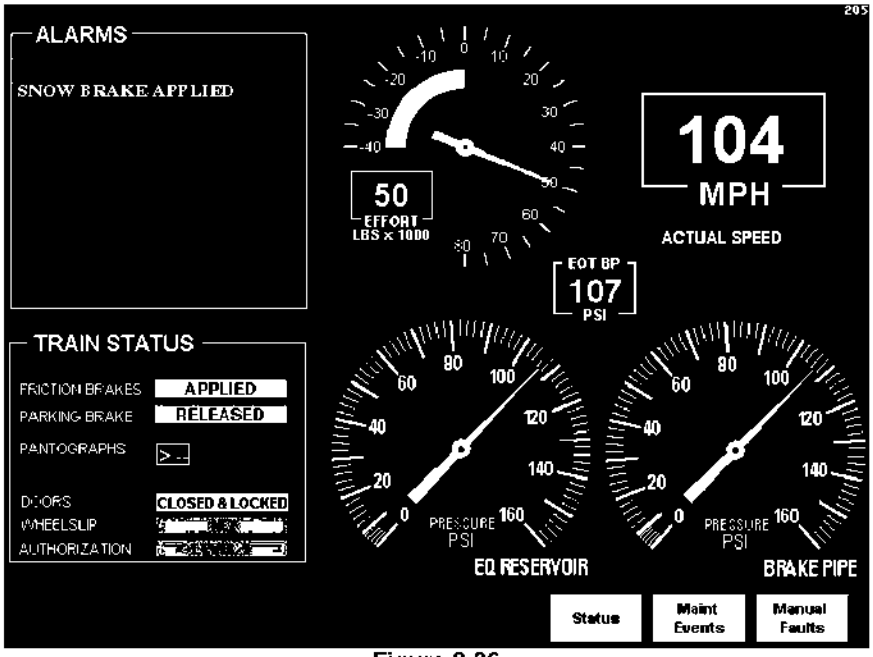


Figure 2-36
Multifunction Display No. 2 Main Operation Page

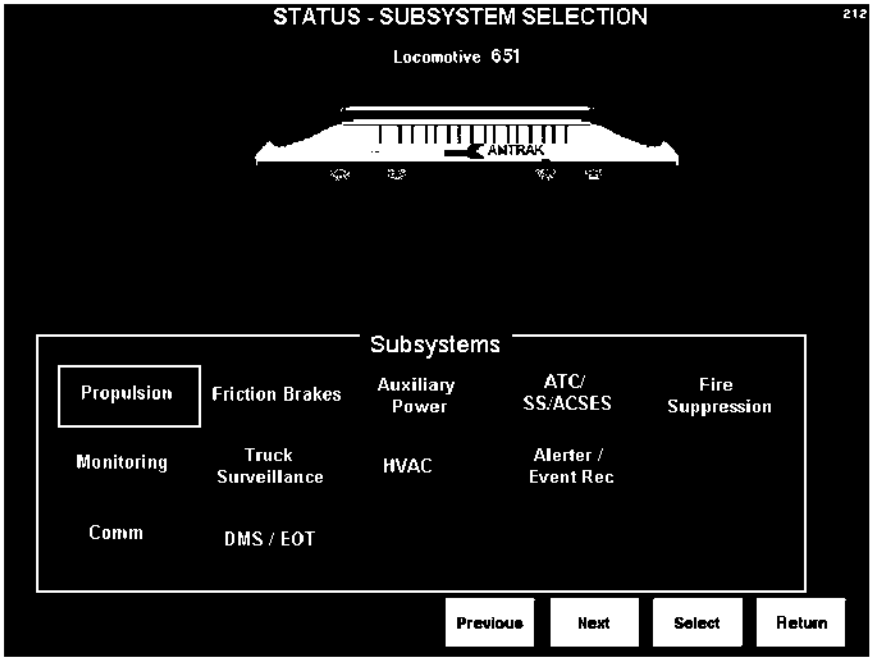


Figure 2-37
Multifunction Display No. 2 Subsystem Status Selection Page

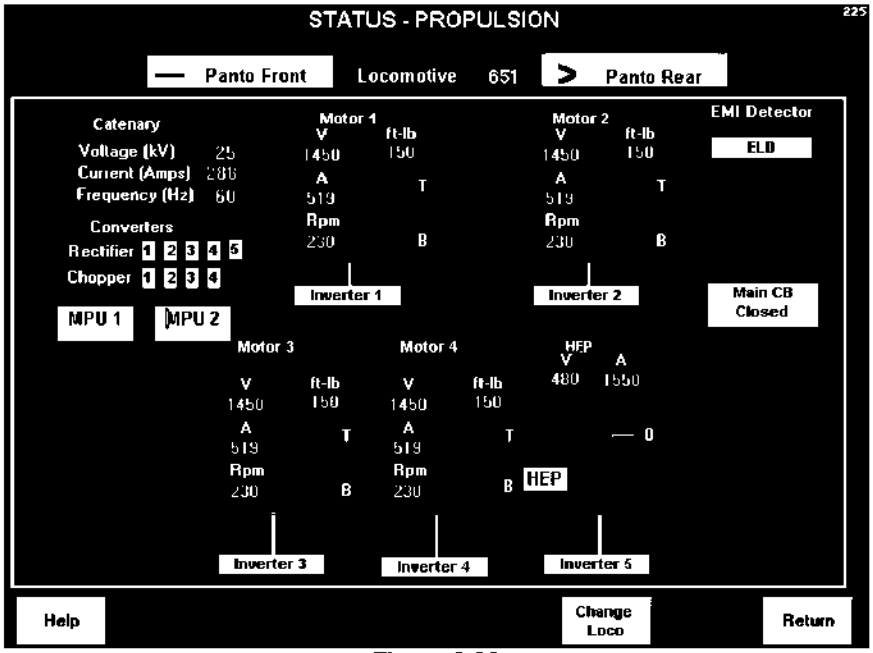


Figure 2-38
Multifunction Display No. 2 Propulsion Subsystem Status Page

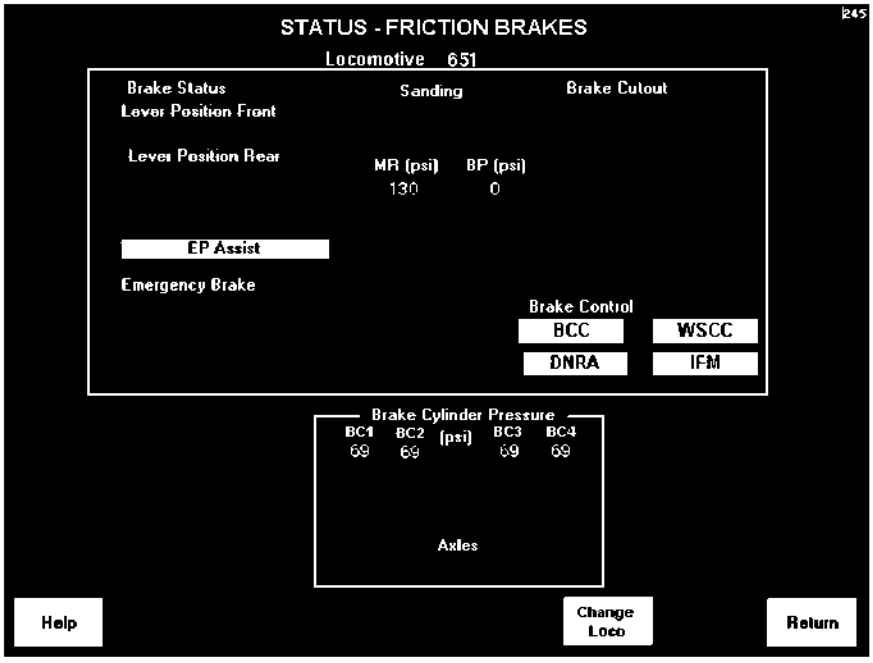


Figure 2-39
Multifunction Display No. 2 Friction Brakes Subsystem Status Page

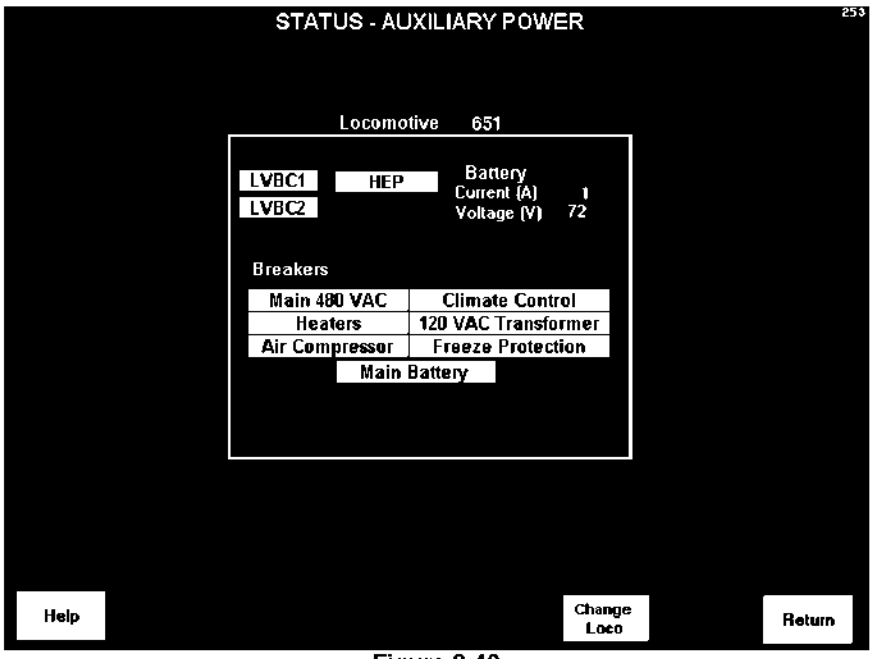


Figure 2-40
Multifunction Display No. 2 Auxiliary Power Subsystem Status Page

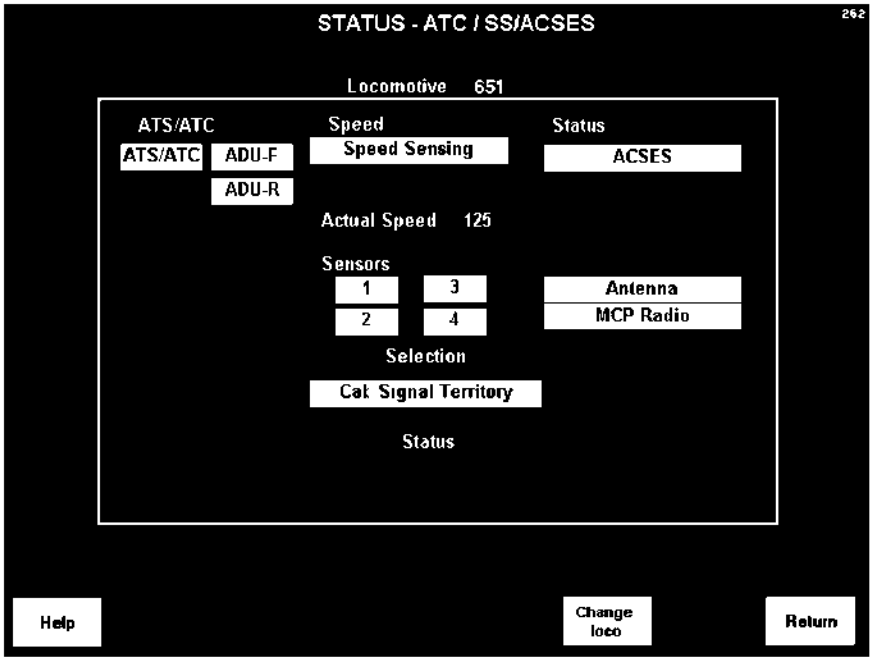


Figure 2-41
Multifunction Display No. 2 ATC/SS/ACSES Subsystem Status Page

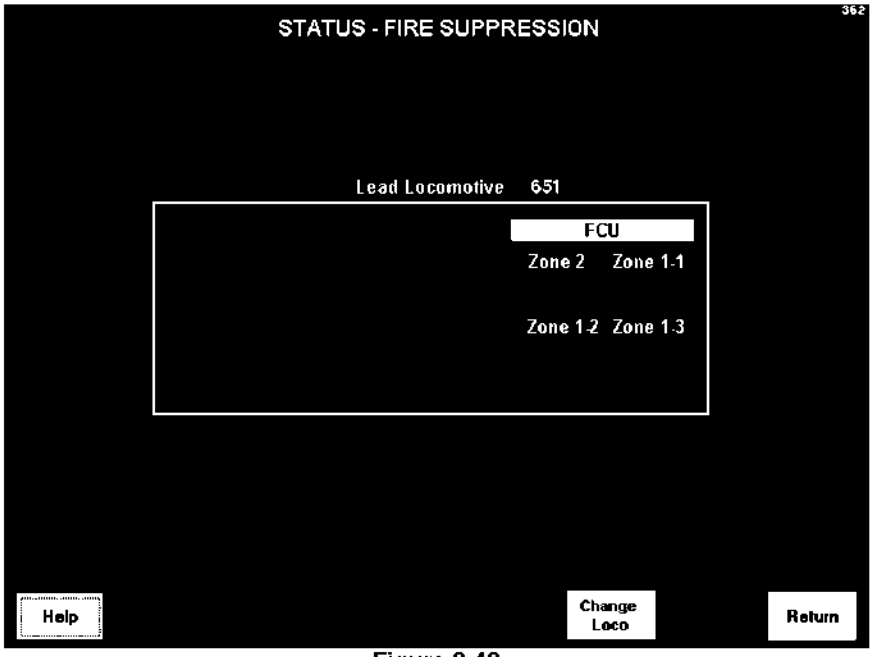


Figure 2-42
Multifunction Display No. 2 Fire Suppression Subsystem Status Page

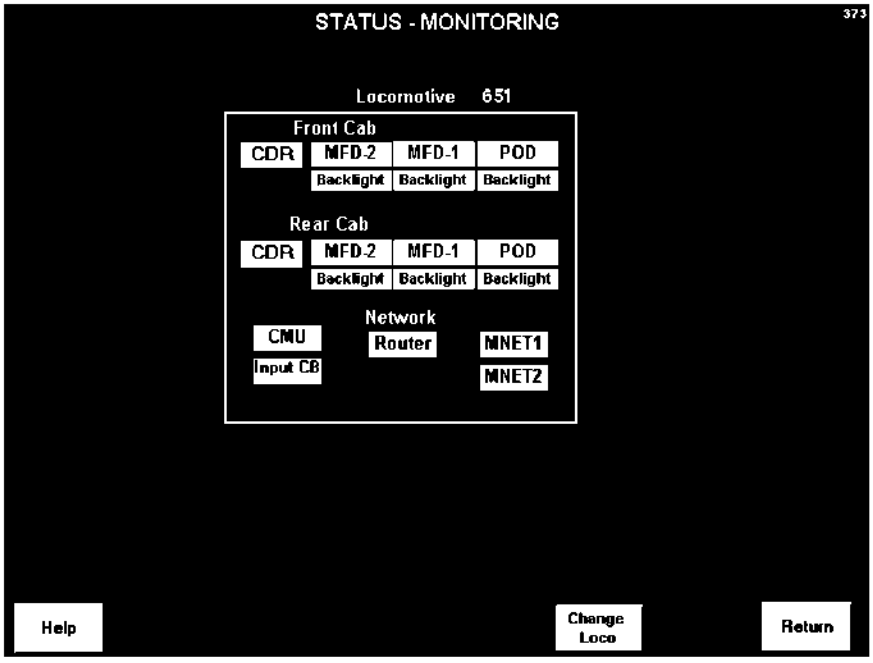


Figure 2-43
Multifunction Display No. 2 Monitoring Subsystem Status Page

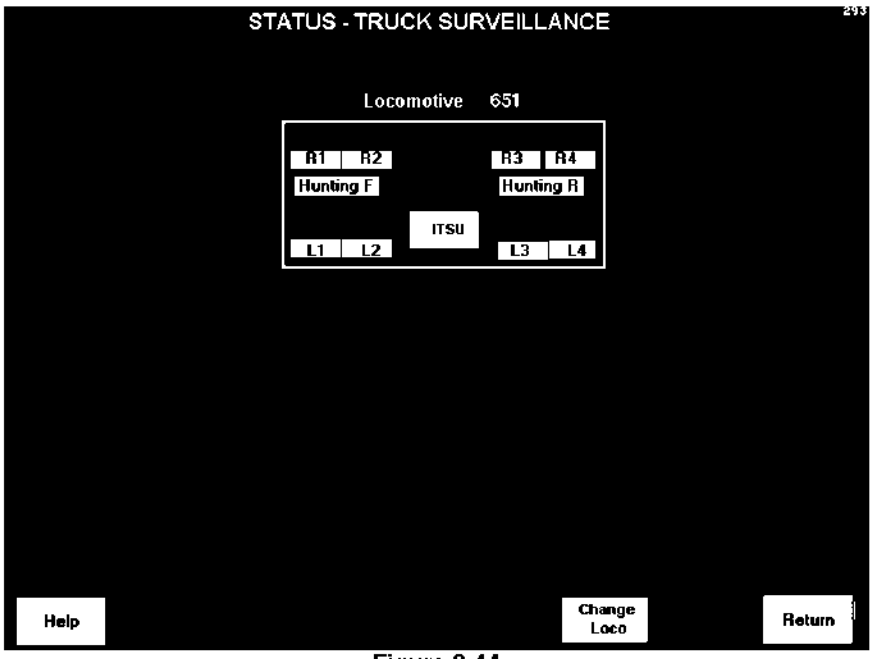


Figure 2-44
Multifunction Display No. 2 Truck Surveillance Subsystem Status Page

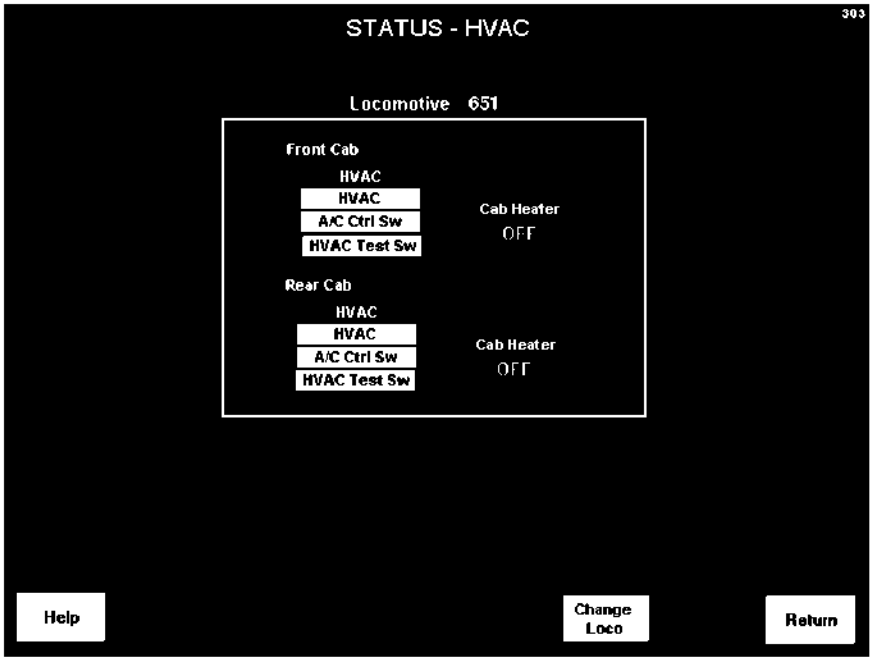


Figure 2-45
Multifunction Display No. 2 HVAC Subsystem Status Page

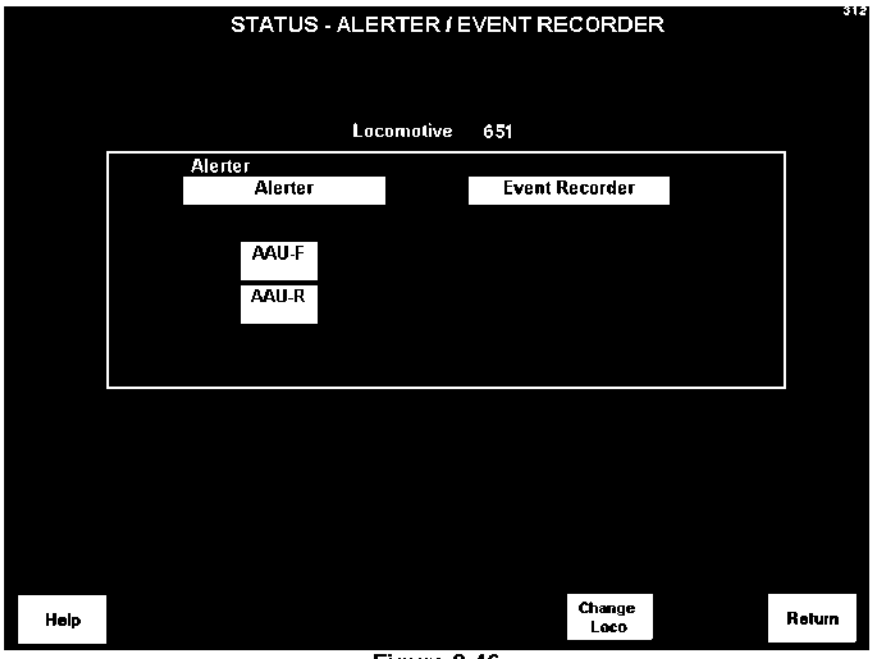


Figure 2-46
Multifunction Display No. 2 Alerter/Event Recorder Subsystem Status Page

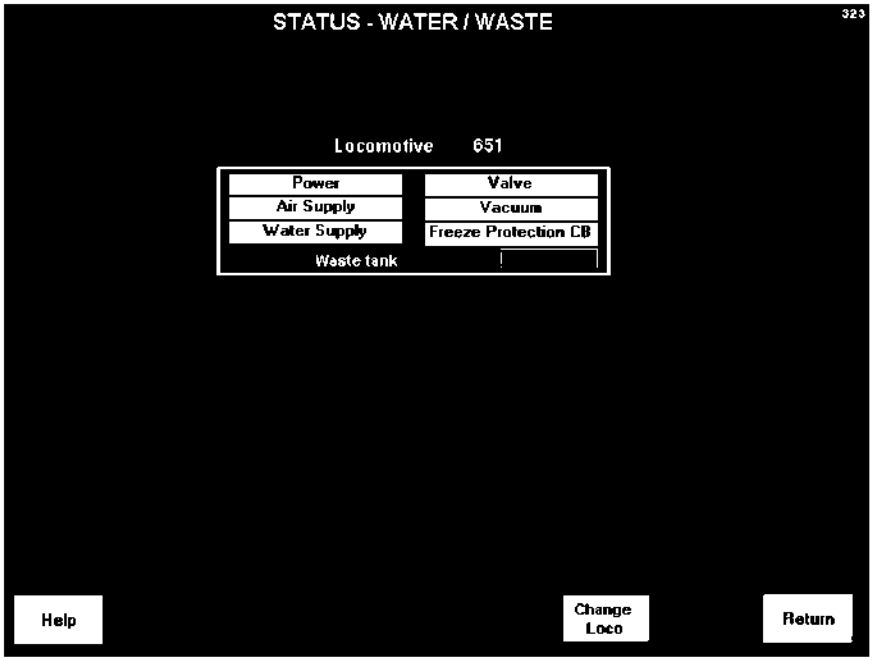


Figure 2-47
Multifunction Display No. 2 Water/Waste Subsystem Status Page

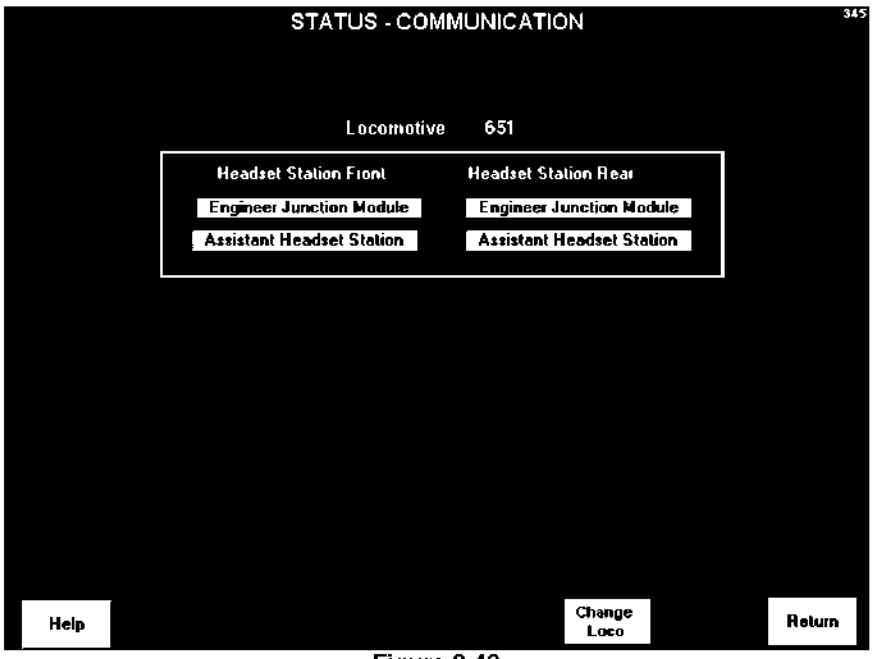


Figure 2-48
Multifunction Display No. 2 Communication Subsystem Status Page

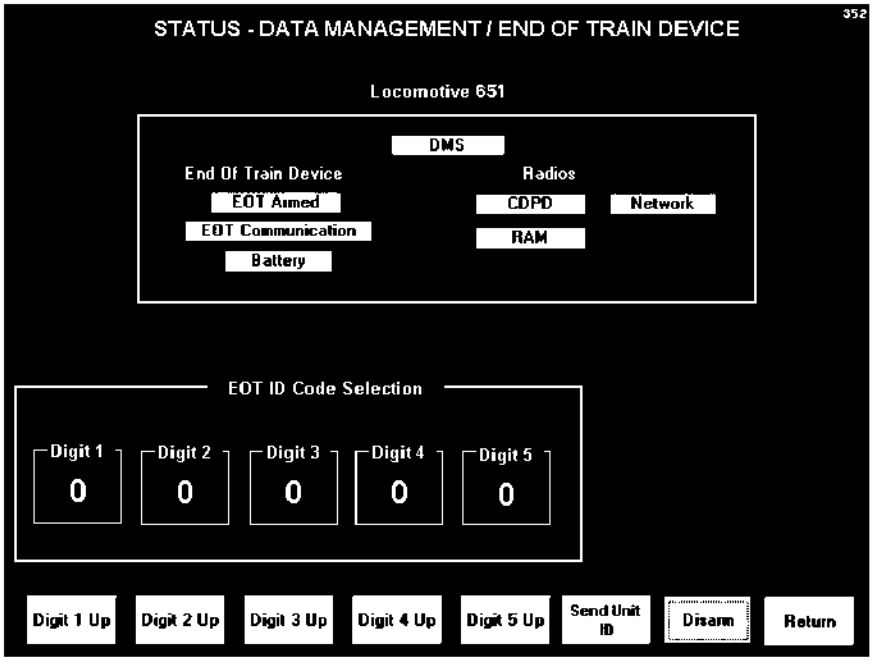
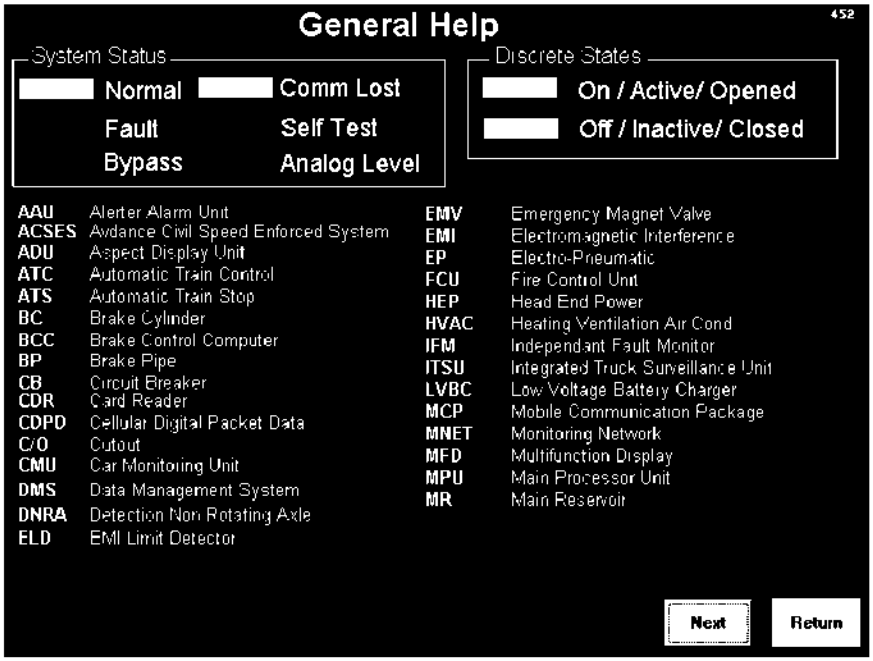


Figure 2-49
Multifunction Display No. 2 DMS/EOT Subsystem Status Page



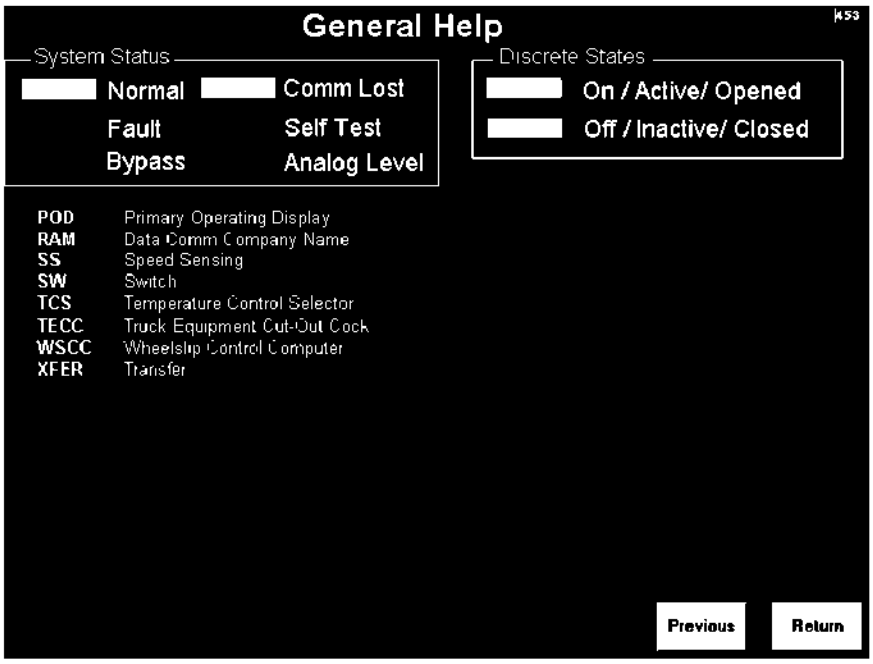


Figure 2-50
Multifunction Display No. 2 Subsystem Status Help Pages

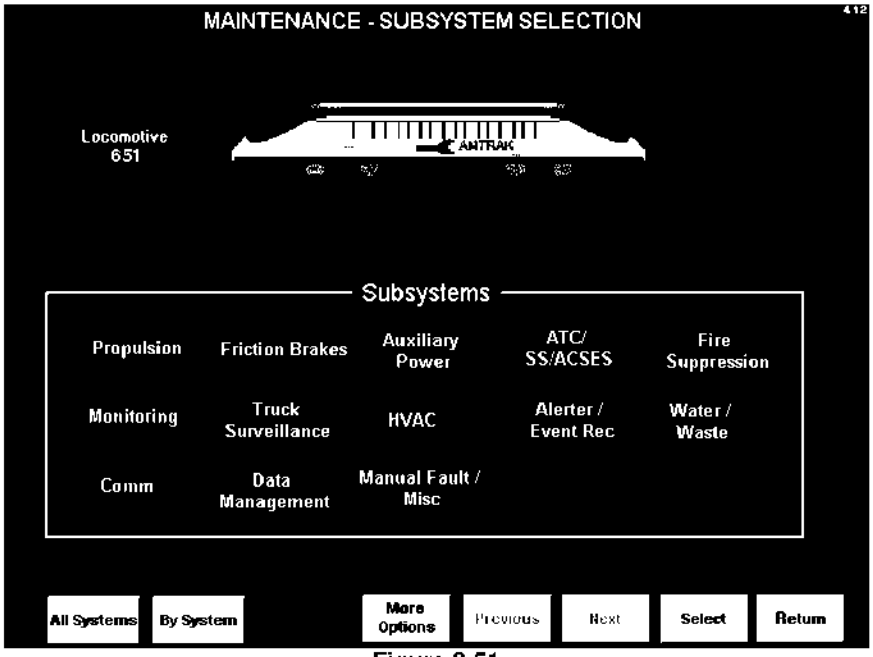


Figure 2-51
Multifunction Display No. 2 Maintenance Events Subsystem Selection Page

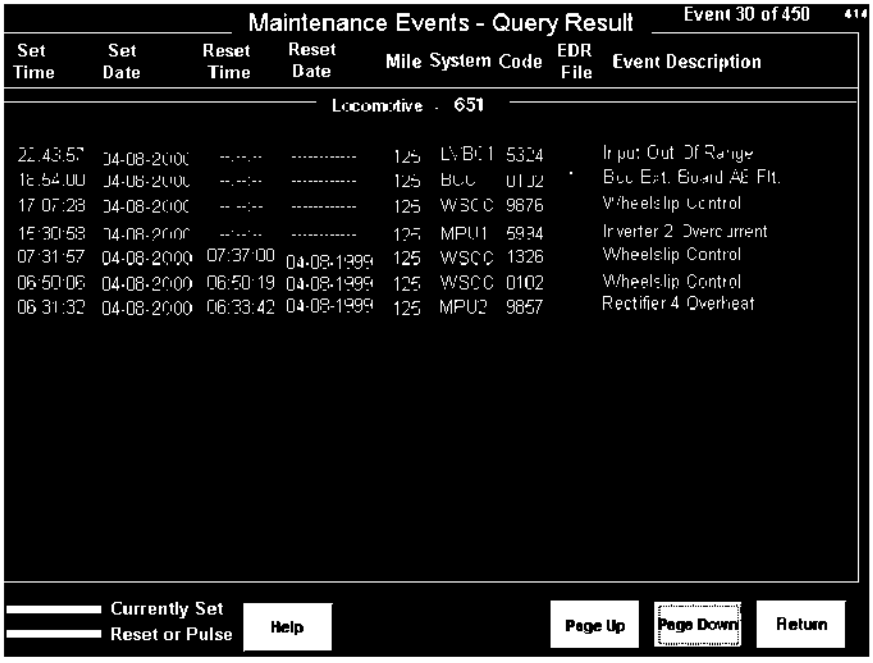


Figure 2-52
Multifunction Display No. 2 Maintenance Events - Query Result Page

Figure 2-53
Multifunction Display No. 2 Manual Fault Entry Page

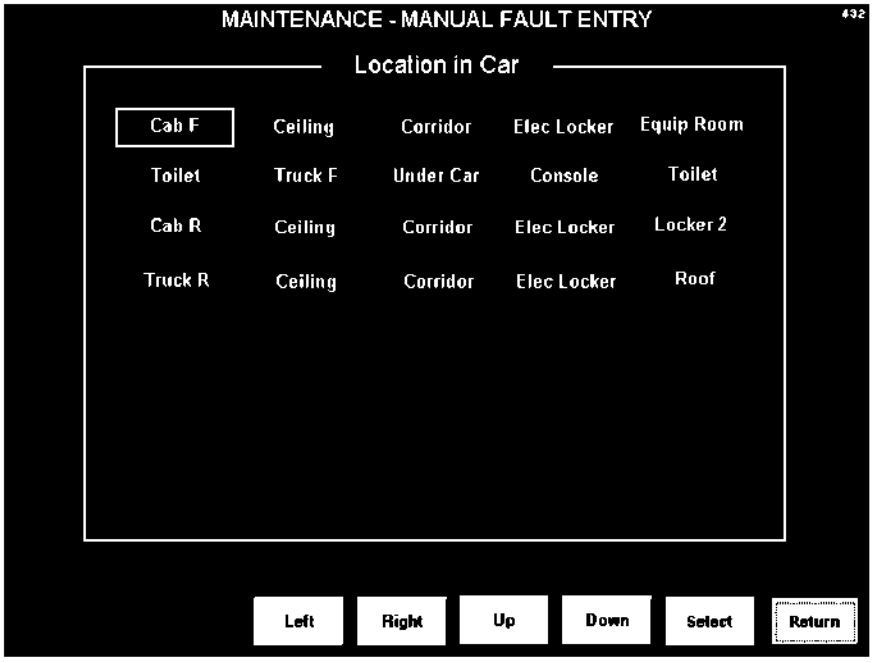


Figure 2-54
Multifunction Display No. 2 Fault Location in Car Manual Entry Page

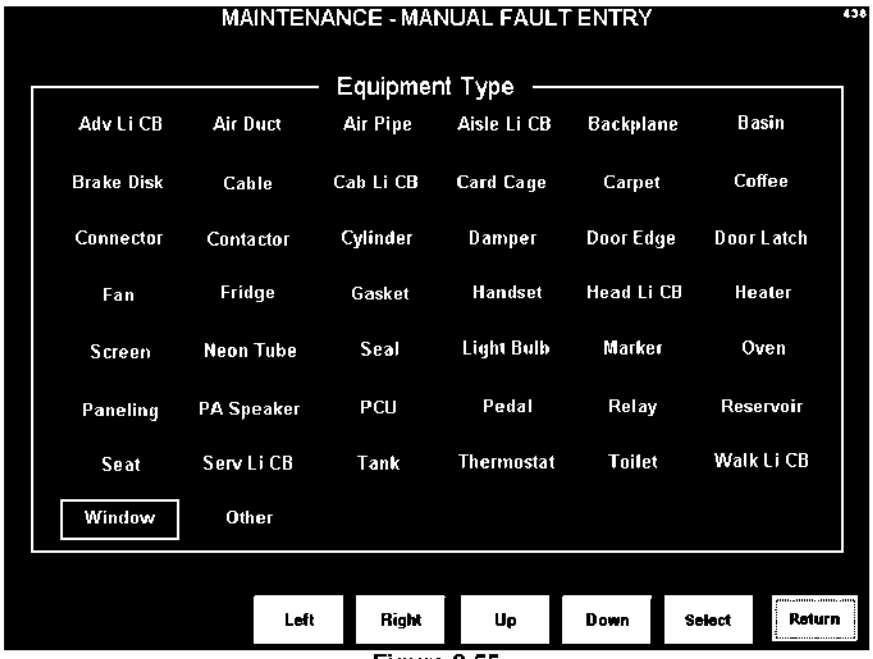


Figure 2-55
Multifunction Display No. 2 Equipment Type Manual Fault Entry Page

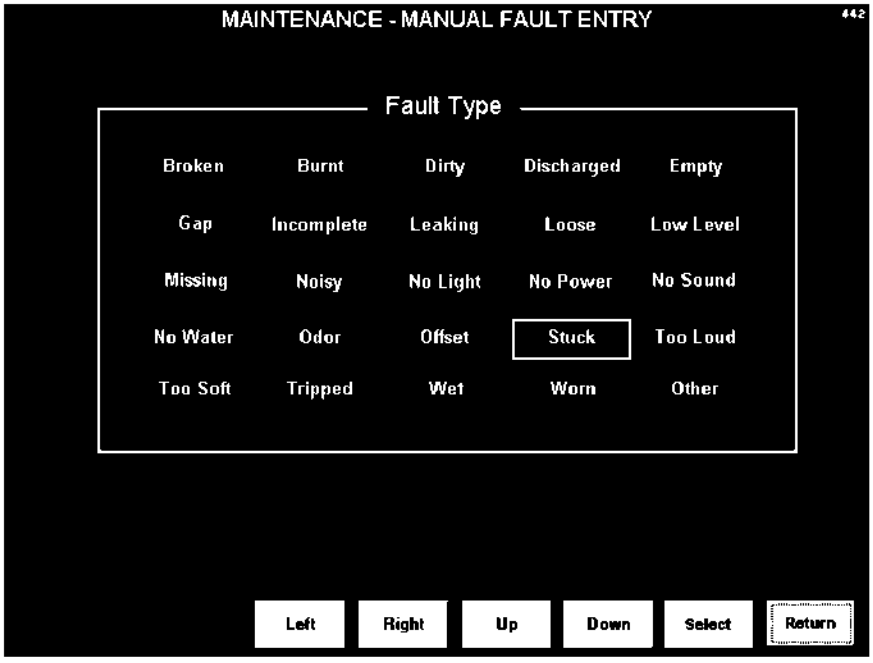
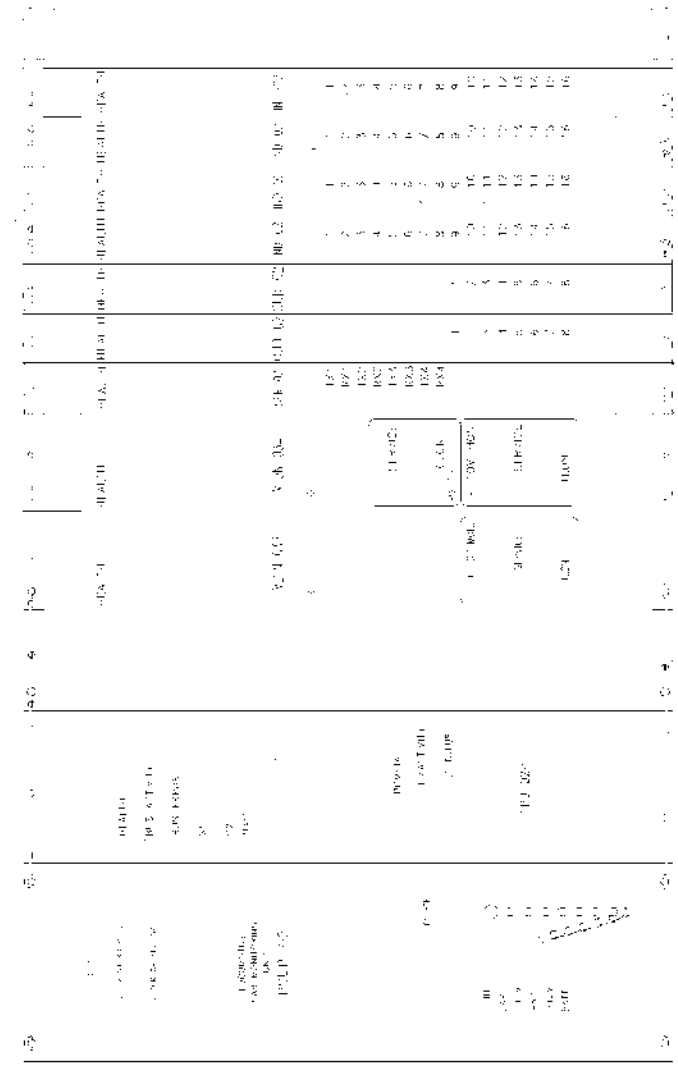


Figure 2-56
Multifunction Display No. 2 Fault Type Manual Fault Entry Page



'F' END LEFT SIDE 'R' END

BB120001

Figure 2-57
Car Monitoring Unit

1. Tab
2. LINE/LOCAL Button
3. PAPER ADVANCE Button
4. Green ONLINE LED
5. Red ERROR LED
6. Yellow POWER LED

'F' END LEFT SIDE 'R' END

3
2
4
5
6
1 1

BB150009

Figure 2-58
Cab Printer

2.1.12.9 End-of-Train System (Fig. 2-26 and 2-49). The two-way End-of-Train (EOT) system consists of the Head of Train Device (HOTD), Locomotive Control Unit, located on electrical locker No. 2 (equipment room) which communicates via radio with an EOT unit mounted on the coupler of the last train car.

The locomotive incorporates all of the functions necessary to communicate with the end unit. In the locomotive cab, the system is controlled by using the cab display units (MFD1 and MFD2). (See Figure 2-49 "Multifunction Display No. 2 DMS/EOT Subsystem Status Page" for a detailed description of the system controls and indications that are available for this system.)

The cab display units, interface with the data management system to provide the following information:

- A digital display of the brake pipe pressure at the rear of the train.
- The end unit battery status (weak or replace).
- A warning of low brake pipe pressure (less than 45 psi).
- Status indication of the radio link (rear-to-front and front-to-rear communications).

NOTE:

The EMERGENCY END-OF-TRAIN BRAKE switch on the engineer's left switch panel allows the engineer to propagate an emergency brake application from the rear of the consist.

2.1.12.9.1 Head Of Train Device (HOTD) Power-up Sequence. When the monitoring system becomes operational, the DMS sets the HOTD default ID value at 00000 (unarmed). The unit ID is set to the default value whenever the DMS is initialized, and when a last car is uncoupled from its corresponding locomotive.

2.1.12.9.2 EOTD Unit ID Programming. When EOT unit ID does not match the one of the last car EOT, the link between the HOTD and the EOTD is not armed. In this case, a level 3 alarm is displayed on the cab display units to inform the engineer that an EOT fault has been detected. The engineer must activate the DMS/EOT Subsystem Status Page on MFD2 to program the unit ID.

2.1.12.9.3 EOTD Arming/Unarming. The EOT is automatically armed when the correct unit ID is entered on MFD2 (which displays the system status). The system is automatically disarmed when the "Disarm" key is pressed on MFD2.

2.1.13 WATER AND WASTE RETENTION SYSTEMS.

2.1.13.1 Potable Water Fill Points (Fig. 2-59). The potable water reservoir can be filled from either side of the locomotive. The fill points consist of a hose fitting protected with a cover and a three-way valve. The three-way valve allows the compressed air of the water raising system to be cut off and vented while refilling the water tank.

A water overflow discharge pipe is located directly below each water fill point.

2.1.13.2 Waste Retention System Controls. The waste collection and retention system is controlled by the equipment described in the following subsections.

2.1.13.2.1 Central Control Panel. The central control panel, behind the access panel of the toilet module, drives all the indicators. The following conditions are monitored:

- Power off
- Low air
- Low water
- No vacuum
- Valve open
- Tank full, 2/3 full, and empty.

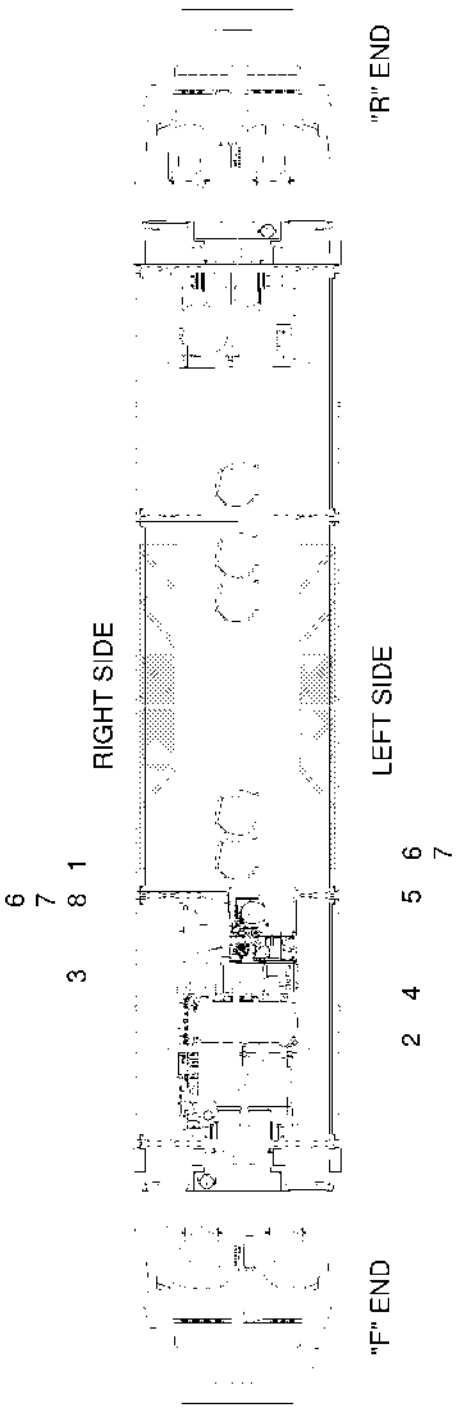
2.1.13.2.2 Waste Tank Status Panel (Fig. 2-60). The waste tank status panel provides a visual status of the system using LEDs with the following indicators:

- TOILET SYSTEM: yellow (activates together with any indicator below)
- POWER OFF: red (HEP, or CB43, waste collection and retention circuit breaker, or disconnect switch off)
- LOW AIR: red (low air pressure in toilet)
- LOW WATER: yellow (water tank less than 1/3 full)
- NO VACUUM: red (low vacuum)
- VALVE OPEN: red (tank drain valve or manual vent valve open)
- TANK FULL: red (waste tank full)
- FULL: yellow (waste tank 2/3 full)
- TANK EMPTY: green (waste tank empty).

2.1.13.3 Water Filling. Connect hose to hose fitting and allow water to flow into tank.

NOTE:

Water escaping from pipe indicates that tank is full.



1. Toilet Assembly
2. Water Tank
3. Waste Tank
4. Waste Tank Status Panel
5. Central Controller
6. Water Fill Station
7. Undercar Service Lines
8. Water Raising Unit

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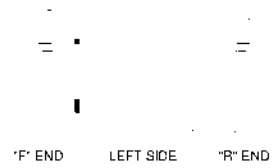
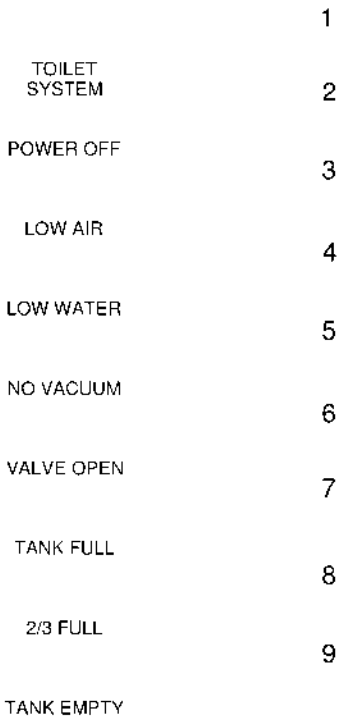
Figure 2-59
Water System Components Location





1. TOILET SYSTEM Yellow LED
2. POWER OFF Red LED
3. LOW AIR Red LED
4. LOW WATER Yellow LED
5. NO VACUUM Red LED
6. VALVE OPEN Red LED
7. TANK FULL Red LED
8. 2/3 FULL Yellow LED
9. TANK EMPTY Green LED

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Figure 2-60
Waste Tank Status Panel

SECTION 2.2
OPERATION

2.2.1 HEP OPERATION. This subsection describes the locomotive Head End Power (HEP) operation.

The HEP (480 Vac, three-phase, 60 Hz) feeds all locomotive and trailer car equipment. The lead locomotive is by default selected as HEP supply.

The locomotive power unit in the central block starts when high voltage is present, and auxiliary inverter become ready. The auxiliary inverter, located in the auxiliary block, is the first inverter to be activated at startup. The auxiliary inverter fed by the DC-Link produces a 1780 Vac, three-phase, 60 Hz output that the auxiliary transformer, located in the main transformer, steps down to produce the HEP. The propulsion electronic control unit also controls the auxiliary inverter.

NOTE:

Head End Power (HEP) is available only if the 480 Vac jumpers are looped at both ends, or when 480 Vac trainlines are looped through all the train consist. If the 480 Vac trainline loop integrity is lost when the locomotive speed is higher than 5 mph, the HEP is still supplied.

The HEP also feeds the Low Voltage Battery Charger (LVBC), which generates 72 Vdc for the battery and the low voltage distribution system. There are two battery chargers with only one active at a time. Both are controlled by the PECU.

The HEP switch on the engineer's overhead switch panel enables the removal and reapplication of the HEP power to passenger cars. In ON position, the switch is operational only in the active cab. The OFF position of the switch is operational at all times, regardless of cab status.

To supply the trailer cars, the HEP switch on the engineer's overhead switch panel is turned on.

2.2.2 PREPARATION FOR OPERATION. Locomotive power-on is achieved locally, from each locomotive. Once pantographs are raised, main circuit breaker closes, machine room power unit starts up, and head end power is available for application to the passenger cars if the two 480 V trainlines are complete.

To prepare the locomotive for operation, proceed as follows:

(1) Press step lighting pushbutton, near entrance door or at bottom of ladder, to turn on access lighting for one minute.

(2) Press CAB ACTIVATE button on cab rear wall switch panel to activate monitoring system, key card reader, propulsion control, and auxiliary compressor.

NOTE:

When the main reservoir pressure is below 90 psi, the auxiliary compressor starts automatically to raise the pantograph, and close the main circuit breaker.

(3) Apply key card against key card reader reading surface.

Key card reader LEDs indicate the following:

NOTE:

Key card reader beeps whenever a status LED is flashing.

- Green LED continuously lit: Key card reader is ready to accept a card.
- Green LED flashing: Card accepted.
- Red LED continuously lit: Key card reader fault.
- Red LED flashing: Key Card rejected.

(4) Type a valid PIN number on keypad. This authorizes operation of reverser, with traction limitations imposed by access level.

NOTE:

If cab is authorized with reverser in other position than OFF, and throttle is in a power position, cycle throttle to "0" and back to power positions to get propulsion controls.

(5) Set reverser to N, FWD, or REV to enable cab controls.

(6) If reverser manipulation is not possible, check that all reversers are in OFF. If opposite cab reverser has been left in another position, correct problem first. (This condition is shown on MFD2.)

(7) Check that POD, MFD1, ADU, and other console indicators come on.

(8) Press PANTO-UP pushbutton on engineer's overhead switch panel to raise the pantograph.

(9) Verify that MCB switch on engineer's overhead switch panel is in AUTO.

(10) When a Cab Car leads train consist, place 13 T CAB CAR switch on engineer's overhead switch panel in ON.

(11) To supply passenger cars, turn momentary HEP switch on engineer's overhead switch panel to ON.

(12) Ensure that all predeparture tests have been successfully completed.

(13) Prior to train movement, turn momentary PARKING BRAKE switch on engineer's right switch panel to RELEASE.

2.2.2.1 Footrest Adjustment (Fig. 2-61). To adjust the engineer's adjustable footrest, use the FOOTREST switch located below the engineer's center console switch panel.

NOTE:

If the switch is defective, the adjustable footrest can be adjusted manually. The handle for manual operation is located on the left side, underneath the access panel to the pneumatic and electric equipment. The handle is used to turn the coupling for manual operation in the proper direction to lower or raise the adjustable footrest.

2.2.2.2 Seat Adjustment (Fig. 2-62). To adjust the engineer's seat and the assistant's seat, use the controls shown on Figure 2-62. The adjustments available are as follows:

2.2.2.2.1 Seat Height. The height adjusting knobs allow 5.25 inches of vertical height adjustment. If excessive resistance is encountered, turn the knob while standing away from seat cushion.

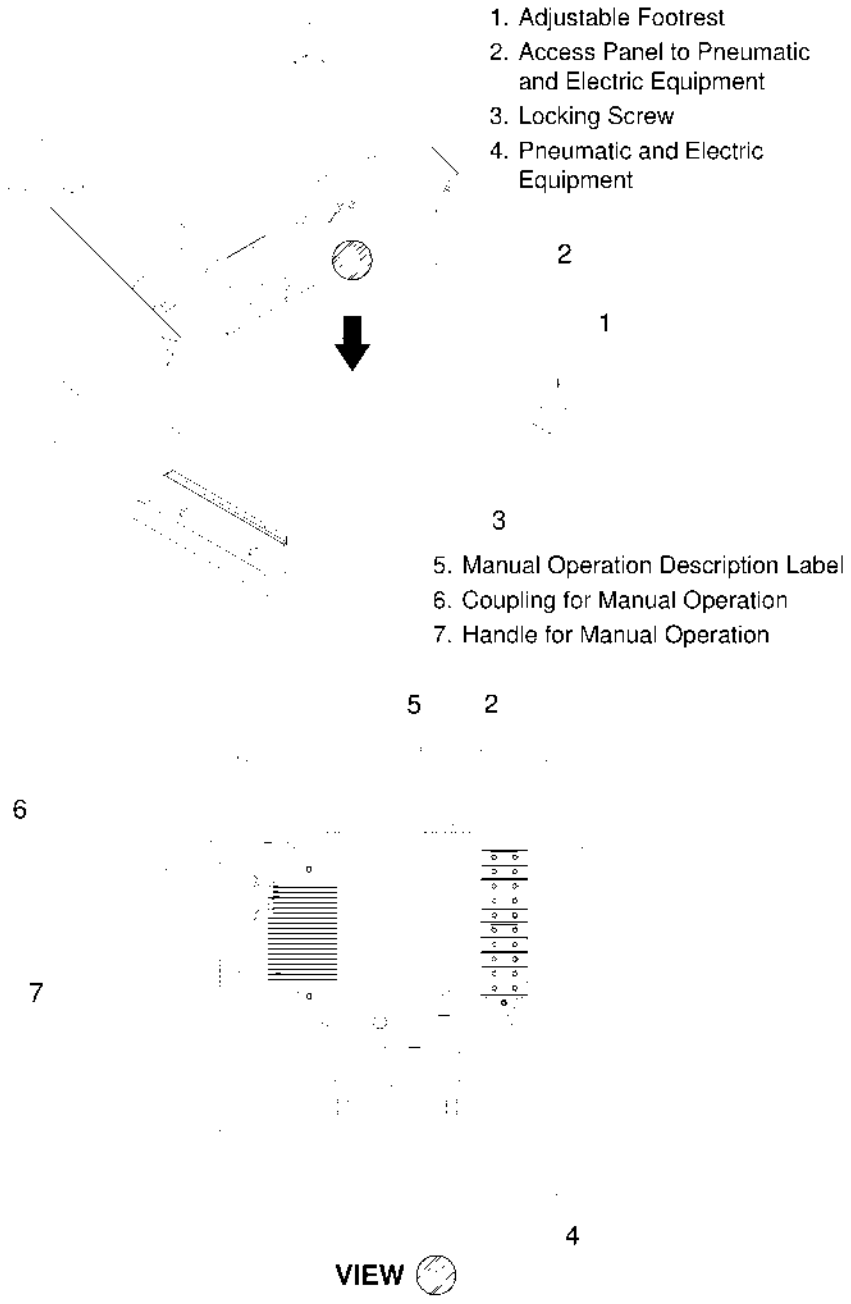
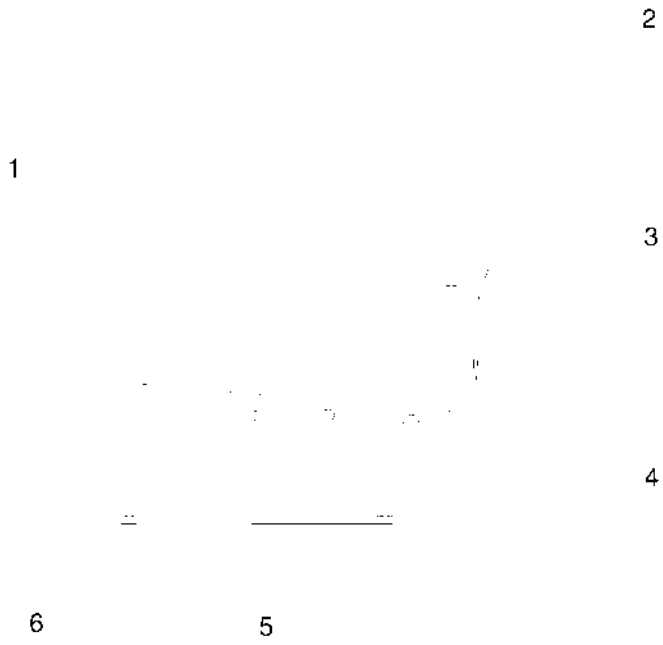


Figure 2-61
Adjustable Footrest



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1. Height Adjusting Knob (Turn Towards the Seat Front to Lower, Towards the Seat Back to Raise)
2. Lumbar Support Adjustment Knob
3. Seat Back Recline Knob
4. Suspension Lockout Limitor
5. Seat Tilt Knob
6. Fore/Aft Slide Handle (Pull Up to Move)

Figure 2-62
Engineer's Seat and Assistant's Seat

2.2.2.2.2 Seat Tilt. The seat tilt knobs allow eight degrees of seat cushion angle adjustment. Seat tilt is independent of seat height adjustment to allow full tilt range at all seat heights.

2.2.2.2.3 Seat Back Recline. The seat back recline knobs allow an adjustment of the seat back angle from 45 degrees forward to 110 degrees backward.

2.2.2.2.4 Lumbar Support. The lumbar support adjustment knobs increase the amount of lumbar support when rotated forward, and decrease it when rotated backward.

2.2.2.2.5 Fore/Aft Slide. The slide handle allows the seat to move front to back when pulled up to release the seat lock.

2.2.2.2.6 Suspension Lockout Limitor. The lockout limitor allows the following settings:

- Outward position: Full suspension range
- Middle position: Limits the vertical suspension range
- Far right position: Locks out the suspension.

NOTE:

To engage the lockout, the seat must be in the middle height position. (See figure 2-62.)

2.2.3 LOCOMOTIVE DEPARTURE TEST. The Locomotive Departure Test must be performed once each calendar day prior to initial departure. Proceed as indicated in the following subsections:

2.2.3.1 Preparation for Test.

NOTE:

In order to be able to perform the locomotive departure test, it is necessary to activate the cab, move the reverser to forward position, and activate the HEP switch.

STEP DESCRIPTION	MFD1 INDICATION
1) Verification of electric brake: Check that following MFD1 indications are not active in the ALARM BOX section: TRACTION LOSS ELECT BRAKE LOSS.	 Not Shown Not Shown
NOTE: If the TRACTION LOSS and ELECT BRAKE LOSS alarms are not active, the electric brake is fully functional.	
2) Apply parking brake and verify that gold indicators are out.	No MFD1 indication required.
3) Move independent brake to RELEASE.	No MFD1 indication required.

STEP DESCRIPTION	MFD1 INDICATION
4) Press "Train Operations" button on MFD1.	No MFD1 indication required.
NOTE: MFD1 screen changes to display the last successful test dates for ATC PreDeparture, Terminal Brake Test, Alerter PreDeparture, Truck Surveillance Pre-Departure. The following buttons become available at the bottom of the screen: • Alerter Test • Brakes Test • ATC Test • ITSU Test.	

2.2.3.2 Brake Predeparture Test.

NOTE:
Next steps are preparation for brake predeparture test.

STEP DESCRIPTION	MFD1 INDICATION
5) Press "Brakes Test" button.	No MFD1 indication required.
NOTE: Brake test procedure is enabled.	
6) Press "Initiate" button.	No MFD1 indication required.
NOTE: MFD1 initiates the test and displays step-by-step instructions in the "Test Procedure" section of the screen, as shown in the MFD1 INDICATION column.	
	Preparation for Test:
NOTE: In this brake test, the BRAKE VALVE C/O switch on the engineer's desk right switch panel must be placed in PASS. position (train consist set-up in graduated release).	
7) Place ABCL to RELEASE position.	Charge the System
NOTE:. For safety reasons, the parking brake must have been applied in step 2 of this procedure.	Apply Parking Brake
8) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	

STEP DESCRIPTION	MFD1 INDICATION
The next steps verify brake pipe air leakage.	Tightness Check
9) Set ABCL position to SUP position to get a BP pressure reduction of 20 psi from released value, as displayed on BP pressure gauge.	Make 20 PSI BP Reduct Brake Pipe drops to 90 PSI.
10) Move BRAKE VALVE C/O switch to OUT position.	Cut Out BP Charging
11) Take a reading of the BP pressure and, with a stop watch, wait 3 minutes, and:	After 3 Min.: Check BP Reduc
12) Take a second reading.	BP Reduct Not Exceed 3 PSI
13) Press Confirm/Next Step button.	Display next Brake Test steps.
14) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the service portion of the brake system.	Full Service Test
15) Move BRAKE VALVE C/O switch to PASS. position and move ABCL to RELEASE position.	Cut In BP Charge, Rel. Brake BP = 110 PSI BC = 0 PSI
16) Move ABCL to FULL SERVICE position.	Put ABCL to Full Service
17) Take a BC pressure reading on MFD1. BC pressure on MFD1 should be 56 psi ± 2 psi.	BC = 56 psi ± 2 psi
18) Verify that all brakes are applied.	Chk if all Vehicles Respond
19) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the operation of the brake control computer.	Computer Mode Test
20) Place ABCL to RELEASE position.	Put ABCL In Release
21) BP pressure should remain at 81 psi.	Chk if BP Remains at 81 Psi
The next steps verify the emergency portion of the brake system.	Emergency Brake Test
22) Move ABCL to EMERGENCY position.	Put ABCL to Emergency

STEP DESCRIPTION	MFD1 INDICATION
23) BP pressure on MFD1 should be 0 psi.	Check if BP Dropping to Zero
24) Verify that all brakes are applied.	Chk if all Vehicles Respond
25) Wait 60 seconds minimum, then move ABCL to RELEASE position.	After 60 S: ABCL to Release
NOTE: BP pressure = 110 PSI, BC pressure = 0 PSI.	
26) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the emergency mushroom portion of the brake system.	EEPV Test
27) Press the engineer EMERGENCY BRAKE VALVE Mushroom.	Activate the EEPV
28) BP pressure on MFD1 should be 0 psi.	Check if BP Dropping to Zero
29) Verify that all brakes are applied.	Chk if all Vehicles Respond
30) Wait 60 seconds minimum, then reset the EMERGENCY BRAKE VALVE mushroom.	AFTER 60 SECONDS: RESET EEPV
NOTE: To charge the system, move ABCL to HANDLE OFF position, and then to RELEASE position.	
31) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the emergency magnet valve operation.	EMV Test
32) The Brake Control Computer activates the Emergency Magnet Valve automatically.	BCC Activates EMV
33) BP pressure on MFD1 should be 0 psi. Verify that all brakes are applied.	Chk if all Vehicles Respond
34) Wait 60 seconds.	After 60 S: BCC to Reset EMV
35) Move ABCL to HANDLE OFF position.	When ER is 0 put ABCL to HO
The next steps verify the independent brake operation.	Independent Brake Test

STEP DESCRIPTION	MFD1 INDICATION
36) Move ABCL to RELEASE position.	Put ABCL to REL
37) Move IBCL to MAX position.	Put IBCL to Full Application
38) BC pressure on MFD1 should be 57 psi ± 2 psi.	Read the BC Pressure
39) Verify that BC pressure is 57 psi ± 2 psi.	Chk if BC Within Tolerance
40) Move IBCL to RELEASE position.	Put IBCL to Release
The next steps verify the pneumatic backup portion of the brake system	Pneumatic Backup Test
NOTE: The Brake Control Computer deenergizes the PCMV for pneumatic backup operation.	
41) Move ABCL to FULL SERVICE position.	Put ABCL to Full Service
42) Take a BC pressure reading on MFD1. BC pressure should be 56 psi ± 2 psi.	Chck if all Vehicles Respond
43) Move ABCL to RELEASE position.	Put ABCL to Release
44) Verify that all brakes are released.	Check if all Vehicles Release
NOTE: BP pressure = 110 PSI, BC pressure = 0 PSI.	
45) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
NOTE: The Brake Control Computer reenergizes the PCMV for normal operation.	
The next steps verify the Electro Pneumatic portion of the brake system.	EP-Brake Test
46) Move ABCL to FULL SERVICE position.	Put ABCL to Full Service
47) Wait until brakes are applied and then move ABCL to RELEASE.	After 10 S: ABCL to Release
48) With a stop watch, measure the time to fully release the brakes.	Note the Release Time
49) The release time should be within tolerances.	Chk if Rel Time WT Tolerance
NOTE: The release time depends on the coach cars, and not on the locomotive only.	

STEP DESCRIPTION	MFD1 INDICATION
50) Press Confirm/Next Step button.	Test Result: Passed
51) Press Print/Record button.	Print OK and Reprint buttons come on.
52) Press Print OK if the report is properly printed. Press Reprint is the report is not properly printed.	No MFD1 indication required.
53) Press Return button.	MFD1 screen displays the Train Operations page.

2.2.3.3 ATC Predeparture Test. For this test, the reverser must be placed in FORWARD position.

STEP DESCRIPTION	MFD1 INDICATION
NOTE: Next steps are preparation for ATC predeparture test	
1) Ensure that parking brake is applied.	Parking Brake: Applied
2) Ensure there is no code present in track.	
3) Verify that CAB TERRITORY switch on cab rear wall switch panel is set to IN position.	
4) Press ATC Test button.	Display menu choice.
NOTE: Next steps test the ATC in a step-by-step operation.	
5) Press Initiate button.	
The system will simulate track codes and for each code will check the overspeed and under speed in an ascending order up to the maximum speed. (The ADU will go through all aspects of the cab signal and display all overspeed points.) For each code, the simulated coded speed and the simulated locomotive speed will be shown on POD. For each coded speed, audible and visual alarms will be generated without the need for acknowledge.	The system will go through all aspects of the cab signal and display all overspeed points

STEP DESCRIPTION	MFD1 INDICATION
6) The system will cease to drive the speedometer and the code changes will be simulated in a descending order until a restricting aspect is reached. The operator must acknowledge downward codes except for the last one.	Acknowledge all warnings except restricted aspect
7) Five seconds after last downward code change, the ATC triggers a penalty brake.	Verify the brake pipe pressure drop and application indication
8) Reset the penalty brake.	Reset penalty
9) Press Confirm Result button.	Test Result: Passed
10) Press Print/Record button.	Display menu choices.
11) Press Print OK if report is properly printed.	Display menu choices.
12) Press Return button.	Display menu choices.

2.2.3.4 Alerter Predeparture Test.

STEP DESCRIPTION	MFD1 INDICATION
1) Move ABCL to FULL SERVICE position.	BC pressure increases.
2) Press Alerter Test button.	Start of Alerter test procedure enabled.
3) Press Initiate button.	Initiate test and display the step-by-step operation.
4) Wait approximately 25 seconds when audible alarm starts and reset the alerter using the Acknowledge button.	Reset the alerter using various inputs
5) Wait approximately 25 seconds when audible alarm starts and reset the alerter by doing one of the following. • Activating any acknowledge switch • Moving the horn button • Moving the horn footswitch • Moving the bell button • Switching on the headlight • Moving the throttle. • Moving the ABCL.	Reset the alerter using various inputs

STEP DESCRIPTION	MFD1 INDICATION
NOTE: If the ATC is cutout, the alerter can't be acknowledged by the acknowledge footswitch and acknowledge whisker switch. One of the other reset functions must then be used.	
6) Wait until timer expires.	Do not acknowledge
7) Penalty brake should be initiated. BC pressure should be greater than 50 psi.	Verify the brake pipe pressure drop and application indication
8) Move ABCL to SUPPRESSION position.	Reset penalty with brake application suppression
9) Press Confirm Result button.	Test Result: Passed
10) Press Print/Record button.	Display menu choices.
11) Press Print OK if the report is properly printed.	Display menu choices.
12) Press Return button.	Display menu choices.

2.2.3.5 ITSU Predeparture Test.

STEP DESCRIPTION	MFD1 INDICATION
1) Press ITSU Test button.	Display menu choice.
2) Press Initiate button.	
This initiate an ITSU self test and in parallel opens the "on board" trainlines. The operator should verify and acknowledge that the ONBOARD FAILURE indicator is ON.	Acknowledge that on board light on the console is lit
3) If there is a second locomotive, press the Next Loco/Passed button.	Select next loco button if second loco is present
4) Press the Next Loco/Passed, or the Test Failed button.	Press passed or failed button to confirm test result
5) Press Print/Record button.	Display menu choices.
6) Press Print OK if the report is properly printed.	Display menu choices.
7) Press Return button.	Display menu choices.
8) Press Return button.	Return to the Main Operations Page of MFD1.

2.2.4 COUPLING (Fig. 2-63). To couple, one of the couplers must be in open position. Proceed as follows:

(1) Apply parking/hand brake on equipment to be coupled.

(2) Open one of the knuckle of couplers to be mated by actuating coupler operating mechanism manually.

CAUTION:

Vehicle must coast into mating vehicle during couple maneuver. Failure to do so may damage equipment.

(3) Couple at speed of 2.5 mph ± 1 mph.

CAUTION:

The speed limit must be adhered to in order to prevent damage to the equipment.

(4) Inspect telltale recess to determine if coupler is properly locked. (See figure 2-63 "Properly Locked Coupler and Mechanical Head Exploded View.")

(5) Release parking/hand brake.

2.2.5 MULTIPLE UNIT OPERATION. When connecting the train control trainlines of the HHP-8 (HSEL) locomotive to any other type of equipment, the jumper must be connected as indicated below:

(1) For another HHP-8 (HSEL) or an AEM-7 locomotive, connect the white MU 27-pin receptacle to the corresponding white receptacle.

(2) For a Cab Car or a conventional locomotive, connect the black MU 27-pin receptacle to the corresponding black receptacle.

The blue door control and communication 27-pin receptacle must be connected to the corresponding blue receptacle of any other type of equipment.

NOTE:

The circuit breaker CB92, Diesel Engine Run, must be set to proper operating position when the HHP-8 is coupled to a diesel locomotive. (See Figure 2-13 "72 Vdc and 120 Vac Circuit Breaker Panels - Electrical Locker No. 3" for exact location.)

2.2.6 CAB PRINTER OPERATION (Fig. 2-58). The following subsections describe all the procedures required for the normal operation of the cab printer.

2.2.6.1 Paper Removal. To remove paper, proceed as follows:

(1) Set printer offline by pressing LINE/LOCAL button until green ONLINE indicator (LED) goes off.

(2) Unlock printer door by pressing on tabs located on either side of printer door.

(3) Pull up on tabs to open door.

(4) Remove printer paper roll holder from printer.

(5) Remove empty printer paper core from roll bar.

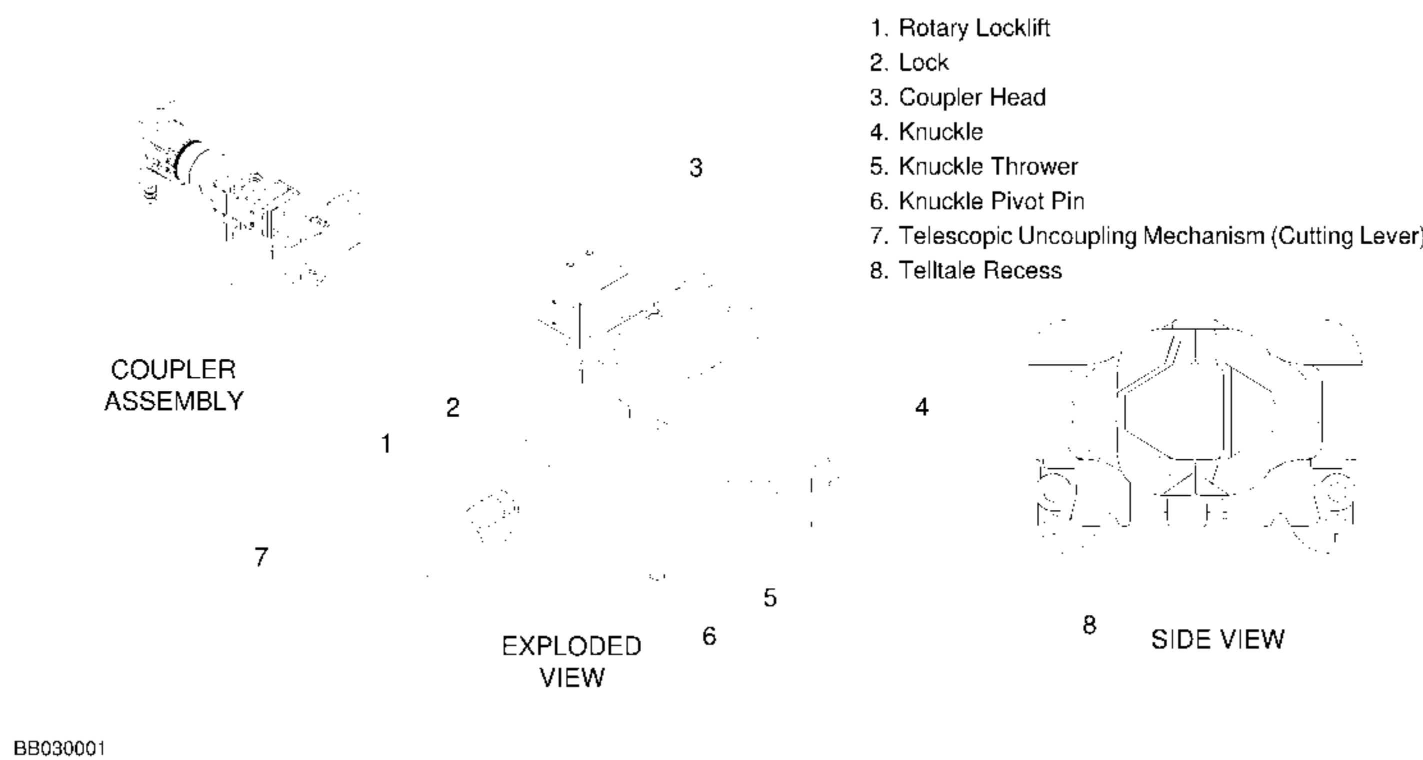


Figure 2-63
Properly Locked Coupler and Mechanical Head Exploded View

2.2.6.2 Paper Installation. To install paper, proceed as follows:

(1) Insert roll bar through core of new printer paper roll.

(2) Install printer paper roll on holder so printer paper feeds from top of roll toward front of roll holder.

(3) Feed printer paper from roll so that it extends over platen after insertion.

(4) Insert printer paper roll holder in printer and close door with tabs unlocked.

(5) Press tabs to lock door.

2.2.6.3 Paper Advance. To advance paper, proceed as follows:

(1) Ensure that green ONLINE LED is off. If not, press LINE/LOCAL button until it goes off.

(2) Press momentarily OR hold PAPER ADVANCE button.

(3) Press LINE/LOCAL button to place printer back online.

(4) To cut paper, lift it and tear along top edge (sharp) of paper opening.

2.2.6.4 Printer Verification. To verify proper operation of printer, proceed as follows:

(1) Ensure that green ONLINE LED is off. If not, press LINE/LOCAL button until it goes off.

(2) Press and hold PAPER ADVANCE button then press LINE/LOCAL button until red ERROR LED turns on to initiate self-test.

(3) Release buttons once self-test has started.

(4) After one complete self-test printout, press and hold PAPER ADVANCE button until red ERROR LED turns off. This terminates printer self-test.

(5) If printout is uneven or does not occur or paper gets jammed, remove printer paper roll and reinstall.

(6) If printout has any missing lines or dots, print head must be replaced.

(7) Press LINE/LOCAL button to place printer back online.

2.2.7 EN ROUTE PROCEDURES. This subsection describes the procedures that have to be performed en route by the locomotive crew.

2.2.7.1 Speedometer Check. To perform a speedometer check, proceed as follows on MFD1:

(1) Press Speed Check button.

(2) Press Start button on first milepost.

(3) Press Stop button on second milepost.

(4) Time taken between two mileposts is indicated in seconds on the screen.

NOTE:

To calculate the actual speed in miles per hour, divide 3600 by number of seconds indicated.

(5) Press return button once to return to MFD1 main status screen.

2.2.7.2 HOT JOURNAL and COACH HOT JOURNAL Alarms. These conditions cause an audible alarm. MFD1 displays HOT JOURNAL or COACH HOT JOURNAL in red. POD displays the alarm identification and a speed restriction. Proceed as follows to correct the situation:

(1) Press MFD1 Alarm Acknowledge key within 6 to 8 seconds.

NOTE:

When alarm is not acknowledged within 6 to 8 seconds, electric (dynamic) braking is used to restrict speed to 20 mph. If no electric (dynamic) braking is available, locomotive is set to coast mode.

(2) Reduce speed to 20 mph within 120 seconds. (Speed target is indicated on POD.)

- If alarm disappears within 120 seconds, normal operation is recovered.
- If alarm is still present after 120 seconds, speed restriction is set automatically.

(3) If alarm disappears after automatic speed restriction, place throttle to 0 position to recover normal operation.

2.2.7.3 TRUCK HUNTING Alarm. This condition causes an audible alarm. MFD1 displays TRUCK HUNTING in yellow. POD displays the alarm identification and a speed restriction. Proceed as follows to correct the situation:

(1) Press MFD1 Alarm Acknowledge key within 6 to 8 seconds.

NOTE:

When alarm is not acknowledged within 6 to 8 seconds, electric (dynamic) braking is used to restrict speed to 20 mph. If no electric (dynamic) braking is available, locomotive is set to coast mode.

(2) Reduce current speed by 5 mph. (Speed target is indicated on POD.)

- If alarm disappears within 120 seconds, normal operation is recovered.
- If alarm is still present after 120 seconds, speed restriction is set automatically.

(3) If alarm disappears after automatic speed restriction, place throttle to 0 position, to recover normal operation.

2.2.7.4 Degraded ITSU Operation. The degraded operation is only used in case of sensor failure. To bypass the defective sensor, press simultaneously on the ITSU SELF TEST and LAMP TEST buttons. The ALARM SENSOR indicator changes from flashing to steady illumination, and the LOCAL ALARM ACKNOWLEDGMENT indicator turns on. In case of multiple sensor failures, one activation of the degraded mode bypasses each defective sensor.

NOTE:

The degraded mode remains active until the system is shut down and restarted. The sensor failure remains as long as the defective sensor is not replaced.

2.2.7.5 ITSS Cutout (Fig. 2-7). In case of ITSS failure, bypass system with ITSU CUTOUT switch. Break seal and lift hinged cover to access switch. With system bypassed, onboard failure trainline is reenergized.

2.2.7.6 Lighting System Operation. To operate the lighting system, use switches as indicated below:

2.2.7.6.1 Headlights. Set FRONT HEADLIGHT switch on engineer's desk right switch panel to DIM or FULL position to control headlights intensity.

NOTE:

When the M.U. LOOPING switch is in TRAIL position, the cab headlights are not functional. Place the switch in LEAD position in any cab not coupled to another cab.

2.2.7.6.2 Marker Lights. Set MARKER LIGHT switch on engineer's overhead switch panel to ON position to turn on marker lights.

2.2.7.6.3 Ditch Lights. Ditch light operation depends on manipulation of DITCH LIGHT switch (engineer's desk right switch panel):

- With switch in AUTO position, blow horn to make ditch lights flash alternately. Press on BELL button on engineer's desk right switch panel to turn off.
- Set switch to FLASH position to make ditch lights flash alternately.
- Set switch to ON position to turn on ditch lights.

NOTE:

Ditch lights operate only when headlights are on.

2.2.7.6.4 Cab Ceiling Lights. Set CAB CEILING LIGHT switch on engineer's left switch panel to ON position to turn on cab ceiling lights.

NOTE:

Set switch to EXIT position to turn on access lights for one minute.

2.2.7.6.5 Timetable and Console Lights. Set TIMETABLE switches on engineer's left switch panel and assistant's left switch panel to ON position to turn on their respective timetable lights. Adjust lighting intensity with CONSOLE DIMMER switch on engineer's left switch panel.

2.2.7.6.6 Walkway Lights. Set WALKWAY LIGHT switch on cab rear wall switch panel to the alternate position to turn on walkway lights

2.2.7.6.7 Maintenance Lights. Set MAINTENANCE LIGHT switch on cab rear wall switch panel to ON position to turn on maintenance lights.

2.2.7.7 HVAC System Operation. To operate HVAC system, use switches on engineer's center console switch panel as indicated below:

- Set A/C switch to AUTO position to enable cab air conditioning.
- Set CAB HEATER switch to HEAT position to enable cab heating.
- Adjust cab temperature from 65 °F to 75 °F with CAB °F temperature selector.
- Set WINDSHIELD HEAT switch to ON position to activate windshield heating, only when the exterior temperature requires it.
- Set DEFROST switch to FAN position to blow air onto windshield, and to HEAT to ensure that air is heated, only when the exterior temperature requires it.

2.2.7.8 Engineer Intercom Operation. Proceed as follows:

(1) Press IC button on remote control head.

(2) Talk in headset.

(3) Or, press and hold down communication footswitch and use microphone in center of console.

(4) Or, press and hold down PTT button on remote control head and use its microphone.

2.2.7.9 Assistant Intercom Operation. Proceed as follows:

(1) Verify if IC LED on assistant's headset station is lit.

(2) If not, press MODE button on assistant's headset station and select IC mode.

(3) Talk in headset, or

(4) Press and hold down PTT button on assistant's headset station and use its microphone.

2.2.7.10 Engineer Radio Operation. Proceed as follows:

(1) Select a channel by pressing on CHAN button and appropriate keys on numeric keypad.

(2) Press RAD button on remote control head.

(3) Talk in headset, or

(4) Press and hold down communication footswitch and use microphone in center of console.

(5) Or, press and hold down PTT button on remote control head and use its microphone.

2.2.7.11 Assistant Radio Operation. Proceed as follows:

(1) Verify if RADIO LED on assistant's headset station is lit.

(2) If not, press MODE button on assistant's headset station and select Radio mode.

(3) Talk in headset.

(4) Or, press and hold down PTT button on assistant's headset station and use its microphone.

2.2.7.12 Automatic Brake Operation. To initiate a service brake, move ABCL from REL into a brake position.

To increase brake effort, push ABCL towards FULL position.

To reduce brake effort, pull ABCL towards REL position.

2.2.7.13 Independent Brake Operation. To apply independent brake, push IBCL towards MAX position.

To release independent brake, pull IBCL towards REL position.

2.2.7.14 Bail Off Operation. To bail off, pull on ring attached to IBCL handle until brake cylinder pressure is at 0 psi.

2.2.7.15 Recovery from a Penalty Brake Application. Proceed as follows:

(1) Move ABCL to SUP position.

(2) As soon as penalty condition has been satisfied, return ABCL to REL position.

2.2.7.16 Degraded Propulsion Operation. If key card reader bypass switch is set to bypass position while throttle is in a power position, no power is applied to traction motors unless throttle is cycled from 0 to a power position.

NOTE:

If key card reader bypass sealed switch is actuated, both locomotive cab reversers are authorized simultaneously.

2.2.7.17 ATS/ATC Alarm. When in coded territory, and ATS/ATC alarm sounds, proceed as follows:

NOTE:

When starting to move, acknowledge all audible alarms from the system within 5 seconds.

(1) Acknowledge change in aspects within 5 seconds, or achieve permanent suppression.

NOTE:

Change to a more restrictive aspect must be acknowledged even when the train is stopped in a station.

(2) If penalty brake application occurs, perform running recovery. (Refer to subsection 2.2.7.22, on page 2-109, "Running Recovery after Penalty Brake Application".)

2.2.7.18 Overspeed Alarm. When change of code or excessive speed causes alarm and overspeed indication, proceed as follows:

(1) Initiate permanent suppression (ABCL in SUPP position) within 5 seconds.

(2) Achieve permanent suppression (steady SUPPRESSION indication), or reduce speed below limit within 5 seconds.

NOTE:

Alarm sounds and overspeed indicator flashes in case of penalty brake application.

(3) Move ABCL to SUPP position to shut off alarm.

(4) To recover from penalty brake application, perform running recovery when underspeed. (Refer to subsection 2.2.7.22, on page 2-109, "Running Recovery after Penalty Brake Application".)

NOTE:

If overspeed condition is caused by more restrictive change of code, acknowledge code change within initial 5 seconds.

2.2.7.19 Requiring Acknowledgment Function. While moving under restricting aspect and after all ATS/ATC conditions have been satisfied, the requiring acknowledgment function of the system is in operation. In this case, an alarm is received as soon as the train starts moving. The engineer must acknowledge the alarm within 5 seconds. Once the alarm is acknowledged, there is no more alarm.

2.2.7.20 Non-Cab Signaled Territory Operation. To operate in non-cab signal territory, reduce speed to below 20 mph, and set CAB TERRITORY switch on cab rear wall switch panel to OUT position. This allows operation with overspeed point of 79 mph until valid track code is received. System ignores OUT position of switch unless train speed is below 20 mph and all ATS/ATC operational requirements are met.

This mode is intended for use in non-cab signal territory. General rules for this mode are as follows:

(1) Upon entering non-cab signal territory, and restricting aspect on ADU is illuminated, and with speed less than or equal to 20 mph, when engineer places CAB TERRITORY switch to OUT position.

(2) The acknowledge alarm is silent.

(3) Speed is restricted to 79 mph.

2.2.7.21 Enforced Cut-In. If a valid code rate is detected, the alarm sounds. Set CAB TERRITORY switch on the cab rear wall switch panel to IN position and acknowledge alarm within 5 seconds to avoid an irretrievable train stop penalty brake application.

2.2.7.22 Running Recovery after Penalty Brake Application. To perform running recovery of penalty brake application from the automatic train control system, proceed as follows:

(1) Acknowledge alarm.

(2) Move ABCL to SUPP position.

(3) Move throttle to 0.

(4) Release brakes.

2.2.7.23 Alerter Timing Reset. To reset alerter timing, either use ACKNOWLEDGE switch on engineer's desk right switch panel, or acknowledge footswitch, or use one of the following resets:

- Activate horn (with pushbutton or footswitch),
- Activate bell,
- Change front headlight switch setting,
- Change throttle position,
- Change ABCL position.

2.2.7.24 Alerter Sleep Mode. To enter sleep mode operation, locomotive must be stopped and brakes applied, or ABCL must be in HO position with no active cab. System automatically switches back to normal operation if status of those two conditions change.

Another sleep mode set of conditions are:

(1) Automatic brake application of suppression or greater.

(2) Parking brake application

(3) Cab deactivated, with ABCL in HO position and no active cab.

In sleep mode, alerter functions of the system are disabled. However events are still logged in memory. Access to PCMCIA interface is available for downloading events by maintenance personnel.

2.2.7.25 Alerter Cutout. When failure in system results in penalty brake application, proceed as follows:

(1) Break seal on alerter cutout switch and place it in cutout position. (See figure 2-29 for exact location.)

NOTE:

Alerter cutout energizes penalty magnet valve using alerter event recorder circuit breaker, CB61. If circuit breaker cannot energize Alerter/Recorder Control Unit (ARU), alerter cutout is not effective.

(2) If cutout is ineffective, use alerter sealed cutout cock (yellow) on pneumatic brake control unit. (See figure 2-25 for exact location.)

2.2.8 HIGH VOLTAGE POWER - TURNING OFF AND ON (Fig. 2-64).
Whenever access to the roof, or to the central or auxiliary block, is required, proceed as follows:

NOTE:

The procedure removes all high voltage power from the equipment.

2.2.8.1 Grounding Switch Key. The grounding switch key is used to unlock the roof hatch and to gain access to the electrical components of the central block and auxiliary block. Proceed as follows:

(1) Set pantograph switch/key, on Pantograph Local Selector (PLS) of propulsion electrical cubicle, to OFF in order to:

- Deenergize the magnet valve
- Vent the cylinder
- Open the Main Circuit Breaker (MCB).

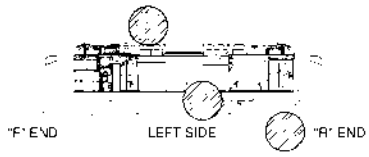
(2) Turn pantograph switch/key clockwise (another tenth of a turn beyond OFF) and remove it.

(3) Insert pantograph switch/key into keyway at back of four-function unit grounding switch in equipment room, below roof; then push and turn a quarter-turn upwards (clockwise).

(4) Pull down handle in front of four-function unit. This grounds both sides of Main Circuit Breaker (MCB) and both sides of main transformer primary.

(5) Push grounding switch key, in front of four-function unit, and turn key a quarter-turn down (clockwise).

(6) Remove grounding switch key.



1. Pantograph Local Selector (Propulsion Electrical Cubicle)
2. Pantograph Switch/Key
3. Four-Function Unit Grounding Switch (Below Roof, Equipment Room)
4. Grounding Switch Handle
5. Grounding Switch Key (Used on Auxiliary Block Key Switch Once Removed from Four-Function Unit Grounding Switch)
6. High Voltage Equipment Access Panels and Roof Hatch Keys

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Figure 2-64
High Voltage Power Removal Keys

2.2.8.2 Access to the Equipment. To gain access to electrical components of the central block and auxiliary block, and to open the roof access hatch, perform the following procedure:

WARNING:

ONLY THE QUALIFIED MAINTENANCE PERSONNEL SHOULD ACCESS THE ROOF AND THE ELECTRICAL COMPONENTS OF THE CENTRAL BLOCK AND AUXILIARY BLOCK.

WARNING:

HIGH VOLTAGE, IN THE 2750 VDC RANGE, IS PRESENT ON THE DC-LINK. BEFORE SERVICING UNIT, ENSURE POWER IS OFF. FAILURE TO DO SO MAY RESULT IN INJURY OR DEATH.

(1) Make sure that all LEDs of the LED display above auxiliary block key switch are off. These LEDs, when illuminated, indicate the presence of 2750 Vdc on the dc-Link.

(2) Insert grounding switch key into auxiliary block key switch, and turn counterclockwise to grounding position. This unlocks seven keys that are used to open the access panels to the equipment in the central and auxiliary blocks, or the roof access hatch.

WARNING:

HIGH VOLTAGES ARE PRESENT ON THE LOCOMOTIVE ROOF. TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK, ALWAYS EXERCISE EXTREME CARE WHEN ACCESSING THE ROOF.

NOTE:

To access the roof, in addition to the unlock interlock of the hatch, a bar in the middle of the roof opening has to be moved. This action mechanically locks down both pantographs.

2.2.8.3 Reestablishing High Voltage Power. To reestablish high voltage power, follow these steps:

NOTE:

Make sure that all the seven keys are in place in the auxiliary block key switch.

(1) Turn grounding switch key, in auxiliary block key switch, clockwise to normal operating position. This locks the central and auxiliary block panels.

(2) Remove grounding switch key.

(3) Insert grounding switch key, into keyway in front of four-function unit, and turn key a quarter-turn counterclockwise (up).

(4) Pull up handle, in front of four-function unit. This removes ground from both sides of the MCB, as well as input side of main transformer primary.

(5) Turn pantograph switch/key, at back of four-function unit grounding switch, a quarter turn counterclockwise (downwards).

(6) Remove pantograph switch/key.

(7) Insert pantograph switch/key into pantograph local selector keyway, slightly to right of OFF position, and move it back to OFF.

2.2.9 END OF TRIP PROCEDURES. This subsection describes the procedures to perform before a locomotive is put out of service and/or to change ends.

2.2.9.1 Changing Ends. To change ends, proceed as indicated in following subsections.

2.2.9.1.1 Cab To Be Cut Out. Proceed as follows:

(1) Set ABCL to FULL position.

(2) Ensure BP reduction is complete (85 psi).

(3) Ensure IBCL is set to REL position.

(4) Set BRAKE VALVE C/O switch on engineer's desk right switch panel to OUT position to cut off brake pipe charging.

(5) Verify brake pipe pressure is maintained at 85 psi.

(6) Apply parking brake.

(7) Set ABCL to HO Position.

(8) Set reverser to OFF position to deactivate cab makeup circuit.

2.2.9.1.2 Cab To Be Energized. Proceed as follows:

(1) Activate cab. (Refer to subsection 2.2.2, on page 2-90, "Preparation for Operation".)

(2) Set reverser to N, FWD, or REV.

(3) Apply parking brake.

(4) Move ABCL to RELEASE position until equalizing reservoir reaches 110 psi.

(5) Set BRAKE VALVE C/O switch on engineer's desk right switch panel to PASS. (passenger cars) or FRT. (freight cars) to cut in brake pipe charging.

(6) BP should increase to 110 psi.

2.2.9.2 Cab Deauthorization. To deauthorize cab, proceed as follows:

(1) Apply key card against key card reader.

(2) Dial "0,0,0,0" before leaving cab.

NOTE:

If locomotive is running, and a speed is detected, system does not allow deauthorization of last highest level existing in system.

- Setting reverser to OFF automatically cancels all authorization levels previously entered. This automatic deauthorization occurs 10 seconds after the reverser is moved to OFF.
- All authorization levels are also nullified whenever train dc power is shut down.

NOTE:

It is the responsibility of the users to authorize and deauthorize their access to the propulsion and monitoring systems.

CAUTION:

Never use the independent brake as a parking brake when the locomotive is stopped. Always place the independent brake control lever in RELEASE position PRIOR TO CAB DEACTIVATION. This ensures that no air is trapped in the system in order to prevent damage to the equipment.

NOTE:

The independent brake control lever is controlled by the brake control computer. If the cab is deactivated with the independent brake applied, some air is trapped in the application trainline. This prevent brake release with the brake pipe while the locomotive is being towed if the application trainline is not connected.

2.2.9.3 Cab Deactivation. There are two scenarios of cab deactivation: Locomotive left powered with 480 Vac (from the catenary, shop supply, or other locomotive), and locomotive without any external power.

2.2.9.3.1 With 480 Vac Supplied. To deactivate cab, set reverser to OFF. This deauthorizes all levels after 10 seconds. This condition extinguishes POD, MFD1, and indicators located on the console; MFD2 turns off after 10 seconds.

2.2.9.3.2 Without External Power. Locomotive DC power shutdown sequence is automatic. If high voltage from pantograph, or 480 Vac from shop supply is lost, and if reverser is set to OFF, complete load shedding occurs after 15 minutes. This condition removes all DC loads from battery. If reverser is left in N, FWD, or REV, load shedding occurs in two stages. Stage 1 removes part of loads, and occurs after 15 minutes. Stage 2 removes remaining DC loads, and occurs when battery decreases below "end of cell" voltage (50 Volts), or after reverser is set to OFF. Only one DC circuit remains powered from battery after complete DC power shut down. This circuit includes step lighting, ceiling lighting in equipment room, and cab activate circuit.

2.2.9.3.3 Access Lighting. To turn on access lights (ground lights, and all incandescent lights near door entrances, and in cab ceiling), place CAB CEILING LIGHT switch on engineer's left switch panel in EXIT position. Access lights go out after one minute.

2.2.9.4 Layover Preparation. For a layover, proceed as follows:

- Momentarily turn PARKING BRAKE switch on engineer's right switch panel to APPLY position.
- Set CAB HEATER switch on engineer's center console switch panel to LAYOVER position to maintain temperature above 45 °F.

2.2.9.5 Water and Waste Retention Systems Operation. The following subsections describe the operation of the water and waste retention systems.

NOTE:

Freeze protection is controlled automatically by the Temperature Control Unit (TCU) and enabled whenever the ambient temperature falls below 45 °F.

2.2.9.5.1 Toilet Flush Cycle. The toilet operational cycle can be summarized as follows:

- Time 0.0 Second: The toilet flush cycle is initiated by pushing the flush button.
- TIME 0.5 to 0.7 Second: The bowl is rinsed with 7 to 8 ounces of water.
- Time 1.0 to 1.5 Seconds: The toilet flush valve opens for 3.0 to 3.5 seconds, allowing the waste and water to be drawn into the waste tank.

2.2.9.5.2 Reset Switch. The reset switch activates all the waste tank status panel indicators. This function is done directly within the waste tank status panel.

2.2.9.5.3 Sewage Draining System Operation. Two drain valves are provided for waste tank draining on each side of the locomotive, under the skirts.

Rinse water is supplied by a separate connection from an external nonpotable water supply. The waste tank incorporates automatic vent and rinse.

The water connections are made on either side of the locomotive. Pipes from each water connector are joined near the waste tank with check valves to prevent cross flow. The check valves are connected to tank internal rinse through two solenoid valves connected in series. The arrangement is especially made to prevent freezing.

When either drain valves are open, the waste tank status panel valve open indicator is activated. It inhibits the air ejector solenoid valve, switches off 120 Vac to the toilet, and energizes the tank vent and rinse solenoids.

Turning either valve station to DRAIN position causes several operations to take place simultaneously:

- Associated drain valve opens.
- Air ejector and toilet operation is disabled.
- Vent valve opens, venting tank to allow rapid draining.
- Rinse valves open, rinsing complete interior of tank.

If the waste tank is full, the tank level measuring system inhibits tank rinsing and venting until the liquid level drops a few inches and the tank FULL light is deactivated. A manual vent valve is provided so that drainage of the tank is possible when power under 72 Vdc is present.

2.2.9.6 Defects Reports (Fig. 2-53 to 2-56). This subsection describes how to report defects by using the manual fault entry feature of MFD2. Proceed as follows:

(1) Press on Manual Faults button of the main operation page.

(2) Press on Location button of the manual fault entry page.

(3) To record the location, press on the appropriate button of the location in car manual fault entry page, as follows:

- Press on Left/Right button to record side
- Press on Car End button to record end

- Press on left or right arrow buttons to specify location by scrolling through list at top of screen.
- Press on Select button, once exact location is recorded.

(4) Press on Equipment button of manual fault entry page.

(5) To record equipment, press on Page Up and/or Page Down button of equipment type manual fault entry page to select proper page for defective equipment. Then, press on left or right arrow buttons to specify equipment by scrolling through list.

(6) Press on Select button, once proper equipment is recorded.

(7) Press on Fault Type button of manual fault entry page.

(8) To record fault type, press on appropriate arrow button of fault type manual I fault entry page to specify fault type by scrolling through list.

(9) Press on Log Event button of manual fault entry page.

(10) Press on Return button of manual fault entry page to return to main operation page.

2.2.9.7 Uncoupling. Uncoupling can only be done manually. Turn telescopic lever to uncoupling position. After equipment separation, the open coupler is ready to be coupled again.

(1) Set parking brake/handbrake on equipment to be separated.

(2) Ensure enough slack is provided to couplers.

(3) Actuate coupler uncoupling mechanism from any side of coupler head.

(4) Coupler is unlocked when a complete rotation of lock lift is achieved, and knuckle opens slightly to maintain locking pin in up position.

(5) Move locomotive away from equipment with parking brake/handbrake set.

SECTION 2.3
EMERGENCY PROCEDURES

This section describes the procedures to be performed during emergencies by the locomotive crew.

See figure 2-65 for the exact location of the emergency equipment and cutout cocks.

2.3.1 CAB REFUGE (Fig. 2-65). In the event of a major impact, the cab refuge (padded area of the floor at the back of the cab) offers the maximum protection to the operating crew in the cab.

2.3.2 EMERGENCY ESCAPE HATCH (Fig. 2-65). To access the emergency escape hatch from the cab:

WARNING:

HIGH VOLTAGES ARE PRESENT ON THE LOCOMOTIVE ROOF. TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK, ALWAYS EXERCISE EXTREME CARE WHEN ACCESSING THE ROOF.

(1) Carefully unlatch ceiling panels and let them hang down.

(2) Turn emergency escape hatch handle counterclockwise to unlock and push up.

NOTE:

Emergency escape hatch can also be removed from outside by breaking glass to access handle, turning handle counterclockwise, and pulling escape hatch out.

2.3.3 FIRE EXTINGUISHER OPERATION. Refer to instructions on the fire extinguisher label for operation.

2.3.4 EMERGENCY TOOLS (Fig. 2-65). A tool box is located on the cab wall. It contains an adjustable 12-inch wrench, a 3-pound hammer, a pinch bar, and a first aid kit.

2.3.5 FIRST AID EQUIPMENT (Fig. 2-65). A first aid kit is located in the tool box on the cab wall.

2.3.6 EMERGENCY BRAKING. The following subsections describe the emergency and penalty brake sequences of operation, and recovery procedure for each event.

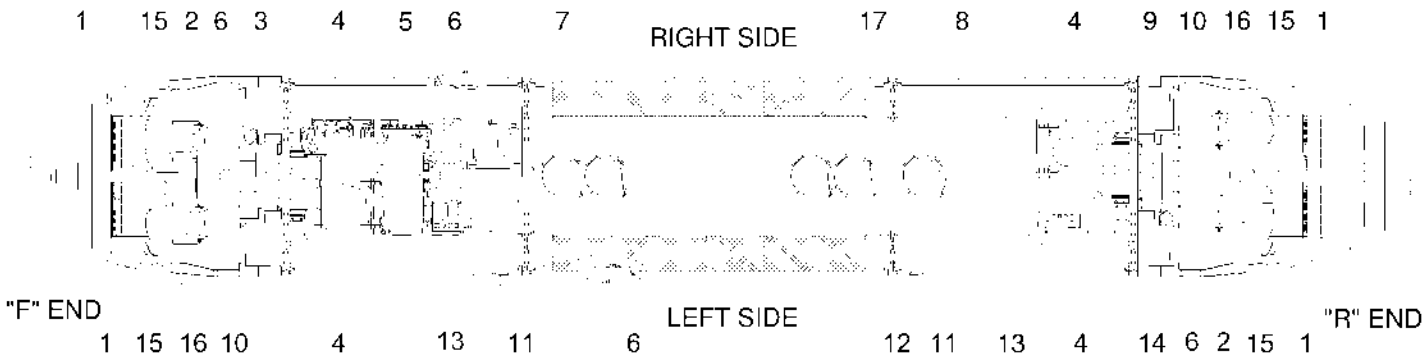
2.3.6.1 Emergency Brake Application. An emergency brake can be initiated by any one of the five methods described in following subsections.

2.3.6.1.1 Automatic Brake Control Lever. Proceed as follows:

(1) Move ABCL to EM position.

(2) Leave ABCL to EM position until stopped.

(3) Set throttle lever to 0 position.



1. Pneumatic Cutout Cocks
2. Emergency Escape Hatch (Overhead)
3. Brake Control Unit, with Conductor's Emergency Brake Valve, and Penalty Magnet Valves, Emergency Magnet Valve Cutout Cocks
4. Parking Brake Manual Override Lever
5. Pantograph Pneumatic Control Panel Cutout Handles
6. Fire Extinguisher
7. Roof Access Ladder
8. Propulsion Electrical Cubicle, with Key Card Reader, Oil Level Detector, Fire Control Unit Bypass Switches, and Pantograph Local Control Catenary Grounding Switch
9. ATSCO, SSCO, and ACSES Cutout Switches
10. Emergency Tools, with First Aid Kit
11. Interior Truck Brake Cutout Cocks
12. Pantograph Pole
13. Exterior Truck Brake Cutout Cocks
14. Electrical Locker No. 1 with ITSU and ARU Cutout Switches
15. Emergency Escape Window
16. Cab Refuge
17. 27-Pin Jumper

Figure 2-65
Emergency Equipment and Cutout Cocks Location

2.3.6.1.2 Emergency Brake Valve. Proceed as follows:

(1) Push EMERGENCY BRAKE VALVE button on engineer's left switch panel or assistant's left switch panel.

(2) Leave valve open until stopped.

(3) Do not attempt to release brakes until stopped.

(4) Move ABCL to EM position.

(5) Set throttle lever to 0 position.

2.3.6.1.3 Emergency Conductor's Valve. Proceed as follows:

(1) Pull valve handle in equipment room. Valve latches in activated position.

(2) Do not attempt to release brakes until stopped.

(3) Move ABCL to EM position.

(4) Set throttle lever to 0 position.

2.3.6.1.4 Parting of Consist or Brake Pipe Rupture. Proceed as follows:

NOTE:

A separation or rupture causes a venting of brake pipe at emergency rate, applying emergency brake cylinder pressure.

(1) Do not attempt to release brakes until stopped.

(2) Move ABCL to EM position.

(3) Set throttle lever to 0 position.

2.3.6.1.5 EMERGENCY END-OF-TRAIN Brake Switch. Proceed as follows:

(1) Lift switch cover and press on button.

(2) Do not attempt to release brakes until stopped.

(3) Move ABCL to EM position.

(4) Set throttle lever to 0 position.

2.3.6.2 Emergency Brake Recovery. The following subsections describe how to recover from any case of emergency brake application.

NOTE:

Wait 64 seconds after the emergency BC pressure is reached before trying to recover from the emergency brake application.

2.3.6.2.1 Automatic Brake Control Lever. Proceed as follows:

(1) After stopping, wait 64 seconds, then move ABCL to HO position.

(2) Return throttle lever to 0 position.

(3) Perform required inspections as per Amtrak operating rules and instructions.

(4) Make sure parking brake is applied.

(5) Move ABCL to RELEASE position to recharge brake pipe.

(6) Perform required air brake tests in accordance with AMT-3.

2.3.6.2.2 Emergency Brake Valve. Proceed as follows:

(1) Verify that ABCL is in HO position after stopping.

(2) Return throttle lever to 0 position.

(3) Reset emergency pushbutton valve.

(4) Perform required inspections as per Amtrak operating rules and instructions.

(5) Make sure parking brake is applied.

(6) Move ABCL to RELEASE position to recharge brake pipe.

(7) Perform required air brake tests in accordance with AMT-3.

2.3.6.2.3 Emergency Conductor's Valve. Proceed as follows:

(1) Verify that ABCL is in HO position after stopping.

(2) Return throttle lever to 0 position.

(3) Reset activated conductor's valve.

(4) Perform required inspections as per Amtrak operating rules and instructions.

(5) Make sure parking brake is applied.

(6) Move ABCL to RELEASE position to recharge brake pipe.

(7) Perform required air brake tests in accordance with AMT-3.

2.3.6.2.4 Break-in-Two. Proceed as follows:

(1) Verify that ABCL is in HO position after stopping.

(2) Return throttle lever to 0 position.

(3) Correct the problem.

(4) Perform required inspections as per Amtrak operating rules and instructions.

(5) Make sure parking brake is applied.

(6) Move ABCL to RELEASE position to recharge brake pipe.

(7) Perform required air brake tests in accordance with AMT-3.

2.3.6.2.5 EMERGENCY END-OF-TRAIN Brake Switch. Proceed as follows:

(1) Verify that ABCL is in HO position after stopping.

(2) Return throttle lever to 0 position.

(3) Close switch cover.

(4) Perform required inspections as per Amtrak operating rules and instructions.

(5) Make sure parking brake is applied.

(6) Move ABCL to RELEASE position to recharge brake pipe.

(7) Perform required air brake tests in accordance with AMT-3.

2.3.7 DEAD ENGINE FEATURE. Locomotive can be towed with a locomotive equipped with 26L brake equipment for rescue purposes using dead engine feature. This allows brake pipe air to fill and charge main reservoir No. 3, allowing pneumatic control of friction brake.

CAUTION:

For any towing operation, if the independent brake has been left applied with the cab deactivated, or when the battery voltage is too low, the application trainline must be connected, or its cutout cock opened at the end of the locomotive to vent any residual pressure.

NOTE:

The independent brake control lever is controlled by the brake control computer. If the cab is deactivated with the independent brake applied, some air is trapped in the application trainline. This prevent brake release with the brake pipe while the locomotive is being towed if the application trainline is not connected.

CAUTION:

For any towing operation, the emergency magnet valve must be cut out to prevent emergency brake application due to loss of battery power.

2.3.8 TOWING SETUP. For any towing operation, proceed as follows:

NOTE:

Perform required air brake tests in accordance with AMT-3.

(1) Apply parking brake, verify indication on MFD1 and confirm with outside gold indicators.

(2) If parking brake does not apply, activate parking brake impulse valve on pneumatic brake control unit, and reverify. (See Figure 2-25 "Pneumatic Brake Control Unit" for exact location.)

CAUTION:

The Independent Brake Control Lever (IBCL) must be placed in release position. Do not use IBCL as a parking brake.

(3) Press on PANTO-DOWN pushbutton.

(4) Set Automatic Brake Control Lever (ABCL) to full service in active cab, and IBCL in release position in both cabs.

(5) Set BRAKE VALVE C/O switch to OUT position in both cabs.

(6) Set ABCL to handle off position in both cabs.

(7) Set reverser to OFF position in both cabs.

(8) Connect and cut in BP trainline to towing locomotive.

(9) Connect and cut in MR trainline to towing locomotive.

(10) Connect and cut in application trainline to towing locomotive.

(11) Verify that both Truck Equipment Cutout Cock (TECC) are in cut in position.

(12) Verify that Emergency Magnet Valve Cutout Cock (EMVCC) is closed (lever horizontal).

NOTE:

This prevents any unrequested emergency brake application.

(13) Perform application and release from towing locomotive. Verify that all cars respond.

(14) Release parking brake, verify indication on MFD1 and confirm with outside gold indicators.

(15) If parking brake does not release, activate parking brake impulse valve on pneumatic brake control unit, and reverify. (See Figure 2-25 "Pneumatic Brake Control Unit" for exact location.)

(16) Move locomotive and perform a brake application. Verify consist responds.

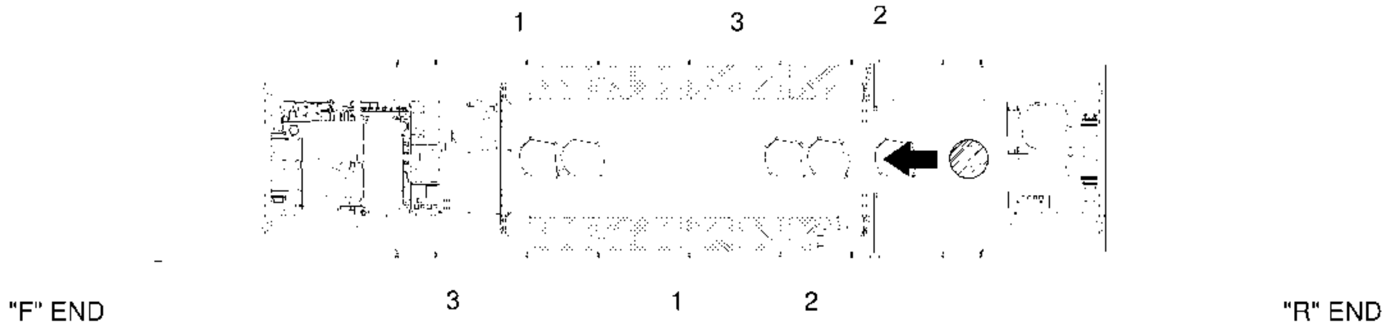
(17) Once consist reaches its destination, apply the HHP-8 parking brake.

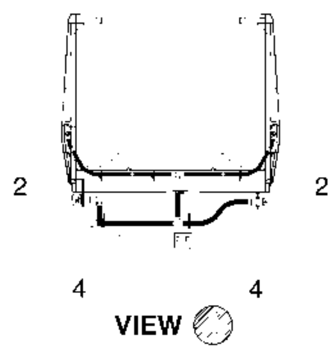
(18) Isolate (cut out) MR, BP, and application trainlines from towing locomotive.

(19) Return EMVCC to open position (lever vertical).

2.3.9 FIRE EXTINCTION - WATER SYSTEM (Fig. 2-66). In case of emergency, a fire in the equipment room can be extinguished by using the exterior water fire extinction system. This equipment, shown on Figure 2-66 "Fire Extinction System - Water System", consists of the following:

- Two brass snoots, accessible from the locomotive exterior, with 2.5 inch diameter entry tube for compatibility with fire hoses.
- Stainless steel tubing, 1.5 inch in diameter, on each side of the equipment room
- 18 brass nozzles inside the equipment room. Each nozzle is oriented at 25 degrees from the horizontal and has a 100 degrees projection.
- Water flow rate of approximately 165 gallon per minute
- Working pressure of 125 psi
- Water distribution of 0.3 gallon per minute per square feet.





1. Brass Nozzle
   (18 Total, at 25 Degrees from Horizontal)
2. Brass Snoot (One on Each Side)
3. Side Tubing (1.5 in. Diameter)
4. Entry Tubing (2.5 in. Diameter)

Figure 2-66
Fire Extinction System - Water System

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CHAPTER 3
TROUBLESHOOTING PROCEDURES

3.1 TROUBLESHOOTING TABLES. This chapter contains all the necessary instructions allowing the locomotive crew to efficiently troubleshoot the equipment for all the systems and subsystems. The troubleshooting tables list symptoms, probable causes and *effects*, and corrective actions. Possible combinations of malfunctions are not listed. It is assumed that all control devices were previously set for normal operating conditions as described in chapter 2, "Operating Instructions."

NOTE:

In all cases, if the corrective actions do not correct the problem, or if a symptom is not listed in the troubleshooting table, notify dispatcher and refer to maintenance.

CAUTION:

Circuit breakers tripped by an overload must be reset only once to prevent damage to the equipment circuitry.

WARNING:

AMTRAK OPERATING RULES AND INSTRUCTIONS MUST BE FOLLOWED WHEN RESETTING ANY DISABLED EQUIPMENT TO CONTINUE.

WARNING:

ANY CIRCUMSTANCE REQUIRING THAT A LEAD AND WIRE SEAL BE BROKEN TO USE A CIRCUIT BYPASS SWITCH MUST BE REPORTED TO AUTHORIZED PERSONNEL.

3.2 ALARMS. For some of the systems listed below, alarms are displayed on the MFD1 and MFD2 to alert the engineer in the case of a true alarm operational situation that requires immediate corrective action.

Refer to subsection 2.1.12.5.2, on page 2-66, "Alarms" for a detailed list of all the alarms that can be displayed on the MFD1 and MFD2.

All alarms appear on the screen as shown in capital letters in the INDICATION column of the following troubleshooting tables.

If an alarm help procedure is available on the screen, it is identified as such and shown as the first item in the CORRECTIVE ACTION column of the following troubleshooting tables.

There are 3 levels of alarm criticality, as explained below.

NOTE:

All levels of alarms are detailed in the troubleshooting tables. The alarm level is indicated in parentheses directly after the alarm text.

3.2.1 Level 1, Safety Affecting Alarms. This level of alarm is indicated by the text flashing in red on the display (until acknowledgement), and an audible warning. It indicates a condition that may put the equipment and/or its passengers in a safety critical situation. Immediate operational action is required by the engi-

neer to reduce safety risks. An acknowledgement is required, and a help procedure is available on the screen.

3.2.2 Level 2, Service Affecting Alarms. This level of alarm is indicated by the text flashing in yellow on the display (until acknowledgement), and an audible warning. It indicates a condition that results in a speed reduction or limitation. An action may be taken by the engineer to regain maximum available operating conditions. An acknowledgement is required, and a help procedure is available on the screen.

3.2.3 Level 3, Advisory Alarms. This level of alarm is indicated by the static text in white on the display. It indicates a condition that results in a degraded performance of the affected subsystem. It is also used to indicate to the engineer certain noncritical operational status. No acknowledgement is required, and no help procedure is available.

SECTION I
CARBODY, INTERIOR FIXTURES, OPERATING CAB

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Windshield heaters (defrost) not operating.	Circuit breaker CB25, Windshield Heater and Defogger "F" End or CB26, Windshield Heater and Defogger "R" End, tripped. Electric circuit is open. Heaters are defective.	Reset circuit breakers. Notify dispatcher and refer to maintenance.
Cab window balance system is too loose.	Springs are not tight enough.	Notify dispatcher and refer to maintenance.
Damaged panel on front nosing.	Small cracks or punctures. Large cracks, holes, and broken section.	Notify dispatcher and refer to maintenance.
Sanding not operating.	Circuit breaker CB91, Snow Brake/Parking/Sanding, tripped. Electric circuit is open. No air supply available. Debris.	Reset circuit breaker. Inspect electric circuit using schematics. Inspect pneumatic line. Notify dispatcher and refer to maintenance.
Adjustable footrest not operating.	Circuit breaker CB45, Foot Platform, tripped. Electric circuit is open. No air supply available. Operating pressure is out of range. Objects or dirt stop adjustable footrest movement.	Reset circuit breaker. Notify dispatcher and refer to maintenance.
Adjustable footrest raising and lowering too slow.	Control valves unadjusted. Air filter blocked. Dirty exhaust mufflers.	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Retractable mirror not operating.	Circuit breaker CB56, General Control, is tripped. Electric circuit is open. No air supply available.	Reset circuit breaker. Notify dispatcher and refer to maintenance.
Retractable mirror operation is too slow.	Retractable mirror control valves unadjusted.	Notify dispatcher and refer to maintenance.
Bell not operating.	Circuit breaker CB54, Cab Control "F" End or CB55, Cab Control "R" End, is tripped. Electric circuit is open. No air supply available.	Reset circuit breaker. Notify dispatcher and refer to maintenance.
Horn not operating.	Circuit Breaker CB54, Cab Control "F" End or CB55, Cab Control "R" End, is tripped. Electric circuit is open. No air supply available.	Reset circuit breaker. Notify dispatcher and refer to maintenance.

SECTION II
TRUCK AND SUSPENSION

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
HOT JOURNAL (Alarm level 1). HHP-8 number and wheels (L1 to L4, R1 to R4) are identified.	Locomotive journal bearing overheating (212 °F detected). *Quick bearing degradation.*	Alarm help procedure: Will cause on-board speed restriction (20mph) Stop train Check journal temperature using tempil stick (212 deg) If hot journal confirmed proceed as per special instructions If false alarm cutout defective sensor on ITSU Notify Dispatcher.
COACH HOT JOURNAL (Alarm level 1). Passenger cars wheels and number are not identified.	Passenger car journal bearing overheating. *Quick bearing degradation.*	Alarm help procedure: Stop Train Follow special instructions Notify Dispatcher.
UNKNOWN SPEED RESTRICTION (Alarm level 1).	Real cause unknown when alarm activated. *Speed restricted to 20 mph.*	Alarm help procedure: Will cause on-board speed restriction (20mph) Could be caused by: -Fire Control Unit -Integrated Truck Surv. (Confirm using MFD-2) Proceed as per special instructions Notify Dispatcher.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
BRG SENSOR FAULT (Alarm level 2). HHP-8 number and wheels (L1 to L4, R1 to R4) are identified.	One of the integrated truck surveillance system journal bearing sensor is defective. The journal bearing can overheat without being detected. *Loss of hot bearing detection for that wheel. Quick bearing degradation can occur.*	Alarm help procedure: Will cause on-board speed restriction (20mph) Stop train Check journal temperature using tempil stick (212 deg) If hot journal confirmed proceed as per special instructions If false alarm cutout defective sensor on ITSU Notify Dispatcher.
TRUCK HUNTING (Alarm level 2). HHP-8 number and ends, front (F), rear (R), are identified.	Truck lateral acceleration too high. *Truck instability.*	Alarm help procedure: Reduce speed in 5mph increments until hunting stops Resume normal speed when fault clears Notify Dispatcher of track location.
TRUCK HUNT FAULT (Alarm level 2). HHP-8 number and ends, front (F), rear (R), are identified.	One of the truck accelerometer is defective.The truck lateral acceleration can be too high without being detected. *Loss of truck hunting detection for that truck. Truck instability can occur.*	Alarm help procedure: Will cause on-board speed restriction (20mph) until defective sensor is bypassed Proceed as per special instructions.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
TRUCK SURVEIL FAULT (Alarm level 2). HHP-8 number identified.	Defective ITSU. Any bearing can overheat and any truck lateral acceleration can be too high without being detected. *Loss of hot bearing and truck hunting detection. Quick bearing degradation and truck instability can occur.*	Alarm help procedure: Will cause on-board speed restriction (20mph) until ITSU is bypassed Proceed as per special instructions.
BRG SENSOR BYPASS (Alarm level 3). HHP-8 number and wheels (L1 to L4, R1 to R4) are identified.	One of the integrated truck surveillance system journal bearing sensor is bypassed. The journal bearing can overheat without being detected. *Loss of hot bearing detection for that wheel. Quick bearing degradation can occur.*	This alarm comes on when a sensor is bypassed on the ITSU. The degraded mode remains active until the unit is shut down and restarted.
TRUCK HUNT BYPASS (Alarm level 3). HHP-8 number and ends, front (F), rear (R), are identified.	One of the truck accelerometer is bypassed. The truck lateral acceleration can be too high without being detected. *Loss of truck hunting detection for that truck. Truck instability can occur.*	This alarm comes on when an accelerometer is bypassed on the ITSU. The degraded mode remains active until the unit is shut down and restarted.
TRUCK SURVEIL C/O (Alarm level 3). HHP-8 number identified.	Defective ITSU bypassed with the cutout switch. Any bearing can overheat and any truck lateral acceleration can be too high without being detected. *Loss of hot bearing and truck hunting detection. Quick bearing degradation and truck instability can occur.*	This alarm comes on when the ITSU is bypassed.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
ON BOARD RESTRICTION C/O (Alarm level 3). HHP-8 number identified.	ONBOARD TL switch placed in BYPASS position. On board failure trainline deenergized. *All alarms related to the truck surveillance system and the fire detection are nor detected. The red ONBOARD FAILURE indicator is ineffective.*	This alarm comes on when the onboard failure trainline is bypassed as a last resort to recover normal operation. Notify dispatcher and refer to maintenance.
Rough lateral ride.	Defective lateral shock absorber.	Check for oil leakage and for loose mounting bolts.
Rough vertical ride.	Defective vertical shock absorber.	Check for oil leakage and for loose mounting bolts.

SECTION III
COUPLER

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Coupler does not couple and /or uncouple.	Foreign material in coupling mechanism.	Remove foreign material.
	Coupler head is out of acceptable working tolerance.	Inspect coupler head to ensure that it is in working order. If in order, recouple, if not, remove from service.

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SECTION IV
ELECTRICAL DISTRIBUTION SYSTEM

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
BATTERY CHARGERS FLT (Alarm Level 2). HHP-8 number identified.	Neither LVBC is functioning. *Batteries take over supply of 72 Vdc.*	Alarm help procedure: No Battery Charger (WARNING: Max 20 minutes operating time left) Proceed to nearest station if possible Notify Dispatcher.
BATTERY CB OPEN (Alarm Level 2). HHP-8 number identified.	The battery circuit breaker is in open position. *Battery power not available.*	Alarm help procedure: Battery power unavailable (Caution: penalty may occur upon MCB opening) Continue operation When practical, close Battery breaker (CB50, near batteries, outside, front end, right side)
One or both battery charger (s) not operating.	Circuit Breaker CB31, Battery Charger No. 1 (CB-BA-CH-1) and/or CB32, Battery Charger No. 2 (CB-BA-CH-2) tripped.	Reset circuit breaker.

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SECTION V
LIGHTING AND INDICATORS

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Marker lights not illuminated.	Marker lights switch on OFF position. Marker lights circuit breaker, CB59, tripped.	Verify marker lights switch position. Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
Headlights not illuminated.	Headlights switches on OFF position. Headlights circuit breaker, CB60, tripped.	Verify headlights switches position. Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
Ditch lights not illuminated.	Ditch lights switch on OFF position. Ditch lights circuit breaker, CB76, tripped.	Verify ditch lights switch position. Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
Exterior ground light not illuminated.	Interior or exterior switch not activated. Access lighting circuit breaker, CB52, tripped.	Verify switches position. Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
Cab lights not illuminated.	Switches on OFF position. Cab lighting circuit breaker, CB57, tripped.	Verify switches position Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
Individual group of the cab lights are extinguished.	Switch on OFF position. Tripped circuit breaker controlling particular group of lights.	Verify switch position. Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
Individual lighting fixture is extinguished.	Lighting switch is off. No lighting for specific location.	Verify switch position. Verify lamp condition.

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SECTION VI
DOORS, DOOR CONTROL AND SIGNAL SYSTEM

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
DOORS C & L BYPASS (Alarm Level 3). HHP-8 number identified.	DOORS CLOSED AND LOCKED switch set to BYPASS. *The switch is used only when a wrong door open signal has to be bypassed to recover traction power.*	Verify that all doors in the consist are effectively closed and locked prior to train movement.

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SECTION VII
HEATING, VENTILATION, AND AIR CONDITIONING

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Cab does not cool, but blower fan is operating.	HVAC Unit circuit breaker, CB21 ("F" End) or CB22 ("R" End), is tripped.	Reset circuit breaker.
Blower Fan is not operating.		Notify dispatcher and refer to maintenance.
Compressor short cycles.		Notify dispatcher and refer to maintenance.
Compressor runs continuously. High temperature in conditioned area.		Notify dispatcher and refer to maintenance.
Oil leak.		Notify dispatcher and refer to maintenance.
Liquid refrigerant leak.		Notify dispatcher and refer to maintenance.
Compressor is noisy.		Notify dispatcher and refer to maintenance.
Air flow normal but too cold.	HVAC Unit circuit breaker, CB21 ("F" End) or CB22 ("R" End), is tripped.	
Cooling stops during operation.	HVAC Unit circuit breaker, CB21 ("F" End) or CB22 ("R" End), is tripped.	Reset circuit breaker.
Cab does not heat (neither forced air cab heaters nor overhead heaters).		Notify dispatcher and refer to maintenance.
Forced air cab heater does not heat.	Cab heater switch in wrong position Cab heater circuit breaker, CB 23 ("F" End) or CB24 ("R" End) is tripped.	Set cab heater switch to HEAT position. Reset circuit breaker.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Module B heater bank does not heat.	HVAC Unit circuit breaker, CB21 ("F" End) or CB22 ("R" End), is tripped.	Reset circuit breaker.
Car does not heat when selector switch is set to layover.		Notify dispatcher and refer to maintenance.
No heat available at heat traces.	Freeze protection circuit breaker, CB41, is tripped	Reset circuit breaker.
Noisy blower operation.		Notify dispatcher and refer to maintenance.
Toilet module too hot or too cold.	Thermostat is defective	Notify dispatcher and refer to maintenance.
Windshield heater and defogger does not operate.	Windshield Heater and Defogger, circuit breaker, CB25 ("F" End) or CB26 ("R" End), tripped.	Reset circuit breaker.
Windshield heater and defogger operates but does not heat.		Notify dispatcher and refer to maintenance.
Windshield heater and defogger operates but does not defog.		Notify dispatcher and refer to maintenance.

SECTION VIII
COMMUNICATION SYSTEMS

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Assistant's headset station does not operate.	Circuit breaker CB63, Communication Control/Radio, is tripped.	Reset circuit breaker.
Remote control head does not operate.	Circuit breaker CB63, Communication Control/Radio, is tripped.	Reset circuit breaker.
With the Remote control head, radio communication does not function.	RAD button is not in Radio mode of operation.	Select Radio mode of operation. Keep PTT button pressed while talking or the footswitch. With the headset, PTT button or footswitch is useful.
With the remote control head, intercom (IC) communication does not function.	IC button is not in IC mode of operation.	Select IC mode of operation. Keep PTT button pressed while talking or the footswitch. With the headset, PTT button or footswitch is useful.
With the assistant headset station, radio communication does not function.	Mode button is not in radio mode of operation.	Select radio with the MODE button. Keep PTT button pressed while talking.
With the assistant headset station, IC communication does not function.	MODE button is not in IC mode of operation.	Select IC with MODE button. Keep PTT button pressed while talking.

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SECTION IX
PROPULSION AND ELECTRIC BRAKING

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
EMI LIMIT EXCEEDED (Alarm Level 1). HHP-8 number identified.	High level of electromagnetic interference detected by the EMI limit detector. *MCB open.* *The EMI limit detector (back of electrical locker No. 3) gives the following indications: For all monitored frequencies (100, 150, 200, 250 Hz), a continuously illuminated red LED indicates that harmonic interference is detected. A flashing red LED indicates MCB has been opened but interference is below threshold.*	Alarm help procedure: Close MCB Proceed.
FIRE DETECTED (Alarm Level 1). HHP-8 number identified.	Fire detected in the equipment room. *Automatic suppression occurs 2 minutes after announcement of alarm if no acknowledge.*	Acknowledge with MFD1 or FIRE SUPP. INHIBIT pushbutton to inhibit automatic fire extinguishing. Fire suppression is automatic after two minutes with no acknowledgment. Whenever the alarm is acknowledged, check in the equipment room. In case of fire, initiate manual fire suppression with the FIRE SUPP. ACTIVATION pushbutton.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
UNKNOWN SPEED RESTRICTION (Alarm level 1).	Real cause unknown when alarm activated. *Speed restricted to 20 mph.*	Alarm help procedure: Will cause on-board speed restriction (20mph) Could be caused by: -Fire Control Unit -Integrated Truck Surv. (Confirm using MFD2) Proceed as per special instructions Notify Dispatcher.
LOW TRANSFORMER OIL (Alarm Level 1). HHP-8 number identified.	Cooling medium in main transformer is too low to provide adequate cooling.	Alarm help procedure: Check oil level If level OK, cutout sensor Proceed. To check the oil level, refer to maintenance for access to the central block. If the oil level is low, notify dispatcher.
BATTERY CB OPEN (Alarm Level 2). HHP-8 number identified.	The battery circuit breaker is in open position. *Battery power not available.*	Alarm help procedure: Battery power unavailable (Caution: penalty may occur upon MCB opening) Continue operation When practical, close Battery breaker (CB50, near batteries, outside, front end, right side)
ELD FAULT/LOCKED OUT (Alarm Level 2).	EMI Limit Detector is in fault/lockout. *Traction power not available.*	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
MAIN CB LOCKED OUT (Alarm Level 2). HHP-8 number identified.	Repetitive MCB fault. *MCB locked out.* *Traction power not available.*	Notify dispatcher and refer to maintenance.
TRACTION LOSS 25% (Alarm Level 2). HHP-8 number identified.	One traction motor has lost power. Each motor accounts for 25%. One of the cooling system circuit breakers, CB7, Auxiliary Block Blower (CB-MF-PCS-5) or CB12, Auxiliary Block Water Pump (CB-M-WP-3) tripped. One of the motor block blower circuit breaker, CB3, CB4, CB5, CB6 (CB-MF-PCS-1/2/3/4) tripped. One of the motor block water pump circuit breaker CB10, CB11, (CB-M-WP-1/2) tripped. One of the main transformer blower circuit breaker CB1, CB2 (CB-MF-MT-1/2) tripped. *Reduced traction power.*	Alarm help procedure: Proceed To view flt log see MFD2
TRACTION LOSS 50% (Alarm Level 2). HHP-8 number identified.	Two traction motors have lost power. Each motor accounts for 25%. Refer to TRACTION LOSS 25% for list of related circuit breakers. *Reduced traction power.*	Alarm help procedure: Proceed To view flt log see MFD-2

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
TRACTION LOSS 75% (Alarm Level 2). HHP-8 number identified.	Three traction motors have lost power. Each motor accounts for 25%. Refer to TRACTION LOSS 25% for list of related circuit breakers. *Reduced traction power.*	Alarm help procedure: Proceed To view flt log see MFD-2
TRACTION LOSS 100% (Alarm Level 2). HHP-8 number identified.	All four traction motors have lost power. Each motor accounts for 25%. Refer to TRACTION LOSS 25% for list of related circuit breakers. *Loss of traction power.*	Notify dispatcher and refer to maintenance.
HEP FAULT (Alarm Level 2). HHP-8 number identified.	No 480 Vac available at Auxiliary transformer output. *No 480 Vac available to supply passenger cars.*	Alarm help procedure: Notify Dispatcher To view flt log see MFD-2
ELECT BRAKE LOSS 25% (Alarm Level 2). HHP-8 number identified.	One traction motor has lost ability to regenerate power. Each motor accounts for 25%. One of the cooling system circuit breakers, CB7, Auxiliary Block Blower (CB-MF-PCS-5) or CB12, Auxiliary Block Water Pump (CB-M-WP-3) tripped. One of the main transformer blower circuit breaker CB1, CB2 (CB-MF-MT-1/2) tripped. *Reduced electric braking power.*	Alarm help procedure: Proceed To view flt log see MFD-2

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
ELECT BRAKE LOSS 50% (Alarm Level 2). HHP-8 number identified.	Two traction motors have lost ability to regenerate power. Each motor accounts for 25%. Refer to ELECT BRAKE LOSS 25% for list of related circuit breakers. *Reduced electric braking power.*	Alarm help procedure: Proceed To view flt log see MFD-2
ELECT BRAKE LOSS 75% (Alarm Level 2). HHP-8 number identified.	Three traction motors have lost ability to regenerate power. Each motor accounts for 25%. Refer to ELECT BRAKE LOSS 25% for list of related circuit breakers. *Reduced electric braking power.*	Alarm help procedure: Proceed To view flt log see MFD-2
ELECT BRAKE LOSS 100% (Alarm Level 2). HHP-8 number identified.	All four traction motors have lost ability to regenerate power. Each motor accounts for 25%. Refer to ELECT BRAKE LOSS 25% for list of related circuit breakers. *Reduced electric braking power.*	Notify dispatcher and refer to maintenance.
CAT VOLTAGE BELOW 8.4 KV (Alarm Level 2)	Catenary voltage is 30% below nominal 12 kV. *Reduced power available to propulsion system.*	Alarm help procedure: Automatic traction power reduction Proceed.
CAT VOLTAGE BELOW 8.7 KV (Alarm Level 2)	Catenary voltage is 30% below nominal 12.5 kV. *Reduced power available to propulsion system.*	Alarm help procedure: Automatic traction power reduction Proceed.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
CAT VOLTAGE BELOW 17.5 KV (Alarm Level 2)	Catenary voltage is 30% below nominal 25 kV. *Reduced power available to propulsion system.*	Alarm help procedure: Automatic traction power reduction Proceed.
PANTO F BROKEN (Alarm Level 2). HHP-8 number identified.	Front pantograph is broken. *Front pantograph should be down.*	Alarm help procedure: Ensure panto is down Perform visual inspection Cutout panto air supply Move panto selector switch to Rear Raise rear panto Proceed
PANTO R BROKEN (Alarm Level 2). HHP-8 number identified.	Rear pantograph is broken. *Rear pantograph should be down.*	Alarm help procedure: Ensure panto is down Perform visual inspection Cutout panto air supply Move panto selector switch to Front Raise front panto Proceed
PANTO F TOO HIGH (Alarm Level 2). HHP-8 number identified.	Front pantograph is higher than 24 ft. 6 in. *Possible damage to the catenary.*	Notify dispatcher and refer to maintenance.
PANTO R TOO HIGH (Alarm Level 2). HHP-8 number identified.	Rear pantograph is higher than 24 ft. 6 in. *Possible damage to the catenary.*	Notify dispatcher and refer to maintenance.
CARD READER C/O (Alarm Level 3). HHP-8 number identified.	Key card reader bypass switch activated. *Locomotive can be operated at any speed without proper authorization level.*	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
FIRE OUTPUTS C/O (Alarm Level 3). HHP-8 number identified.	Fire control unit bypass switch (propulsion electrical cubicle) activated. *Fire suppression system is cutout.*	Notify dispatcher and refer to maintenance.
FIRE SUPP INHIBITED (Alarm Level 3). HHP-8 number identified.	FIRE SUPP. INHIBIT pushbutton (cab rear wall switch panel) activated. *Fire suppression is inhibited.*	In case of fire, fire suppression can be activated with FIRE SUPP. ACTIVATION pushbutton on cab rear wall switch panel. Notify dispatcher and refer to maintenance.
FIRE SUPP CYL BYPASS (Alarm Level 3). HHP-8 number identified.	Fire suppression cylinder is bypassed. *Extinguishing agent cannot be discharged.*	Notify dispatcher and refer to maintenance.
ON BOARD RESTRICTION C/O (Alarm level 3). HHP-8 number identified.	ONBOARD TL switch placed in BYPASS position. On board failure trainline deenergized. *All alarms related to the truck surveillance system and the fire detection are nor detected. The red ONBOARD FAILURE indicator is ineffective.*	This alarm comes on when the onboard failure trainline is bypassed as a last resort to recover normal operation. Notify dispatcher and refer to maintenance.
EXCESSIVE MOTOR CURRENT (Alarm Level 3)	Trainline "Excessive Motor Current" activated by a trailing Amfleet locomotive. *Excessive motor current in the trailing unit.*	Notify dispatcher and refer to maintenance.
DYNAMIC BRAKE WARNING (Alarm Level 3)	Trainline "Dynamic Brake Warning" activated by a trailing Amfleet locomotive. *Electric (dynamic) brake may not be available from the trailing unit.*	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
AUTO POWER LIMIT (Alarm Level 3).	Trainline "Auto Power Limit" activated by a trailing Amfleet locomotive. *Electric (dynamic) brake may not be available from the trailing unit.*	Notify dispatcher and refer to maintenance.
MAIN CB OPEN (Alarm Level 3). HHP-8 number identified.	MCB manual selector set to OPEN position. Overcurrent detected in main transformer primary. No current return to ground. Inverter or FCRB failure. Fire detected. EMI limit exceeded, or lockout. Pantograph down command detected. Insufficient air pressure. Propulsion (PECU) MCB close command not present. Overtemperature detected in main transformer. *Main circuit breaker open.*	Acknowledge. Since high voltage power is unavailable, come to a controlled stop. Check for other alarms to determine the cause of the problem. Check and reset circuit breaker CB1, Rheostatic and Main Transformer Blower No. 1 (CB-MF-MT-1). Notify dispatcher and refer to maintenance.
HEP OUTPUT OFF (Alarm Level 3).	HEP switch set to OFF position. *No HEP supplied to passenger cars.*	Set HEP switch to ON position.
CAT VOLTAGE BELOW 10.8KV (Alarm Level 3).	Catenary voltage is 10% below nominal 12 kV.	Notify dispatcher if required.
CAT VOLTAGE BELOW 11.2KV (Alarm Level 3).	Catenary voltage is 10% below nominal 12.5 kV.	Notify dispatcher if required.
CAT VOLTAGE BELOW 22.5KV (Alarm Level 3).	Catenary voltage is 10% below nominal 25 kV.	Notify dispatcher if required.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
FAULT TRAILING UNIT (Alarm Level 3)	Trailing unit (Amtrak locomotive) is in fault condition, alarm generated by a locomotive trainline. *Propulsion problem on the trailing locomotive.*	Notify dispatcher and refer to maintenance.
NO 480V LEFT T/L CONT. (Alarm Level 3).	480 VAC trainline loop is open on the left side of the locomotive. *HEP not available if speed is below 5 mph.*	Notify dispatcher and refer to maintenance.
NO 480V RIGHT T/L CONT. (Alarm Level 3).	480 VAC trainline loop is open on the right side of the locomotive. *HEP not available if speed is below 5 mph.*	Notify dispatcher and refer to maintenance.
TRANSFORMER OIL C/O (Alarm Level 3). HHP-8 number identified.	Transformer oil detector in cutout (oil level detector bypass switch activated). One of the main transformer oil pump circuit breaker CB13, CB14 (CB-M-OP-1/2) tripped (power loss 30%). *Overheating of main transformer is no longer detected.*	Acknowledge. Reset circuit breaker. Stop locomotive as soon as possible. Meanwhile reduce speed and, consequently, power handled by main transformer.
PANTO PB F ACTIVATED (Alarm Level 3). HHP-8 number identified.	PANTO-DOWN pushbutton activated in the front cab of the locomotive. *Pantograph cannot be raised.*	Reset PANTO-DOWN pushbutton by pressing on it.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
PANTO PB R ACTIVATED (Alarm Level 3). HHP-8 number identified.	PANTO-DOWN pushbutton activated in the rear cab of the locomotive. *Pantograph cannot be raised.*	Reset PANTO-DOWN pushbutton by pressing on it.
NO POWER BRAKES (Alarm Level 3).	Trainline "No Power Brakes" activated by a trailing Amtrak locomotive, as determined by the HHP-8 propulsion system main processing unit. *No power brake available from the trailing unit.*	Notify dispatcher and refer to maintenance.
Traction power reduced by 30%.	One of the main transformer oil pumps is not operating. Circuit breaker CB13, Main Transformer Oil Pump No. 1 (CB-M-OP-1) or CB14, Main Transformer Oil Pump No. 2 (CB-M-OP-2) tripped. *Loss of traction power.*	Reset circuit breaker.

SECTION X
FRICTION BRAKE EQUIPMENT

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
BRAKE CONTROL FAULT (Alarm Level 1). HHP-8 number identified.	The brake parameters monitored by the independent failure monitor (brake pipe pressure, electric (dynamic) brake feedback, brake handle position) do not match with brake handle position command. *Brake effort is probably not equal to brake demand*	Alarm help procedure: Pneumatic Backup activated Perform running brake test If brake response proceed If no brake response then apply Emergency brake Notify Dispatcher.
CONDUCTOR VALVE APPL (Alarm Level 1)	Emergency brake valve applied in a cab or in the equipment room *Emergency Brake Applied*	Alarm help procedure: Identify car then reset valve (see MFD-2).
LOCKED AXLE (Alarm Level 1). HHP-8 number and axles (1 to 4) are identified.	A locked axle is detected on the locomotive.	Alarm help procedure: Activate TECC on the affected truck.
INDEPENDENT BRAKE FAULT (Alarm Level 2)	One component of the independent brake is defective *No independent brake control*	Alarm help procedure: IBCL does not function Use the automatic brake only.
BOTH BRAKE LEVERS ACTIVE (Alarm Level 2)	Both automatic brake control levers are active at the same time in the same locomotive.	Alarm help procedure: Move ABCL in non-active cab to Handle Off position.
NO WHEEL SLIP PROTEC (Alarm Level 2)	Fault of wheelslide control computer and major fault of detection of non-rotating axle. *No protection against wheelslip/slide.*	Do not apply the brake at a greater rate than suppression until stopped, then cut out the brakes to proceed. Refer to Amtrak operating rules and instructions for operation with brakes cut out.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
TRUCK EQ C/O (Alarm Level 3). HHP-8 number and trucks (1 and 2) are identified.	Interior or exterior truck brake equipment cutout cock activated. *No brakes available on that truck.*	Refer to Amtrak operating rules and instructions for operation with brakes cut out.
SNOW BRAKE APPLIED (Alarm Level 3)	Snow brake activated. *Normal condition: brake cylinder pressure at 6 psi on all brake units for 60 seconds.*	Notify dispatcher and refer to maintenance if snow brake is activated for more than 60 seconds.
SANDING (Alarm Level 3)	Sanding activated. *Normal condition: sanding activated only if locomotive is at more than 3 mph. Sanding automatic in emergency.*	Notify dispatcher and refer to maintenance if sanding is activated when locomotive is not in motion.
PNEUMATIC BACKUP ACTIVE (Alarm Level 3)	Brake system is in pneumatic backup mode. *Brake Control Computer has failed.*	Notify dispatcher and refer to maintenance.
EMERG C/O COCK (Alarm Level 3). HHP-8 number identified.	Emergency Magnet Valve Cutout Cock (EMVCC) activated. *Emergency magnet valve cutout.*	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Service brakes do not apply.	Dump valves not functioning.	Notify dispatcher and refer to maintenance.
	Truck Equipment Cut-out cock (TECC) 1 &2 open.	Close TECC 1 &2.
	Brake cylinder relay valve not functioning.	Notify dispatcher and refer to maintenance.
	Snow brake double check valve not functioning.	Notify dispatcher and refer to maintenance.
	KE valve not functioning.	Notify dispatcher and refer to maintenance.
	Brake pipe cutout cock. is open.	Close cutout cock.
	Brake pipe relay is open or not functioning.	Close BPRV.
	No MR pressure.	Notify dispatcher and refer to maintenance.
Emergency brakes do not apply.	Automatic brake control lever is not functioning.	Notify dispatcher and refer to maintenance.
	Brake pipe relay valve is closed or not functioning.	Notify dispatcher and refer to maintenance.
	Emergency magnet valve is open or not functioning.	Notify dispatcher and refer to maintenance.
	Brake Control Computer (BCC) failure.	Notify dispatcher and refer to maintenance.
	KM-2 rapid vent valve closed or not functioning.	Notify dispatcher and refer to maintenance.
	Emergency Magnet Valve Cutout Cock (EMVCC) open.	Close EMVCC.
Erratic brake function	Leakage from individual components.	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Unexpected emergency brake application	Defective emergency brake valve/*Air leak noise at the valve.*	Cut out the KE valve (red lever) on the brake control unit. The independent brake is still available.
	Brake pipe break-in-two.	Notify dispatcher and refer to maintenance.
	Defective towing feature.	Make sure that the dead engine feature cutout cock is closed.
	Defective KE valve.	Cut out the KEV. Only the independent brake is then available.
	Defective Emergency Magnet Valve (EMV)/*Air leak noise at the magnet valve.*	Cut out the EMV with the EMVCC.
	Any other cause to be determined by maintenance personnel.	Refer to maintenance.

EMERGENCY BRAKE APPLICATION STEP-BY-STEP TROUBLESHOOTING

A. To determine if the emergency condition is caused by a manual device, penalty backup, or operational error, proceed as follows:

1) Verify that ABCL(s) is (are) in HO position. In leading cab, use MFD2 brake status display, to verify handle position in the other cab. ABCL(s) need to be in HO.

2) With locomotive stopped, verify if EMV (check label on BCU) is warm at touch. If not, BCC is either in penalty backup mode or there is a BCC failure. To determine if BCC is in penalty backup mode, check ER pressure on MFD1. In penalty back-up mode, ER pressure should be 105 psi.

3) Verify that POD displays NO MOTION. If not, with ABCL(s) in HO, use NO-MOTION bypass switch as required.

4) Using MFD2 brake status display, select each individual locomotive and verify if the emergency source is identified. Possible indications in emergency brake box are:

a. "PUSH PB F": Engineer's or assistant's emergency brake valve mushroom pushbutton activated in front cab.

b. "PUSH PB R": Engineer's or assistant's emergency brake valve mushroom pushbutton activated in rear cab.

c. "BRAKE CONTROL LEVER": ABCL in emergency position

d. "CORD A": Conductor's emergency brake valve activated in equipment room.

e. "EMERGENCY": Indicates that no emergency activation device is set to emergency. Indication provided if there is a break-in-two (BP drops below 50 psi).

5) When emergency activation device is identified by monitoring, try to reset it manually. If identification is not removed from MFD2, problem is electrical.

6) NO MOTION indication on POD is provided by Speed Sensing (SS) system but does not reflect relay status. Depress NO MOTION BYPASS switch. POD should then display NO MOTION BYPASS.

7) If after all these steps, emergency condition is still present, there is a system problem.

B. Determine if the emergency condition is caused by an electrical problem.

NOTE:

Electrical problems troubleshooting should be performed by a qualified electrician. Report any further problem to maintenance.

C. Determine if the emergency condition is caused by a pneumatic problem.

NOTE:

Pneumatic problems troubleshooting should be performed by qualified maintenance personnel. Report any further problem to maintenance.

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SECTION XI
CAB SIGNAL AND AUTOMATIC TRAIN CONTROL SYSTEMS

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
1. ACSES		
ACSES FAULT (Alarm Level 1)	Failure of a vital circuit occurs in the ACSES system. *The ACSES magnet valve is dropped, thus causing an irretrievable full service brake application with loss of traction power.*	Alarm help procedure: Break seal and cutout electrical portion of ACSES If cannot recover from penalty, cutout ACSES pneumatic magnet valve (blue) Proceed with reduced speed as per operating rules Notify Dispatcher.
ACSES C/O (Alarm Level 3)	Electrical portion of ACSES system bypassed with cutout switch on equipment cabinet. *ACSES system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
ACSES MAGN VALVE C/O (Alarm Level 3)	Pneumatic portion of ACSES system bypassed with penalty magnet valve blue cutout cock on brake control unit. *ACSES system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
ACSES DATA NOT AVAILABLE (Alarm Level 3)	ACSES system offline. *ACSES system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
2. ALERTER RECORDER		
ALERTER FAULT (Alarm Level 1)	Defective alerter recorder control unit *No alerter functions available*	Alarm help procedure: If cannot recover from penalty, cutout Alerter pneumatic magnet valve (yellow) If audible alarm sounds continuously then break seal and cutout electrical portion of Alerter (Electrical locker #2) Proceed as per special instructions Notify Dispatcher.
EVENT RECORDER FAULT (Alarm Level 2)	Failure of a vital circuit occurs in the recorder portion of the alerter/recorder control unit. *Events are not recorded.*	No corrective action possible. Note that the electrical cutout on the alerter/recorder control unit in electrical locker No. 1 cuts out the alerter portion only.
ALERTER C/O (Alarm Level 3)	Electrical portion of alerter bypassed with cutout switch on ARU. *Alerter not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
ALERTER MAGN VALVE C/O (Alarm Level 3)	Pneumatic portion of alerter bypassed with penalty magnet valve yellow cutout cock on brake control unit. *Alerter not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
Alerter acknowledge not available with acknowledge switches.	ATC system not functional. *No acknowledge available for the alerter with the whisker switch or the acknowledge footswitch.*	Use any other means to reset the Alerter. Reset the ATC circuit breaker and/or place the ATSCO switch in NORMAL position to recover normal operation of the ATC system.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
3. ATS/ATC		
ATS/ATC FAULT (Alarm Level 1)	Failure of a vital circuit occurs in the ATS/ATC system. *The ATS/ATC magnet valve is dropped thus causing an irretrievable full service brake application with loss of traction power.*	Alarm help procedure: Break seal and cutout electrical portion of ATC/ATS If cannot recover from penalty, cutout ATC/ATS pneumatic magnet valve (red) Proceed with reduced speed as per operating rules Notify Dispatcher.
ATS C/O (Alarm Level 3)	Electrical portion of ATS system bypassed with ATSCO cutout switch on equipment cabinet. *ATS system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
ATS/ATC MAGN VALVE C/O (Alarm Level 3)	Pneumatic portion of ATS/ATC system bypassed with penalty magnet valve red cutout cock on brake control unit. ATS/ATC *system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
ATS/ATC DATA NOT AVAILABLE (Alarm Level 3)	ATS/ATC system offline. ATS/ATC *system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.
NO-MOTION BYPASS (Alarm Level 3)	NO-MOTION BYPASS switch activated. *Speed sensing system bypassed.*	Release NO-MOTION BYPASS switch.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
4. SPEED SENSING		
SPEED SENSING FAULT (Alarm Level 1)	Failure of a vital circuit occurs in the speed sensing system. *The ATS/ATC magnet valve is dropped thus causing an irretrievable full service brake application with loss of traction power.*	Alarm help procedure: Break seal and cutout electrical portion of SS Proceed with reduced speed as per operating rules Notify Dispatcher.
SPEED SENSING C/O (Alarm Level 3)	Speed sensing system bypassed with SSCO cutout switch on equipment cabinet. *Speed sensing system system not functional.*	Proceed with reduced speed as per operating rules. Notify dispatcher and refer to maintenance.

SECTION XII
TRAIN MONITORING AND DATA MANAGEMENT

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
INCOMING TRAIN ORDER (Alarm Level 2)	Train order received from wayside. *Alarm activated after the CMU has received a train order file from the local DMS. Deactivated when the train order has been successfully printed.*	Alarm help procedure: Acknowledge alarm Confirm printout is OK Proceed as per special instructions.
EOT COMMUNICATION LOSS (Alarm Level 2)	The head of train device in the locomotive has lost communication with the end of train device. *No communication available between front and rear of consist.*	Alarm help procedure: Proceed as per special instructions.
END OF TRAIN NOT ARMED (Alarm Level 2)	End of train device has not been armed (wrong or no radio ID code). *No communication available between front and rear of consist.*	Verify EOT information on MFD-2. Proceed as per special instructions.
EOT BATTERY LOW/DEAD (Alarm Level 2)	End of train device has a weak or dead battery. *No communication available between front and rear of consist.*	Notify dispatcher and refer to maintenance.
CARD READER C/O (Alarm Level 3). HHP-8 number identified.	Key card reader bypass switch activated. *Locomotive can be operated at any speed without proper authorization level.*	Notify dispatcher and refer to maintenance.
ALARMS NOT AVAILABLE (Alarm Level 3)	The local CMU in the lead locomotive is not functional. Alarm generated by MFD1, MFD2. *No alarms can be generated.*	Notify dispatcher and refer to maintenance.

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SECTION XIII
WATER AND WASTE RETENTION SYSTEMS

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
POWER OFF indicator on.	Toilet control circuit breaker, CB 79, tripped.	Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
	Main reservoir pressure below 60 psig.	Verify pressure on pressure regulator gauge.
	Vacuum too low.	Open air isolation valve if closed.
	No 120 Vac power available and toilet operation disabled	Open air ejector valve if closed.
LOW AIR indicator on.	Main reservoir pressure below 60 psig	Verify pressure on pressure regulator gauge.
	Toilet operation is disabled.	Open air isolation valve if closed.
LOW WATER indicator on.	Water level in water tank less than 1/3.	Notify dispatcher and refer to maintenance.
NO VACUUM indicator on.	Vacuum too low.	Open air ejector valve if closed. Notify dispatcher and refer to maintenance, air ejector might be clogged.
	Toilet operation is disabled.	
VALVE OPEN indicator on.	Drain valve open on draining station.	Close drain valve on both draining station if opened.
	Toilet operation is disabled.	
TANK FULL indicator on.	Waste tank full.	Close lavatory.
	Toilet operation is disabled.	Notify dispatcher and refer to maintenance.

INDICATION	CAUSE/*EFFECT*	CORRECTIVE ACTION
Toilet fails to flush.	No 120 Vac power available.	Verify on breaker panel if breaker has tripped. Reset circuit breaker if necessary.
	Main reservoir pressure below 60 psig.	Verify pressure on pressure regulator gauge.
	Drain valve open on draining station.	Open air isolation valve if closed.
	Vacuum too low	Open air ejector valve if closed.
		Close drain valve on both draining station if opened.
	Flush control and/or isolation valve closed	Open flush control and/or isolation valve.

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PREPARATION FOR OPERATION CHECK LIST

OPERATION	RESULT
At the exterior of the locomotive, verify that: All pneumatic cutout cocks at each corner of the locomotive are closed. All parking brake manual override levers (4 on each side) are locked in their respective spring plate. Both exterior truck brake cutout cocks (one for each truck, on the left side) are cut in.	All exterior cutout cocks and levers are in normal operating position.
Press step lighting pushbutton.	Access lighting on for one minute.
At the interior of the locomotive, verify that: Conductor's emergency brake valve is not activated. All penalty magnet valves cutout cocks are cut in. Emergency magnet valve cutout cock is in normal position. All pantograph pneumatic control panel cutout handles are cut in. All propulsion electrical cubicle switches are in NORMAL position. The ATSCO, and SSCO cutout switches (ATC equipment cabinet) are cut in. The ACSES cutout switch (ACSES equipment cabinet) is cut in. Both interior truck brake cutout cocks (one for each truck, on the left side) are cut in. The ITSU and ARU cutout switches (electrical locker No. 1) are cut in. All circuit breakers are in their normal operating position. The pantograph pole, emergency tools, with first aid kit, and 27-pin jumpers, are in their proper location.	All interior equipment, including cut-out cocks, levers, and bypass switches, are in normal operating position. All the safety equipment is present.

PREPARATION FOR OPERATION CHECK LIST (Cont'd)

OPERATION	RESULT
Press CAB ACTIVATE button.	Monitoring system, key card reader, propulsion control, and auxiliary compressor activated.
NOTE: When the main reservoir pressure is below 90 psi, the auxiliary compressor starts automatically to enable pantograph raising, and close the main circuit breaker.	
Apply key card against key card reader.	Key card reader LEDs indicate the following: Green LED continuously lit: Key card reader is ready to accept a card. Green LED flashing: Card accepted. Red LED continuously lit: Key card reader fault. Red LED flashing: Invalid PIN number entered. Key card reader beeps whenever a status LED is flashing
Type valid PIN number on keypad.	Reverser operation authorized, with traction limitations imposed by access level.
NOTE: If cab is authorized with reverser in other position than OFF, and throttle is in a power position, cycle throttle to "0" and back to power positions to get propulsion controls.	
Set Reverser to N, FWD, or REV.	Cab controls enabled. POD, MFD1, ADU, and other indicators come on.
If step above fails, set opposite cab reverser to OFF.	POD, MFD1, ADU, and other indicators on.
Press PANTO-UP pushbutton.	Pantograph raises.
NOTE: Pantograph raising is in accordance with the setting of the Pantograph Local Selector (PLS) on the propulsion electrical cubicle. If the pantograph is not raising, check all PANTO-DOWN pushbuttons in the train consist for proper position. Press on the pushbutton to regain pantograph control with the PANTO-UP pushbutton.	

PREPARATION FOR OPERATION CHECK LIST (Cont'd)

OPERATION	RESULT
Verify MCB switch in AUTO.	Main circuit breaker closed in this position.
If cab car leads, set 13 T CAB CAR switch to ON.	Cab car takes control.
Set HEP switch to ON.	Passenger cars supplied.
Set PARKING BRAKE switch to RELEASE.	Parking brakes released.
Verify that throttle is at "0" and ABCL in HO position.	Locomotive ready to run.
NOTE: Perform all predeparture tests as listed below	

PREPARATION FOR TEST.

STEP DESCRIPTION	MFD1 INDICATION
1) Verification of electric brake: Check that following MFD1 indications are not active in the ALARM BOX section: TRACTION LOSS ELECT BRAKE LOSS.	 Not Shown Not Shown
NOTE: If the TRACTION LOSS and ELECT BRAKE LOSS alarms are not active, the electric brake is fully functional.	
2) Apply parking brake and verify that gold indicators are out.	No MFD1 indication required.
3) Move independent brake to RELEASE.	No MFD1 indication required.
4) Press "Train Operations" button on MFD1.	No MFD1 indication required.

STEP DESCRIPTION	MFD1 INDICATION
NOTE: MFD1 screen changes to display the last successful test dates for ATC PreDeparture, Terminal Brake Test, Alerter PreDeparture, Truck Surveillance Pre-Departure. The following buttons become available at the bottom of the screen: • Alerter Test • Brakes Test • ATC Test • ITSU Test.	

BRAKE PREDEPARTURE TEST.

NOTE:
Next steps are preparation for brake predeparture test.

STEP DESCRIPTION	MFD1 INDICATION
5) Press "Brakes Test" button.	No MFD1 indication required.
NOTE: Brake test procedure is enabled.	
6) Press "Initiate" button.	No MFD1 indication required.
NOTE: MFD1 initiates the test and displays step-by-step instructions in the "Test Procedure" section of the screen, as shown in the MFD1 INDICATION column.	
	Preparation for Test:
NOTE: In this brake test, the BRAKE VALVE C/O switch on the engineer's desk right switch panel must be placed in PASS. position (train consist set-up in graduated release).	
7) Place ABCL to RELEASE position.	Charge the System
NOTE:. For safety reasons, the parking brake must have been applied in step 2 of this procedure.	Apply Parking Brake
8) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify brake pipe air leakage.	Tightness Check

STEP DESCRIPTION	MFD1 INDICATION
9) Set ABCL position to SUP position to get a BP pressure reduction of 20 psi from released value, as displayed on BP pressure gauge.	Make 20 PSI BP Reduct Brake Pipe drops to 90 PSI.
10) Move BRAKE VALVE C/O switch to OUT position.	Cut Out BP Charging
11) Take a reading of the BP pressure and, with a stop watch, wait 3 minutes, and:	After 3 Min.: Check BP Reduc
12) Take a second reading.	BP Reduct Not Exceed 3 PSI
13) Press Confirm/Next Step button.	Display next Brake Test steps.
14) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the service portion of the brake system.	Full Service Test
15) Move BRAKE VALVE C/O switch to PASS. position and move ABCL to RELEASE position.	Cut In BP Charge, Rel. Brake BP = 110 PSI BC = 0 PSI
16) Move ABCL to FULL SERVICE position.	Put ABCL to Full Service
17) Take a BC pressure reading on MFD1. BC pressure on MFD1 should be 56 psi ± 2 psi.	BC = 56 psi ± 2 psi
18) Verify that all brakes are applied.	Chk if all Vehicles Respond
19) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the operation of the brake control computer.	Computer Mode Test
20) Place ABCL to RELEASE position.	Put ABCL In Release
21) BP pressure should remain at 81 psi.	Chk if BP Remains at 81 Psi
The next steps verify the emergency portion of the brake system.	Emergency Brake Test
22) Move ABCL to EMERGENCY position.	Put ABCL to Emergency
23) BP pressure on MFD1 should be 0 psi.	Check if BP Dropping to Zero

STEP DESCRIPTION	MFD1 INDICATION
24) Verify that all brakes are applied.	Chk if all Vehicles Respond
25) Wait 60 seconds minimum, then move ABCL to RELEASE position.	After 60 S: ABCL to Release
NOTE: BP pressure = 110 PSI, BC pressure = 0 PSI.	
26) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the emergency mushroom portion of the brake system.	EEPV Test
27) Press the engineer EMERGENCY BRAKE VALVE Mushroom.	Activate the EEPV
28) BP pressure on MFD1 should be 0 psi.	Check if BP Dropping to Zero
29) Verify that all brakes are applied.	Chk if all Vehicles Respond
30) Wait 60 seconds minimum, then reset the EMERGENCY BRAKE VALVE mushroom.	AFTER 60 SECONDS: RESET EEPV
NOTE: To charge the system, move ABCL to HANDLE OFF position, and then to RELEASE position.	
31) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
The next steps verify the emergency magnet valve operation.	EMV Test
32) The Brake Control Computer activates the Emergency Magnet Valve automatically.	BCC Activates EMV
33) BP pressure on MFD1 should be 0 psi. Verify that all brakes are applied.	Chk if all Vehicles Respond
34) Wait 60 seconds.	After 60 S: BCC to Reset EMV
35) Move ABCL to HANDLE OFF position.	When ER is 0 put ABCL to HO
The next steps verify the independent brake operation.	Independent Brake Test
36) Move ABCL to RELEASE position.	Put ABCL to REL

STEP DESCRIPTION	MFD1 INDICATION
37) Move IBCL to MAX position.	Put IBCL to Full Application
38) BC pressure on MFD1 should be 57 psi ± 2 psi.	Read the BC Pressure
39) Verify that BC pressure is 57 psi ± 2 psi.	Chk if BC Within Tolerance
40) Move IBCL to RELEASE position.	Put IBCL to Release
The next steps verify the pneumatic backup portion of the brake system	Pneumatic Backup Test
NOTE: The Brake Control Computer deenergizes the PCMV for pneumatic backup operation.	
41) Move ABCL to FULL SERVICE position.	Put ABCL to Full Service
42) Take a BC pressure reading on MFD1. BC pressure should be 56 psi ± 2 psi.	Chck if all Vehicles Respond
43) Move ABCL to RELEASE position.	Put ABCL to Release
44) Verify that all brakes are released.	Check if all Vehicles Release
NOTE: BP pressure = 110 PSI, BC pressure = 0 PSI.	
45) Press Confirm/Next Step button.	
NOTE: MFD1 displays the next brake test steps.	
NOTE: The Brake Control Computer reenergizes the PCMV for normal operation.	
The next steps verify the Electro Pneumatic portion of the brake system.	EP-Brake Test
46) Move ABCL to FULL SERVICE position.	Put ABCL to Full Service
47) Wait until brakes are applied and then move ABCL to RELEASE.	After 10 S: ABCL to Release
48) With a stop watch, measure the time to fully release the brakes.	Note the Release Time
49) The release time should be within tolerances.	Chk if Rel Time WT Tolerance
NOTE: The release time depends on the coach cars, and not on the locomotive only.	
50) Press Confirm/Next Step button.	Test Result: Passed

STEP DESCRIPTION	MFD1 INDICATION
51) Press Print/Record button.	Print OK and Reprint buttons come on.
52) Press Print OK if the report is properly printed. Press Reprint is the report is not properly printed.	No MFD1 indication required.
53) Press Return button.	MFD1 screen displays the Train Operations page.

ATC PREDEPARTURE TEST. For this test, the reverser must be placed in FORWARD position.

STEP DESCRIPTION	MFD1 INDICATION
NOTE: Next steps are preparation for ATC predeparture test	
1) Ensure that parking brake is applied.	Parking Brake: Applied
2) Ensure there is no code present in track.	
3) Verify that CAB TERRITORY switch on cab rear wall switch panel is set to IN position.	
4) Press ATC Test button.	Display menu choice.
NOTE: Next steps test the ATC in a step-by-step operation.	
5) Press Initiate button.	
The system will simulate track codes and for each code will check the overspeed and under speed in an ascending order up to the maximum speed. (The ADU will go through all aspects of the cab signal and display all overspeed points.) For each code, the simulated coded speed and the simulated locomotive speed will be shown on POD. For each coded speed, audible and visual alarms will be generated without the need for acknowledge.	The system will go through all aspects of the cab signal and display all overspeed points

STEP DESCRIPTION	MFD1 INDICATION
6) The system will cease to drive the speedometer and the code changes will be simulated in a descending order until a restricting aspect is reached. The operator must acknowledge downward codes except for the last one.	Acknowledge all warnings except restricted aspect
7) Five seconds after last downward code change, the ATC will trigger a penalty brake.	Verify the brake pipe pressure drop and application indication
8) Reset the penalty brake.	Reset penalty
9) Press Confirm Result button.	Test Result: Passed
10) Press Print/Record button.	Display menu choices.
11) Press Print OK if the report is properly printed.	Display menu choices.
12) Press Return button.	Display menu choices.

ALERTER PREDEPARTURE TEST.

STEP DESCRIPTION	MFD1 INDICATION
1) Move ABCL to FULL SERVICE position.	BC pressure increases.
2) Press Alerter Test button.	Start of Alerter test procedure enabled.
3) Press Initiate button.	Initiate test and display the step-by-step operation.
4) Wait approximately 25 seconds when audible alarm starts and reset the alerter using the Acknowledge button.	Reset the alerter using various inputs
5) Wait approximately 25 seconds when audible alarm starts and reset the alerter by doing one of the following. • Activating any acknowledge switch • Moving the horn button • Moving the horn footswitch • Moving the bell button • Switching on the headlight • Moving the throttle. • Moving the ABCL.	Reset the alerter using various inputs

STEP DESCRIPTION	MFD1 INDICATION
NOTE: If the ATC is cutout, the alerter can't be acknowledged by the acknowledge footswitch and acknowledge whisker switch. One of the other reset functions must then be used.	
6) Wait until timer expires.	Do not acknowledge
7) Penalty brake should be initiated. BC pressure should be greater than 50 psi.	Verify the brake pipe pressure drop and application indication
8) Move ABCL to SUPPRESSION position.	Reset penalty with brake application suppression
9) Press Confirm Result button.	Test Result: Passed
10) Press Print/Record button.	Display menu choices.
11) Press Print OK if the report is properly printed.	Display menu choices.
12) Press Return button.	Display menu choices.

ITSU PREDEPARTURE TEST.

STEP DESCRIPTION	MFD1 INDICATION
1) Press ITSU Test button.	Display menu choice.
2) Press Initiate button.	
This initiate an ITSU self test and in parallel opens the "on board" trainlines. The operator should verify and acknowledge that the ONBOARD FAILURE indicator is ON.	Acknowledge that on board light on the console is lit
3) If there is a second locomotive, press the Next Loco/Passed button.	Select next loco button if second loco is present
4) Press the Next Loco/Passed, or the Test Failed button.	Press passed or failed button to confirm test result
5) Press Print/Record button.	Display menu choices.
6) Press Print OK if the report is properly printed.	Display menu choices.
7) Press Return button.	Display menu choices.
8) Press Return button.	Return to the Main Operations Page of MFD1.