MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

Push-Pull
Suburban Coach

OPERATING INSTRUCTIONS

Blind Trailer Cars
600-653
Control Trailer Cars
1600-1652

Bombardier Inc.
Mass Transit Division

GENERAL OUTLINE

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF ABBREVIATIONS

A or Amp	Ampere
AAR	Association of American Railroads
ABV	Automatic Brake Valve
AC	Alternating Current
A/C	Air Conditioning
ACL	Active Control Location (Side Entrance Doors)
ATC	Automatic Train Control
ATS	Automatic Train Stop
AUTO	Automatic
BAV	Brake Application Valve
BCAP	Brake Cylinder Application Pipe
BP	Brake Pipe
BV	Brake Valve
CCW	Counterclockwise
COC	Cutout Cock
CU	Control Unit
CU. FT.	Cubic Feet
CU. IN.	Cubic Inch
CV	Control Valve
CW	Clockwise
DC	Direct Current
DCL	Decelostat (Controller or Valve)
EBV	Emergency Brake Valve
EX	Exhaust
F	Farhenheit (temperature)
HEP	Head End Power
HVAC	Heating, Ventilation and Air Conditioning
Hz	Hertz
IC	Intercommunication
IND	Indicating
Kw	Kilowatt
LH/LS	Left Hand / Left Side
LO	Layover
MR	Main Reservoir
MR/EP	Main Reservoir Equalizing Pipe
MU	Multiple Units
MV	Magnet Valve
NC	Normally Closed
NO	Normally Open
PA	Public Address
PB	Push Button
PCS	Pneumatic Control Switch
PSI	Pounds Per Square Inch
PSIG	PSI, gauge
PS	Pressure Switch
PTT	Press-to-Talk (Switch)
PU	Pick-Up
RH/RS	Right Hand/Right Side
SPK	Speaker
T/L	Trainline
TLL	Trainline Location (Side Entrance Doors)
TLR	Trailer
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
W	Watt

300, 600, 1600 CAR DATA

Length Over Couplers (Pulling Faces) .....85 ft. 3 in.
Exterior Body Width (nominal) .....10 ft. 6-1/8 in.
Interior Floor Level Width (nominal) .....9 ft. 5-9/16 in.
Roof Height Exterior (Nominal) .....12 ft. 8-1/4 in.
High Ceiling Height Interior (Nominal) .....7 ft. 1 in.
Low Ceiling Height Interior (Nominal) .....6 ft. 7 in.
Vestibule Side Door Height (Nominal) .....6 ft. 3-1/2 in.
Vestibule Side Door Width (Nominal) .....32 in.
Passenger Compartment End Door
Height (Nominal) .....6 ft. 5-1/4 in.
Passenger Compartment End Door
Width (Nominal) .....33 in.
Aisle Width (Nominal) .....20-1/4 in.
Truck Centers .....59 ft. 6 in.
Truck Wheelbase .....8 ft. 6 in.
Wheel Diameter .....32 in.
Minimum Radius of Horizontal Track Curve
to be Negotiated with Cars Coupled.....250 ft. = 23°
Blind Trailer Seating Capacity 122
Control Trailer Seating Capacity 122
Blind Trailer Weight (Approximate) .....89,500 lb
Control Trailer Weight (Approximate) .....95,000 lb
Control Trailer Sand Box Capacity (Each) .....1.9 cu. ft.
Standard Coach Key .....J. L. Howard 2567

1. Diaphragm
2. Carbody Lifting Eyes
3. Fixed Window in Side Door
4. Sliding Side Entrance Door
5. Handicapped Access Symbol
6. Fresh Air Intake Grille
7. Ventilation Exhaust Grille
8. Vertical Handhold (Both Ends)
9. Brake Status Lights
10. Flag Bracket (4 per Car)
11. Jacking Pads (Both Ends)
12. Hinged Trap Door
13. Fixed Steps (Both Ends)
14. Platform Light (Both Ends)
15. Conductor's Signal Push Button (Both Ends)
16. Side Door Exterior Crew Key Switch
17. Side Door Exterior Emergency Handle
18. Emergency Escape Window (L-4, R-1, L-11 and R-8)
19. No. 1 End Truck with Wheels No. 1L, 1R, 2L and 2R
20. No. 2 End Truck with Wheels No. 3L, 3R, 4L and 4R
21. Illuminated Car Number Sign
22. Fresh Air Intake Grille in Air Scoop
23. Air Scoop
24. Headlights
25. Radio Antenna
26. Air Horn
27. Red Marker Lights
28. Windshield with Stone Guard
29. Sliding Sash Window in Engineman's Control Compartment Side Door
30. Snow Plow
31. Cab Signal Track Receiver
32. Sand Box

NOTE: Equipment shown is similarly arranged on both sides of car with the exception of additional window, and location of Brake Status Lights on Left Side.

Figure 1
Control Trailer Car General Arrangement — Exterior Layout

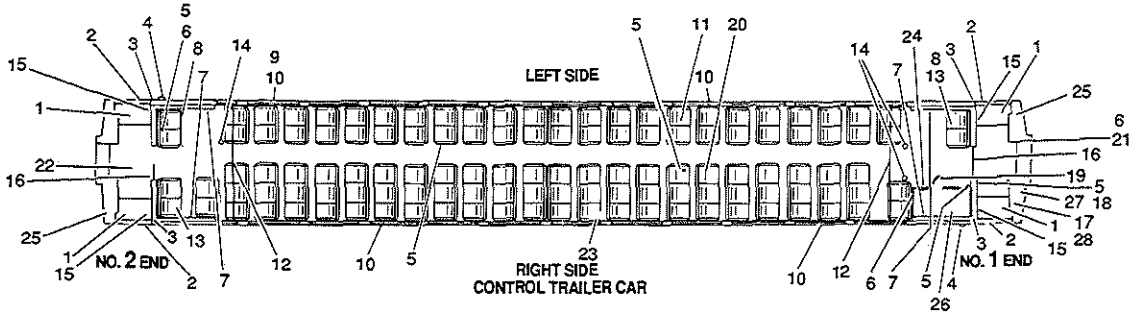
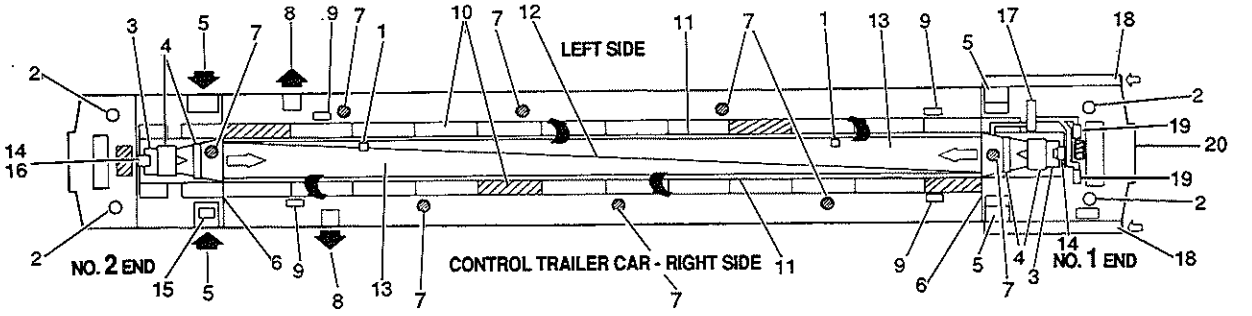


Figure 2
Control Trailer Car General Arrangement — Interior Layout

1. Fixed Steps and Hinged Trap Door
2. Vestibule Side Entrance Door
3. Side Door Mechanical Lock
4. Brake Status Lights
5. Convenience Outlet (5 per car)
6. Emergency Brake Valve
7. Side Door Operator Access Door
8. Wheelchair Tiedown Device
9. Emergency Tool Kit (Above Window L-2)
10. Emergency Escape Window (L-4, R-1, L-11 and R-8)
11. Two Passenger Seat (Typical)
12. Low-Ceiling/High-Ceiling Transition Header
13. Bulkhead Seat with Body End Sliding Door Closer and Check Assembly
14. Stanchions
15. Master Side Door Control Panel
16. Body End Sliding Door
17. No. 1 End Vestibule (Engineman's Control Compartment Area)
18. PA and IC Control Panel (Conductor's)
19. Electrical Locker Access Door
20. Three Passenger Seat (Typical)
21. Handbrake
22. No. 2 End Vestibule Area
23. Fire Extinguisher (Above Luggage Rack)
24. Layover Heat Thermostat (LHT) (Electrical Locker)
25. Wheelchair Access Plate
26. Electrical Locker
27. Engineman's Remote Control Head (Radio, PA and IC)
28. Engineman's Control Compartment



1. Conductor's Signal Push Button
2. Emergency Handle
3. Recirculation Grille (Return Air)
4. Overhead HVAC Unit
5. Fresh Air Intake Grille and Duct (Inside Air Scoop, No. 1 End Only)
6. Low-Ceiling/High-Ceiling Transition Header
7. PA Speaker
8. Ventilation Exhaust Grille and Duct (Static)
9. Interior Ventilation Exhaust Grille (Static)
10. Fluorescent Lighting Fixture (Typical)
    (Shaded areas indicate Emergency Light Fixtures)
11. High Ceiling HVAC Diffuser (Bottom of Duct, along Fluorescent Fixtures)
12. Main Air Duct Splitter (Divider)
13. Main Air Duct (No. 1 and No. 2 End Halves)
14. Solid Odor/Fume Controllant
15. Fresh Air Thermistor (FAT)
16. Return Air Temperature Sensor (RAT)
17. Engineman's Control Compartment Fan
18. Air Scoop
19. HVAC Grille (Diffuser) with Manual Damper
20. Collision Post Door (Engineman's Control Compartment Only)

Figure 3
Control Trailer Car General Arrangement — Ceiling Layout

1. E-3 Brake Application Valve
2. No. 8 Vent Valve
3. Air Spring
4. Leveling Valve (3 per car)
5. Wheel Slide Dump Valve
6. Local A/C Unit Control Panel
7. 480 VAC Breaker Panel Box
8. Reduction Relay Valve
9. No. 1 End Truck with Wheels No. 1L, 1R, 2L and 2R
10. Brake Control Unit
11. No. 2 End Truck with Wheels No. 3L, 3R, 4L and 4R
12. Wheel Slide Cutoff Pressure Switch (EDCO)
13. Main (Supply) Reservoir
14. Combined Control/Selector Volume Reservoir
15. 480 VAC Junction Box
16. Protective Heat Thermostat Assembl (Inside Junction Box)
17. Jumper Storage Box
18. 480/120 VAC Transformers (3)
19. A/C Compressor/Condenser Unit
20. Battery Box
21. Battery Charger
22. Second Main Reservoir
23. Air Filter
24. Sand Box and Trap
25. Sanding Control Valve (2 per car)
26. Snow Plow
27. Air Brake Equalizing Reservoir
28. Bell and Magnet Valve
29. Cab Signal Track Receiver
30. First Main Reservoir
31. Battery Disconnect Switch
32. Reservoir Release Valve

Figure 4
Control Trailer Car General Arrangement — Underframe Layout

NOTE: For undercar filling, draining and cutout locations, see Figure 5-3.

1. Diaphragm
2. Carbody Lifting Eyes
3. Fixed Window in Side Door
4. Sliding Side Entrance Door
5. Handicapped Access Symbol
6. Fresh Air Intake Grille
7. Ventilation Exhaust Grille
8. Vertical Handhold (Both Ends)
9. Brake Status Lights
10. Flag Bracket (4 per Car)
11. Jacking Pads (Both Ends)
12. Hinged Trap Door
13. Fixed Steps (Both Ends)
14. Platform Light (Both Ends)
15. Conductor's Signal Push Button (Both Ends)
16. Side Door Exterior Crew Key Switch
17. Side Door Exterior Emergency Handle
18. Emergency Escape Window (L-4, R-1, L-11 and R-8)
19. No. 1 End Truck with Wheels No. 1L, 1R, 2L and 2R
20. No. 2 End Truck with Wheels No. 3L, 3R, 4L and 4R

NOTE: Equipment shown is similarly arranged on both sides of car with the exception of location of Brake Status Lights on Left Side.

Figure 5
Blind Trailer Car General Arrangement—Exterior Layout

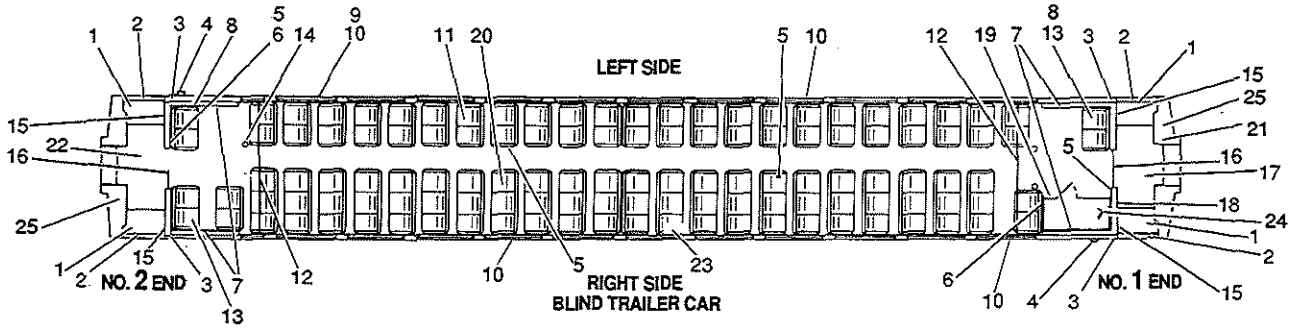
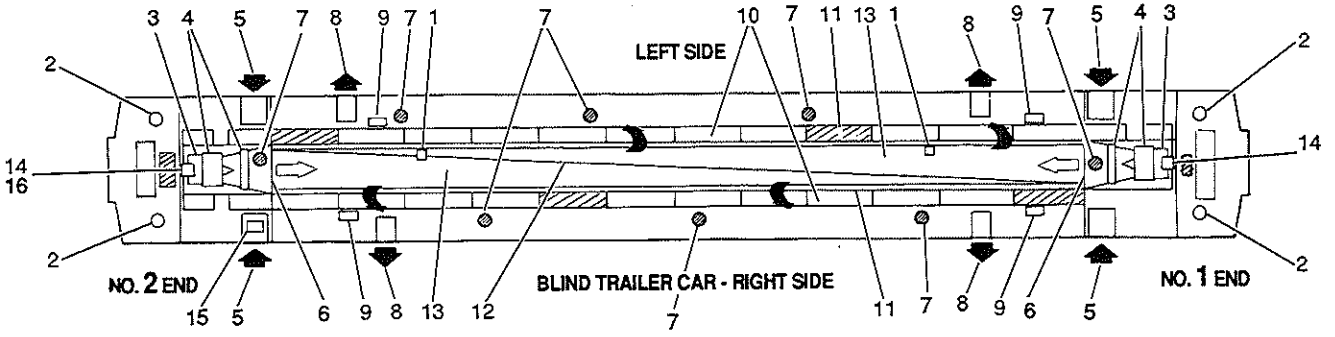


Figure 6
Blind Trailer Car General Arrangement — Interior Layout

1. Fixed Steps and Hinged Trap Door
2. Vestibule Side Entrance Door
3. Side Door Mechanical Lock
4. Brake Status Lights
5. Convenience Outlet (4 per car)
6. Emergency Brake Valve
7. Side Door Operator Access Door
8. Wheelchair Tiedown Device
9. Emergency Tool Kit (above Window L-2)
10. Emergency Escape Window (L-4, R-1, L-11 and R-8)
11. Two Passenger Seat (Typical)
12. Low-Ceiling/High-Ceiling Transition Header
13. Bulkhead Seat with Body End Sliding Door Closer and Check Assembly
14. Stanchions
15. Master Side Door Control Panel
16. Body End Sliding Door
17. No. 1 End Vestibule Area
18. Conductor's PA and IC Control Panel
19. Layover Heat Thermostat (LHT) (Electrical Locker)
20. Three Passenger Seat (Typical)
21. Handbrake
22. No. 2 End Vestibule Area
23. Fire Extinguisher (Above Luggage Rack)



1. Conductor's Signal Push Button
2. Emergency Handle
3. Recirculation Grille (Return Air)
4. Overhead HVAC Unit
5. Fresh Air Intake Grille and Duct
6. Low-Ceiling/High-Ceiling Transition Header
7. PA Speaker
8. Ventilation Exhaust Grille and Duct (Static)
9. Interior Ventilation Exhaust Grille (Static)
10. Fluorescent Lighting Fixture (Typical)
    (Shaded areas indicate Emergency Light Fixtures)
11. High Ceiling HVAC Diffuser
    (Bottom of Duct, along Fluorescent Fixtures)
12. Main Air Duct Splitter (Divider)
13. Main Air Duct (No. 1 and No. 2 End Halves)
14. Solid Odor/Fume Controllant
15. Fresh Air Thermistor (FAT)
16. Return Air Temperature Sensor (RAT)

Figure 7
Blind Trailer Car General Arrangement — Ceiling Layout

1. E-3 Brake Application Valve
2. No. 8 Vent Valve
3. Air Spring
4. Leveling Valve (3 per car)
5. Wheel Slide Dump Valve
6. Local A/C Unit Control Panel
7. 480 VAC Breaker Panel Box
8. Reduction Relay Valve
9. No. 1 End Truck with Wheels No. 1L, 1R, 2L and 2R
10. Brake Control Unit
11. No. 2 End Truck with Wheels No. 3L, 3R, 4L and 4R
12. Wheel Slide Cutoff Pressure Switch (EDCO)
13. Main (Supply) Reservoir
14. Combined Control/Selector Volume Reservoir
15. 480 VAC Junction Box
16. Protective Heat Thermostat Assembly (Inside Junction Box)
17. Jumper Storage Box
18. 480/120 VAC Transformers (3)
19. A/C Compressor/Condenser Unit
20. Low Voltage Power Supply
21. Reservoir Release Valve

NOTE: For undercar filling, draining and cutout locations, see Figure 5-4.

Figure 8
Blind Trailer Car General Arrangement — Underframe Layout

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 1

CAR GENERAL DESCRIPTION

1.1 INTRODUCTION

The push-pull passenger cars, as built for MASSACHUSETTS BAY TRANSPORTATION AUTHORITY (MBTA) by Bombardier Inc., are designed for push-pull operation in a train consist of up to eleven cars.

The cars are of two types: Control Trailer Cars which are equipped with an Engineman's control compartment and Blind Trailer Cars which are not equipped with controls.

The control trailer car configuration permits control of the locomotive from the Engineman's control compartment. This control compartment converts into a normal vestibule area when the locomotive is leading.

Although the control trailer car will normally be located at the end of the train farthest from the locomotive, a control trailer car may be placed in any position throughout the train, in which case it will function as a blind trailer car.

1.2 ACCESS TO CAR INTERIOR

The control trailer cars and the blind trailer cars have a vestibule located at each end. Each vestibule is equipped with manually operated side entrance doors and manually operated trap doors which close over the stepwells. This equipment permits high level or low level platform boarding of passengers from either side of the train.

The area of each vestibule is sufficient to permit negotiating a wheelchair through the side entrance doors and passenger compartment end door. A wheelchair access plate is located at the No. 1 End Left Side and No. 2 End Right Side for use at high platform only.

1.3 CAR ORIENTATION

1. The following definitions govern when designating the ends and sides of the cars:

A. The No. 1 End is the vestibule in which the handbrake is located.

B. The No. 2 End is the opposite vestibule.

C. The RIGHT SIDE and LEFT SIDE of the car are determined standing in the No. 2 End vestibule while facing the No. 1 End.

2. Wheels, journal boxes and contained parts are designated as follows:

— Standing in the No. 2 End vestibule while facing the No. 1 End, these parts or components are numbered consecutively, starting at the No. 1 End of the car with No. 1L on the LEFT SIDE, No. 1R on the RIGHT SIDE, No. 2L on the LEFT SIDE, No. 2R on the RIGHT SIDE, etc., until all similar units are designated.

3. Windows, seats, and other unevenly distributed components are designated as follows:

— Standing in the No. 2 End vestibule while facing the No. 1 End, these parts or components are numbered consecutively, starting at the No. 1 End of the car with No. 1L on the LEFT SIDE, No. 1R on the RIGHT SIDE, No. 2L on the LEFT SIDE, No. 2R on the RIGHT SIDE, etc., until all similar units are designated.

NOTE: The numbering sequence used for side doors, door operators and associated equipment is discussed in Section 4.

4. To simplify the description of the undercar component locations, the latter are given in reference to the crossbearers which are numbered XB-1 through XB-7 starting at the No. 1 End. In addition, identification labels are affixed to the sides of the car in proximity of the major components.

NOTE: When reporting defects, the preceding designations and others mentioned in this Manual should be used in order to help the personnel concerned in locating the components requiring attention.

1.4 CAR FLOOR PLAN AND INTERIOR ARRANGEMENT

A manually operated, sliding, body end door separates each vestibule from the passenger compartment. Overhead panels permit access to the No. 1 and No. 2 End low ceiling areas.

1.4.1 Passenger Seating Area Layout (Fig. 2 and 6)

Both the control trailer car and the blind trailer car have a total seating capacity of 122 passengers with a seating arrangement comprising 22 triple seats, 24 double seats, 1 bulkhead double seat, 1 double folding seat without wheelchair tiedown device, and 2 double folding seats each equipped with a wheelchair tiedown device. The wheelchair tiedown devices are discussed in the following text.

A. Seat Assemblies (Fig. 1-3)

All seats are of the fixed back type, transversely mounted and supported on the wall side by a bracket above the sideboard heater guard. Ticket holders are provided on the top of seat backs. Bulkhead seat ticket holders are mounted on the bulkheads adjacent to the seats.

B. Luggage Racks (Fig. 1-3)

Aluminum luggage racks of open type construction are provided on both sides of each car and run the full length of the seating area.

C. Lighting Fixtures (Fig. 3 and 7)

Interior lighting is provided by two continuous rows of ceiling-mounted fluorescent light fixtures, one row on each side of the aisle. Each row of fixtures extends the full length of the passenger compartment. Evenly distributed emergency lighting is provided by four lighting fixtures, each equipped with one battery power pack mounted in the ceiling on the fixture. One power pack fluorescent fixture is installed in each vestibule. Refer to Section 3.

D. Air Diffusers (Fig. 1-1 and 1-2)

Conditioned air, heated or cooled as required, is supplied to the passenger compartment by two linear, slot type diffusers, one on each side of the aisle, in the high ceiling area. Each diffuser is routed along the inboard edge of the fluorescent light fixtures, and is shaped to deflect the air towards the center of the aisle, as well as towards the sidewalls. Refer to Section 8.

E. Side Wall Heaters (Fig. 1-1, 1-2 and 1-3)

The passenger compartment is also heated by two continuous rows of double side wall heating units located along the sidewall, below seat level, one row on each side of the car. Refer to Section 8. Side walls have channels to permit some heated air to rise up through perforations located under the windows.

F. Ventilation Grilles (Fig. 3 and 7)

Two flush-mounted exhaust grilles are installed at each end of the high ceiling, one on each side of the car, near the sidewall. These four exhaust grilles serve for removing stale air from the passenger compartment. Refer to Section 8.

G. PA Speakers and Amplifiers (Fig. 3 and 7)

Eight public address speakers are flush-mounted in the ceiling of the passenger compartment. The amplifier is located inside the electrical locker (on locker wall, towards No. 2 End). Refer to Section 7.

H. Emergency Windows (Fig. 1-3)

Both types of cars are equipped with four emergency side window exits, two on each side, at the following locations: windows No. R-1, R-8, L-4 and L-11.

Key to Figure 1-1

1. Public Address Speaker
2. Fluorescent Light Fixture (High Ceiling)
3. Linear Air Diffuser
4. "No Smoking" Plate
5. Car Number Plate
6. HVAC Main Duct
7. HVAC Main Duct Divider
8. High-Ceiling/Low-Ceiling Transition Header
9. Emergency Brake Valve
10. Electrical Locker
11. Overhead Luggage Rack
12. Horizontal Grab Bar
13. Heated Air Outlet
14. Side wall Heater Guard and Grille
15. 120 VAC Electrical Outlet
16. Body End Door Handle with Key Lock
17. Car Number
18. Body End Door Window
19. Body End Door Closer Enclosure
20. Side Door Pocket (At Car Ends Only)
21. Electrical Release for Sliding Body End Door and "Hold Open" Catch in Door Pocket
22. Passenger Side Window
23. Advertising Card Frame
24. Vertical Grab Bar

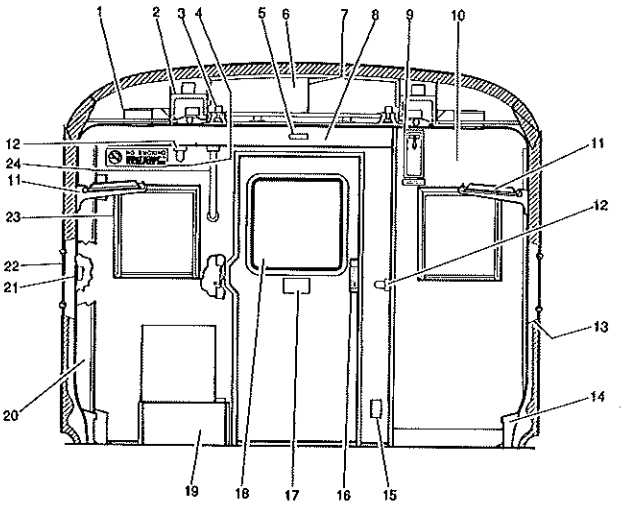


Figure 1-1
Cross-Sectional View of Passenger Compartment — Control Trailer Car and Blind Trailer Car, No. 1 End (Typical)

The emergency window units are similar in appearance to all other side window units, except that these are provided with a RED quick-release sash pull handle that serves for removing the rubber strip to permit pulling the window into the car. For procedure, refer to Section 14.

I. Emergency Tool Set (Fig. 1-3)

One set of emergency tools is provided in each car. These tools are mounted in a wall-mounted enclosure located above EMERGENCY window L-11. The enclosure is closed off with a removable polycarbonate panel that carries the words EMERGENCY TOOLS painted in RED. For procedure, refer to Section 14.

J. Fire Extinguisher

A fire extinguisher is located above the luggage rack, on the Right Side of the passenger compartment at the center of the car. It is of the dry chemical type and can be used on all types of fires.

1.4.2 Low-Ceiling Area Layout

In addition to the equipment discussed in the preceding text, the low-ceiling area is arranged as follows:

A. Ceiling Transition Headers and Signs (Fig. 1-1 and 1-2)

A vertical header is located at the low-ceiling and high-ceiling transition, at each end of the passenger compartment. The car identification number is located on the header.

B. Electrical Locker

On the Right Side of the aisle, at the No. 1 End, an electrical locker is provided. An access door, equipped with a coach key lock, opens outward into the passenger compartment aisle. An incandescent light fixture is provided inside and is energized by means of a wall-mounted switch. The interior arrangement of the electrical locker is discussed in Section 3.

C. B-3-B Emergency Brake Valves (Fig. 1-1, 1-2 and 5-5)

Both types of cars are provided with two emergency brake valves which are located at diagonally opposed corners of the passenger compartment. The No. 1 End valve is recessed into the electrical locker transverse partition, while the No. 2 End valve is recessed into the transverse partition wall. In the control trailer car only, a supplementary valve is located on the Left Side of the No. 1 End vestibule. Each emergency brake valve is equipped with an operating "T" handle color-coded RED, and the valves are discussed in Section 5.

D. Wheelchair Tiedown Devices (Fig. 1-4)

Folding, cushion-type, two-passenger seats are provided on the transverse bulkhead at both ends. When the seat is placed in the normal (down and locked) position, it is used as a regular passenger seat. When the seat is raised, a tiedown device is in position to accommodate a wheelchair. When the chair is backed into the spring-loaded device, the outboard wheel is gripped and the chair is held in position without effort on the part of its user. The operating lever requires only one hand to release the wheelchair. To lower the cushion, pull down on the knob under the aisle end of the cushion.

E. Side Door Operator Access Door (Fig. 4-2)

The side door operator assemblies are installed in the sidewalls in the door pocket extensions. A flush-mounted, hinged panel equipped with a ring handle type latch is provided for three side door locations to permit access to the door operators and associated devices. Access to the door operator in the 1R position is located in the electrical locker behind the HVAC contactor panel. The panel must be unbolted to access the door operator assembly.

F. Passenger Compartment End Doors (Fig. 1-1 and 1-2)

A sliding door with fixed window is located at both ends of the passenger compartment. The door is manually operated and is equipped with a latch/catch arrangement which can be utilized to HOLD the door in the OPEN position. The latch/catch can then be released by pulling firmly on the door, or it can also be remotely released (electrical control) via trainlines upon application of locomotive traction power. Refer to Section 4.

The window of the No. 1 End body end door in the control trailer car is tinted to provide a screen from the passenger compartment light during night operation.

A door closer and check assembly is located at the foot of the door. The door is provided with a lock operated from both sides by the coach key, but the arrangement permits opening the door from the passenger compartment, even when locked, without the use of a key.

1.5 VESTIBULE EQUIPMENT ARRANGEMENT (FIG. 1-5)

The vestibule equipment which is common to both types of cars is listed in the following text. Figure 1-5 shows the No. 1 End of a blind trailer car vestibule layout as viewed from outside the car, on the Left Side. Door system equipment is further discussed in Section 4. In a control trailer car, in addition to this equipment, an operating compartment is provided which is discussed in Section 2.

Key to Figure 1-2

1. Public Address Speaker
2. Fluorescent Light Fixture (High Ceiling)
3. Linear Air Diffuser
4. Car Number Plate
5. HVAC Main Duct
6. HVAC Main Duct Divider
7. High Ceiling/Low Ceiling Transition Header
8. Emergency Brake Valve
9. Car Builder Name Plate
10. Overhead Luggage Rack
11. Heated Air Outlet
12. Side Door Pocket
13. Side Wall Heater Guard and Grille
14. 120 VAC Electrical Outlet
15. Body End Door Handle with Key Lock
16. Car Number
17. Body End Door Window
18. Body End Door Closer Enclosure
19. Heated Air Passage
20. Electrical Release for Sliding Body End Door and "Hold Open" Catch in Door Pocket
21. Passenger Side Window
22. Advertising Card Frame
23. Vertical Grab Bar
24. Horizontal Grab Bar

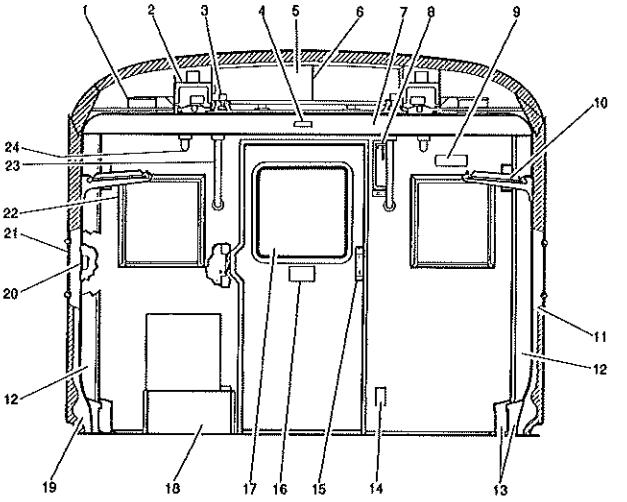


Figure 1-2
Cross-Sectional View of Passenger Compartment — Control Trailer Car and Blind Trailer Car, No. 2 End (Typical)

Key To Figure 1-3

1. Overhead Luggage Rack
2. Removable Polycarbonate Panel with Lettering
3. Emergency Tool Set at L-11 Window Location
4. Emergency Escape Window with Quick-Release Sash Handle
5. Ticket Holder
6. Armrest
7. Side Wall Heater Grille
8. Seat Pedestal
9. Fire Extinguisher

9a. Fire Extinguisher Release Mechanism

10. Window Rubber Seal Strip
11. Rubber Filler Strip
12. Red Handle (fixed on glass with screws) with wording PULL GLASS
13. Red Handle (attached to filler strip) with wording EMERGENCY EXIT, PULL HANDLE REMOVE RUBBER
14. Polycarbonate Window Panel
15. Metal Cutting Saw
16. Pinch Bar
17. Polycarbonate Panel (in actual installation, tools cannot be seen)
18. Sledge Hammer

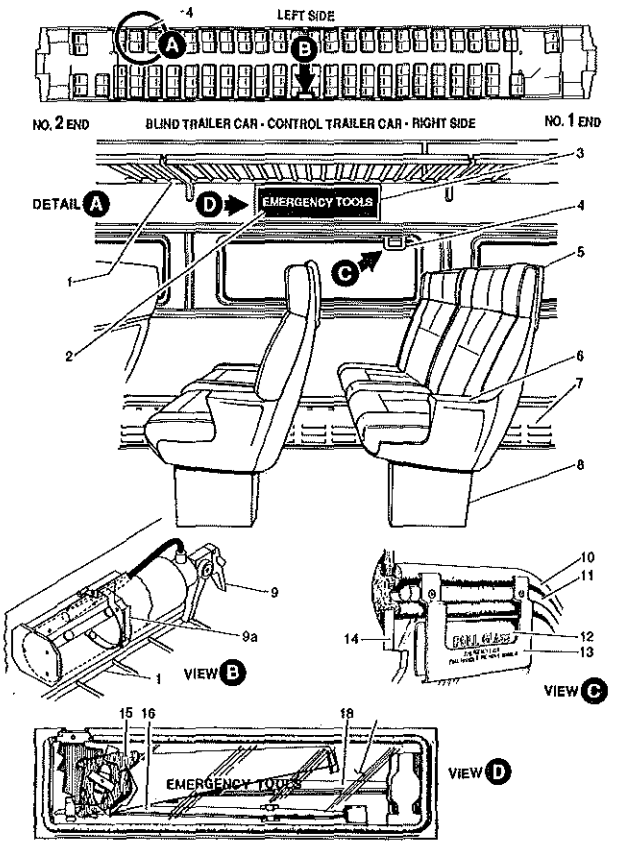
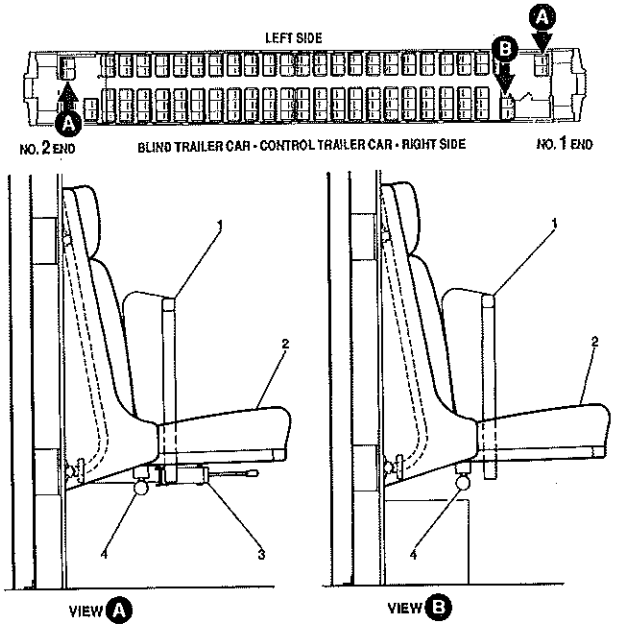


Figure 1-3
Seating Area, Side View including Emergency Window and Tool Set — Control Trailer Car and Blind Trailer Car



1. Seat Cushion in Raised Position
2. Seat Cushion in Normal Seating Position
3. Wheelchair Tiedown Device with Operating Lever
4. Seat Release, to permit cushion to be lowered.
   Cushion may be raised upward without use of Release

Figure 1-4
Wheelchair Tiedown Devices
— Control Trailer Car and Blind Trailer Car

1.5.1 Side Entrance Doors

A manually operated (with provision for electric operation) side entrance door, of the sliding type, is installed on both sides of each vestibule. The side door is supported at the top and guided at the bottom. When opened, it slides into the pocket which is built into the sidewall. The side doors are equipped with a fixed type window, except at the No. 1 End of the control trailer car, where both side doors have a sliding type sash. The doors can be locked and unlocked only with the use of the standard coach key.

1.5.2 Trap Doors and Steps

A stepwell consisting of four fixed steps with safety tread is located at each of the four vestibule entrances. A hinged trap door is installed over the stepwell, and this arrangement permits passengers to board at low level or high level station platforms. The trap door, which is secured in the DOWN position by means of a foot-released latch, is manually raised. When the trap door is lowered, a track provided on its top surface serves for guiding the bottom edge of the sliding door.

1.5.3 Side Door Threshold Heaters

Heating elements are used to prevent snow and ice from accumulating in the side door guide tracks of the trap door.

1.5.4 Side Door Controls and Associated Devices

Side entrance doors are designed to allow for remotely controlled electrical operation in the future. The following control equipment is present in all vestibules.

A. Master Side Door Control Panels

There are four Master Side Door Control Panels per vehicle for controlling the operation of the side doors in the train. Each panel is mounted on the inboard vestibule partition, near the ceiling next to the side door. Its operation is enabled by means of a key switch contained in the control panel, and most of the panel (except for the conductor signal pushbutton) is covered by a blanking plate when manual operation only is used.

At each of the four side door locations, a side door exterior crew key switch is directly associated with the Master Side Door Control Panel. It is flush-mounted into the carbody exterior, near the side door, and is accessible through a spring-loaded hinged cover.

The Master Side Door Control Panels and the exterior crew key switches are operated by means of the MBTA coach key.

Key To Figure 1-5

1. Ceiling Access Panel
2. Handhold
3. Incandescent Light Fixture
4. Side Door Emergency Release Handle
5. Fluorescent Light Fixture with Power Pack
6. Master Side Door Control Panel
7. Conductor's Signal Push Button
8. PA/IC Conductor's Control Head (No.1 End Only)
9. Sliding Body End Door
10. Left Side Door Exterior Latch Handle
11. Interior Handle (Manual Door Operator)
12. Key Operated Side Door Mechanical Lock
13. Trap Door Latch
14. Manual Hinged Trapped Door
15. Fixed Steps
16. Trap Door Switch
17. Foot Operated Trap Door Latch
18. Handbrake (No.1 End Only)
19. Wheelchair Access Plate Support Handle
20. Right Side Door Manual Latch
21. Sash Window in Side Sliding Door
22. "DO NOT LEAN..." Sign

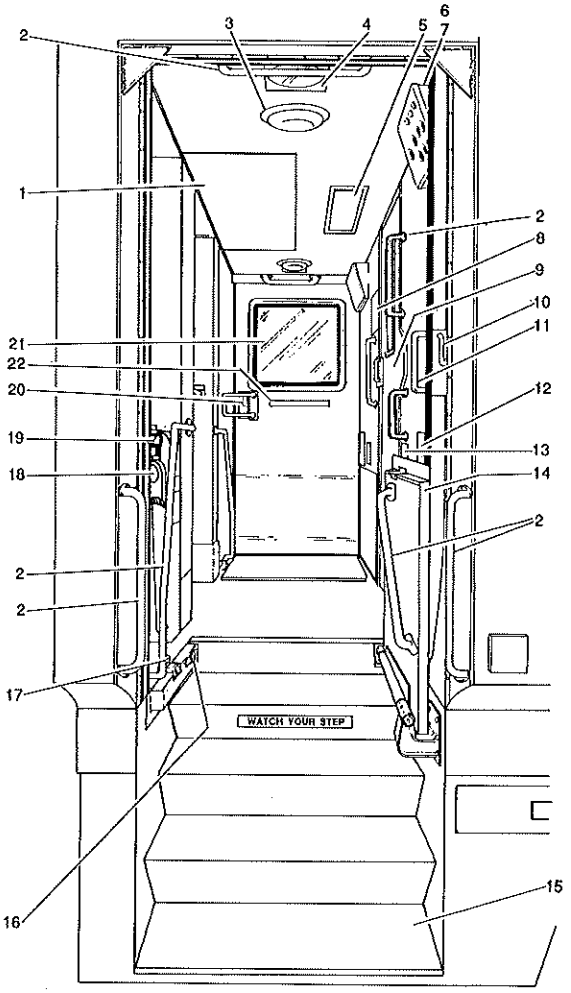


Figure 1-5
Vestibule Layout Viewed from Outside
No. 1 End, Blind Trailer Car, Left Side

B. Trap Door Switches

A trap door, normally OPEN proximity switch, which is held CLOSED when the trap door is latched in the down position, is located in the stepwell side edge, near the foot-operated latch, at each door location.

C. Side Door Mechanical Locks

A mechanical door lock arrangement is located in the rear wall of the vestibule, near each door. The locks are operated by means of the coach key. Their function is to hold the side door in the closed position in the event of a malfunction. Cutoff switches are mounted on the lock shaft and are actuated by the lock when in the locked and unlocked positions.

D. Side Door Control Relay Panel Access Door

A small switch locker is built into the inboard transverse partition, on the Left Side of the No. 2 End vestibule. A door equipped with a key operated latch, flush handle and spring door closer provides access to the door control relay panel.

E. Side Door Zone Control Switches

A door zone control switch is installed in the switch locker that houses the door control relay panel. A second switch is mounted on the inside front wall of the electrical locker.

1.5.5 Signalling Push Buttons and Bells

The car is equipped with two bells, one in each vestibule ceiling. There are signalling push button switches on the Master Side Door Control Panel, one at each side door location. Four more push buttons, which are located on the outside of the car, are accessible from the ground. These are recessed into the stepwell structure near the platform lights. In addition, there are two other signalling push buttons in the high ceiling of the passenger compartment. Ten push buttons per car. Refer to Section 3.

1.5.6 Vestibule Lights

Two incandescent light fixtures are mounted in the ceiling of each vestibule, one above each side entrance doorway. These lights have no switches and are controlled directly by the circuit breaker VPLB, VESTIBULE AND PLATFORM LIGHTS.

One fluorescent light, equipped with a power pack for emergency lighting, is also located in each vestibule. These lights are part of the main lighting system and are controlled by circuit breaker PLB. Refer to Section 3.

1.5.7 PA and IC Control Panel and Speaker

A public address and intercommunication control panel (Conductor's Control Head) is flush mounted in each No. 1 End vestibule, on the rear vestibule wall on the Right Side of the car. In addition, for the control trailer car there is an Engineman's Control Head located on the Left Hand console of the Engineman's Control Compartment. For system description, refer to Section 7.

1.5.8 Handbrake

A mechanical handbrake is mounted beside the collision post, on the Left Side of the No. 1 End vestibule. Refer to Sections 5 and 10.

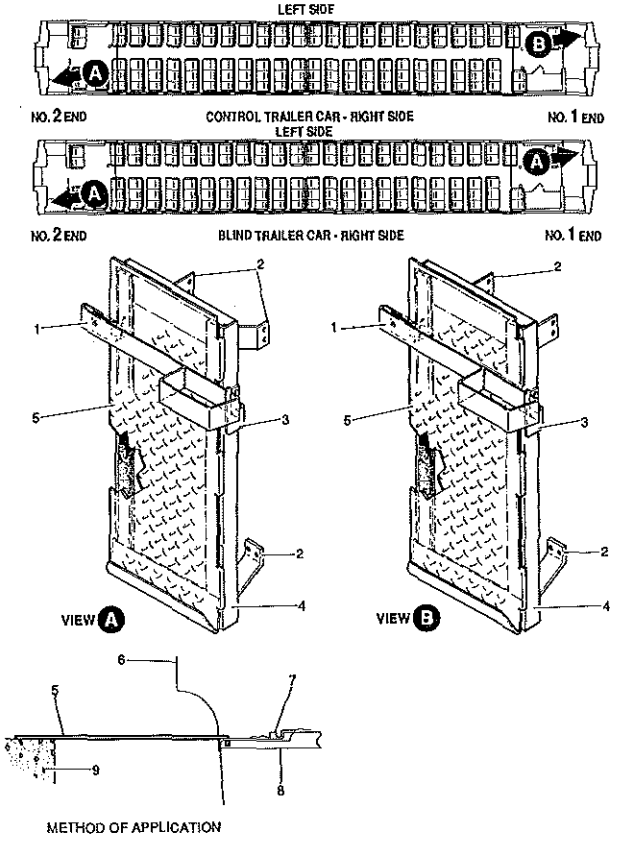
1.5.9 Safety Appliances

Each hinged trap door, in the raised position, provides a diagonal handhold for use in ascending the steps. A matching handhold is mounted on the end wall structure, opposite the trap door handhold. In the operating compartment of the control trailer car, this handhold is mounted on the exterior panel of the vestibule end door. Also, handholds are provided at each side of side entrance doors, above each side door opening, and on each side of the passenger compartment end door.

1.5.10 Wheelchair Access Plates (Fig. 1-6)

Wheelchair access at high platform stations is aided by a plate that bridges the gap between the trap door and platform. When required, a crew member removes the plate from its retaining bracket in the outboard vestibule wall by pressing and lifting the retaining bar. One end of the plate contains flanges which fit into slots on the trap door in order to hold it in place. These plates are located at the No. 1 End Left Side and No. 2 End Right Side positions, and all trap doors have slots.

NOTE: The additional equipment which makes up the Engineman's control compartment in the No. 1 End of the control trailer car, is discussed in Section 2.



1. Handle
2. Brackets to Carbody Wall
3. Retaining Hook
4. Support Assembly
5. Wheelchair Access Plate
6. Car Side Wall
7. Door Guide
8. Trap Door
9. High Level Platform

Figure 1-6
Wheelchair Access Plate

1.6 END OF CAR EQUIPMENT ARRANGE (FIG. 1-7 AND 1-8)

1.6.1 Couplers

A type "H" Tightlock coupler is installed at each car to provide a mechanical connection betwee uncoupling rod is provided on each side of the each end of the car. With an operating lever i each corner of the car, uncoupling can be acco from either side of the car (or train). The arrangement is discussed in Section 11.

1.6.2 Diaphragms and Safety Curtains

A modular type diaphragm is provided at both e both types of cars. The function of the diaphragn provide protection for the passengers as they move car to car. Also, a rolled diaphragm safety curta provided at each end of the car. When extended coupled to the adjacent car, the curtains provide a passage between cars, and are arranged to automatic unlatch and retract when the cars are uncoupled.

1.6.3 Pneumatic Trainline Equipment

Two flexible end hoses and two associated end cuto cocks are located below the coupler at each end of t car. The larger diameter hose is the Brake Pipe line, a the smaller hose is the Main Reservoir Equalizing Pi line. The Brake Pipe hose is supported by a chain hangi from the coupler. Two dummy hose couplings attached their respective chains are also provided. Thes couplings, when connected to the trailing car end hose will prevent the latter from hanging down and bei damaged, as well as preventing dirt entry. Th arrangement is further discussed in Section 5.

1.6.4 Electrical Trainline Equipment

The electrical trainline jumper cables and mating (liv receptacles are similar in arrangement at both ends of t cars.

The electrical trainlines of the cars are arranged so th the locomotive can be connected to either end of the trai However, cars are intended to be placed in a normal tra consist so that a No. 1 End is always connected to a No. End. Trainlines are further discussed in Section 3.

A. 480 VAC Head End Power

Two 480 VAC Head End Power (HEP) trainlir receptacles coded RED are located below coupler level, each side of the coupler carrier. Eight receptacles and fo jumper cables are provided per car. Two spare cables a also provided, and are stored in an undercar box. provide loop circuit protection, four RED cables should connected between each pair of coupled cars.

Key to Figure 1-7

,on Post Handholds
) Antenna
ody Lifting Eyes
lorns
.dlights
l Door Latch and Lock
phragm Lifting Ring
aphragm
indshield and Wiper Arm Assembly
ed Marker Light
.ir Scoop
Flag Bracket
Stone Guard
Safety Curtain
Safety Bar
Handhold
Trap Door Foot Latch Actuating Lever Mechanism
. Horizontal Handhold
. Door Control and Communication Receptacle Coded BLUE
0. Locomotive Control Receptacle (MU) Coded BLACK
1. Uncoupling Lever
22. 480 VAC HEP Receptacle Coded RED
23. Vestibule End Door (Collision Post Door)
24. Dummy Couplings and Chains
25. Hose Support Chains
26. Brake Pipe Hose
27. Main Reservoir Equalizing Pipe Hose
28. Coupler
29. Snow Plow Pilot
30. Safety Curtain Hook

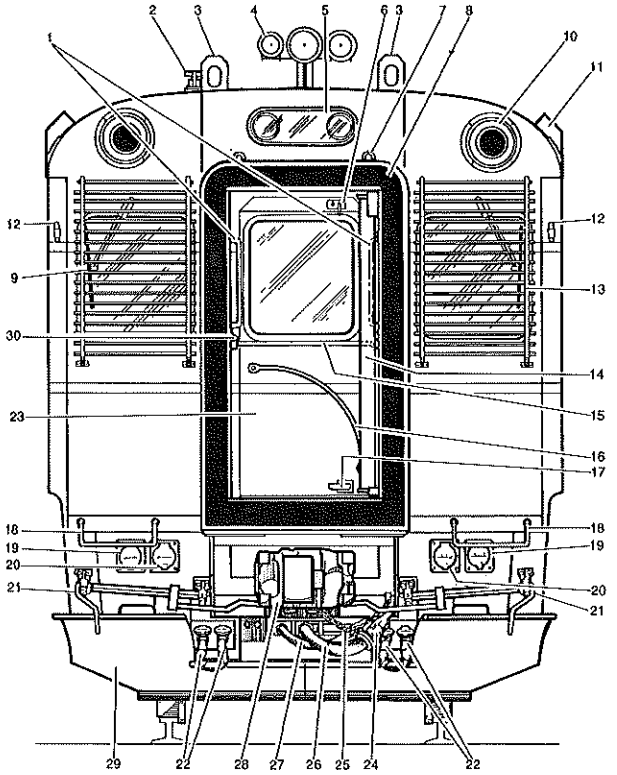


Figure 1-7
Equipment Arrangement at No. 1 End
— Control Trailer Car

Key to Figure 1-8

1. Carbody Lifting Eyes
2. Diaphragm Lifting Ring
3. Diaphragm
4. Safety Curtain Hook
5. Flag Bracket
6. Safety Bar
7. Safety Curtain
8. Horizontal Handhold
9. Door Control and Communication Receptacle Coded BLUE
10. Locomotive Control Receptacle (MU) Coded BLACK
11. Uncoupling Lever
12. 480 VAC HEP Receptacle Coded RED
13. Collision Post Handhold
14. Dummy Couplings and Chains
15. Hose Support Chain
16. Brake Pipe Hose
17. Main Reservoir Equalizing Pipe Hose
18. Coupler

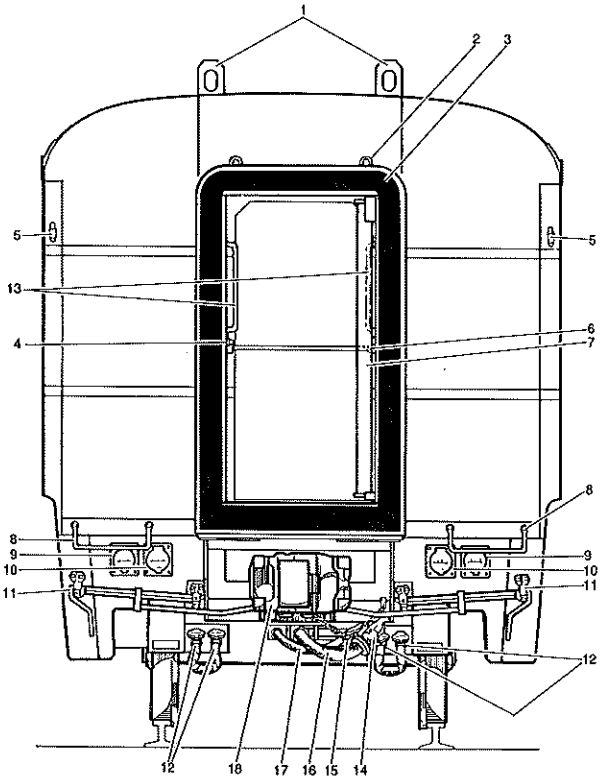


Figure 1-8
Equipment Arrangement at No. 1 and No. 2 Ends of Blind Trailer Car and at No. 2 End of Control Trailer Car

B. Locomotive Control (Multiple Unit — MU)

A Locomotive Control receptacle coded BLACK is located outboard of the HEP receptacles, on both sides of the car, at both ends. These receptacles accommodate a removable jumper with 27 point plugs coded BLACK. Two jumper cables (plus one spare cable which is stored in an undercar box) and four receptacles are provided per car. Between coupled cars, one jumper cable coded BLACK is to be connected. One side is sufficient, and either one of the appropriate receptacles on either side may be used.

C. Door Control and Communication

A Door Control and Communication receptacle coded BLUE is located outboard of the MU receptacles, on both sides of the car, at both ends. These receptacles accommodate a removable jumper with 27 point plugs coded BLUE. Two jumper cables (plus one spare which is stored in an undercar box) and four receptacles are provided per car. Between coupled cars, one jumper cable coded BLUE is to be connected. One side is sufficient, and either one of the appropriate receptacles on either side may be used.

1.6.5 Flag Bracket

A flag bracket is mounted near the top of each corner post, at both ends of the car. Four per car.

1.6.6 Control Trailer Marker Lights

A marker light fixture with red lens is mounted near each top corner of the exterior end sheet, at No. 1 End of the control trailer car. Two per Control Trailer Car.

1.6.7 Control Trailer Car Headlights

The control trailer car is equipped with a dual headlight assembly located at the No. 1 End, above the vestibule end door, on the center line of the car.

1.6.8 Control Trailer Car Air Horns

The control trailer car is equipped with a roof-mounted, three-bell, pneuphonic horn located near the center line of the car, at the No. 1 End.

1.6.9 Safety Appliances

A horizontal handhold is installed on the end sheet at the buffer sill height at each corner. Two vertical handholds are mounted on the collision post door frame, in the diaphragm passageway. A hinged safety bar is mounted on the collision posts at each end of the car. The bar is secured in the horizontal or vertical position by means of a simple mechanical locking receptacle which prevents disengagement except by manual operation.

1.7 UNDERCAR EQUIPMENT AND ACCESSIBILITY

The general undercar arrangement is such that the equipment requiring attention when performing pre-run inspections or running maintenance is readily accessible without the use of a maintenance pit. Undercar equipment boxes are accessible from the side of the car and most are equipped with top hinged access covers. These covers are equipped with quick-release safety catches and safety latches.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 2

CONTROL TRAILER CAR ENGINEMAN'S CONTROL COMPARTMENT

2.1 GENERAL DESCRIPTION

The vestibule located at the No. 1 End of the control trailer car is equipped with all of the controls and apparatus necessary for operating the train with the locomotive in the trailing (pushing) position. These are mounted on the control console at the Engineman's control compartment on the Right Side of the vestibule.

2.2 VESTIBULE END DOOR (FIG. 2-1)

A vestibule end (collision post) door is provided at the No. 1 End of the control trailer car to permit closing off the end of the car and/or train when the control trailer car is coupled at the extreme end of the train. The door is equipped with an FRA approved, Type 1, safety glass window. When open, the door can be swung 180 degrees to cover the Engineman's control console to prevent unauthorized access and/or to open the passageway between cars when the control trailer car is coupled in a position other than the extreme end of the train. The automatic brake valve operating handle must be removed to permit latching the door over the controls. The door is equipped with a key lock at the top and is lockable in either position by means of the coach key. The key lock must be used to secure the door over the operating controls. A cab heater cutoff switch is mounted on the door jamb to prevent the cab heaters from operating when the door is swung open over the controls.

2.3 SIDE DOOR SLIDING SASH WINDOW (FIG. 2-1)

Both Engineman's control compartment side entrance doors are equipped with an FRA approved, Type 2, sliding type sash window. The window slides horizontally and is provided with a stop catch that allows a three inch ventilation opening.

2.4 ENGINEMAN'S CONTROL COMPARTMENT SEAT (FIG. 2-1 AND 2-3)

The Engineman's control compartment is provided with a folding seat which, when open, is adjustable forward and rearward as well as upward and downward. When not in use, the seat folds rearward into a pocket located in the vestibule partition wall.

2.5 WINDSHIELD, WINDSHIELD GUARD, WIPER AND SUN VISOR (FIG. 2-4)

The Engineman's control compartment is equipped with FRA approved Type 1, glass windshields and heavy stainless steel wire guards for the crew's protection. An air operated windshield wiper motor is located above each windshield. A handle is provided on both wiper motors for manual operation should a malfunction occur. A wiper air control valve, located on the overhead panel for the right windshield wiper and on the left corner post for the left windshield wiper, provides for variable speed adjustment. Pneumatic system is discussed in Chapter 5. A roller curtain type sun visor is provided over the Engineman's windshield.

2.6 CAB HEATERS AND WINDSHIELD HEATERS (FIG. 2-2, 2-4 AND 2-5)

An electric heating unit, equipped with a fan, is located on each side of the Engineman's control compartment.

The cab heater unit located on the Left Side of the Engineman's control compartment is controlled by a three-position switch labelled CAB HEATER, which is located on the Left Side equipment layout (Fig. 2-2).

The cab heater unit located on the Right Side of the Engineman's control compartment (bottom Left Side of the Engineman's console) is controlled by a three-position switch labelled CAB HEATER, located on the Engineman's console Left Hand control panel (switch panel assembly) (Fig. 2-5).

Switch positioning provides the following:

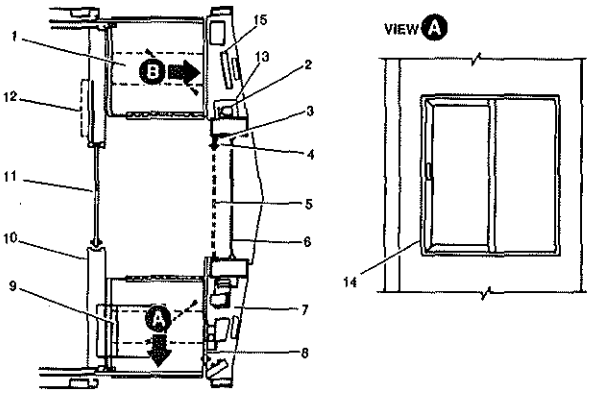
OFF (Center) — Heating elements and fan motor not operating.

LOW (Down) — Half heating capacity and fans operating.

HIGH (Up) — Full heating capacity and fans operating.

NOTE: The collision post end door must be CLOSED and DOGGED for the heaters and fans to operate. When the door is OPEN and latched over the controls, the heater cutoff switch (EDS), which is mounted on the door jamb, prevents the heaters from being energized.

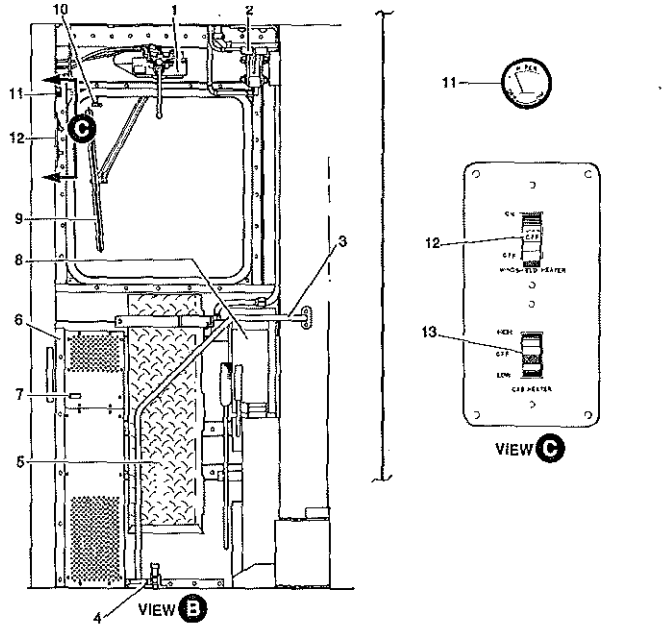
An amber indicating light is connected across a protective thermostat for each heater unit to provide an indication of heater fan failure. The HEATER FAN FAILURE light (HFFLR) is located on the Engineman's control compartment LH panel (Fig. 2-5) and another fan failure light (HFFLL) is on the left cab heater itself (Fig. 2-2). HVAC system is discussed in Section 8. HVAC selector switch (HSS) must be in NORMAL position for the cab heaters and fans to be operational.



1. Hinged Trap Door (Manually Operated)
2. Emergency Brake Valve
3. Cab Heater Cutoff Switch
4. Coach Key Lock
5. Vestibule End Door (Collision Post Door) – Closed Position
6. Safety Bar
7. Engineman's Control Compartment Console
8. Vestibule End Door Opened and Locked Over Controls
9. Engineman's Seat Shown in Open Position (Folds into Partition)
10. Electrical Locker Partition
11. Body End Door
12. Body End Door Closer Assembly
13. Handbrake
14. Sliding Sash Window in Sliding Side Door (Inside View)
15. Wheelchair Access Plate

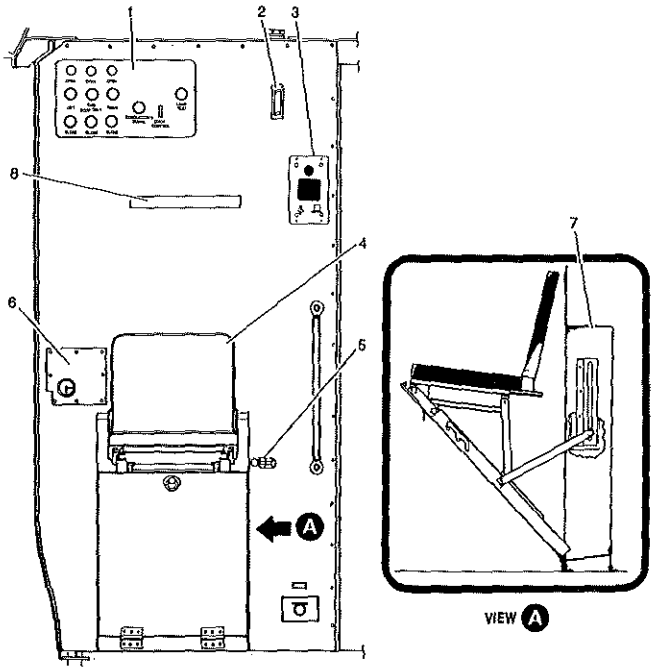
NOTE: View "B" is shown on Figure 2-2

Figure 2-1
Engineman's Control Compartment Layout (Top View) and Sliding Sash Window — Control Trailer Car, No. 1 End



1. Windshield Wiper Motor (can be manually operated)
2. Emergency Brake Valve
3. Handhold
4. Foot Released Trap Door Latch
5. Wheelchair Access Plate
6. Left Side Heater
7. Heater Fan Failure Indicating Light (AMBER)
8. Handbrake
9. Windshield Wiper
10. Windshield Heater Contact Block
11. Windshield Wiper Valve Control Knob
12. Windshield Heater Switch
13. Cab Heater Switch

Figure 2-2
Engineman's Control Compartment, Left Side
Equipment Layout — Control Trailer Car

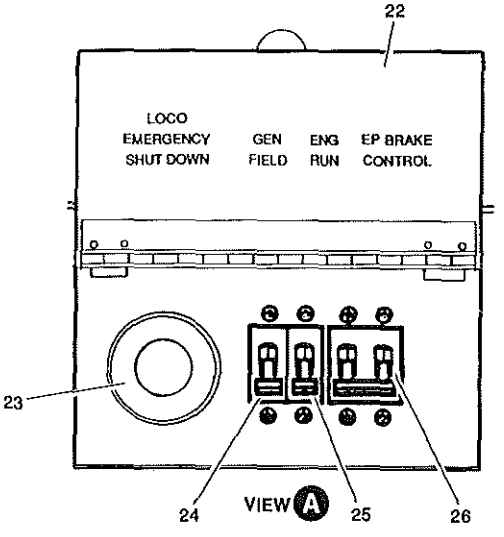


1. Master Side Door Control Panel
2. Coat Hook
3. PA and IC Control Panel (Coach Key energized)
4. Engineman's Folding Seat (Shown in Open Position)
5. Trap Door "Raised" Position Latch
6. Side Door Mechanical Lock (Coach Key operated)
7. Pocket for Folded Seat

Figure 2-3
Engineman's Control Compartment, Rear Wall Layout (Right Side) — Control Trailer Car

Key to Figure 2-4

1. Windshield Wiper Valve Control Knob
2. RH Control Panel, Cab Signal (Aspect Display Unit) (Fig. 2-6)
3. Wiper Arm and Blade Assembly
4. Utility Tray
5. Duplex Air Gauge (AG2), Brake Cylinder (Red Needle), Brake Pipe (White Needle)
6. Duplex Air Gauge (AG1), Main Reservoir (Red Needle), Equalizing Reservoir (White Needle)
7. 26-C Automatic Brake Valve
8. Bell Knob
9. P-2-A Brake Application Valve
10. Trap Door Release Latch
11. Engineman's Heater
12. Master Controller
13. Air Horn Valve
14. LH Control Panel (Switch Panel Assembly) (Fig. 2-5)
15. Windshield
16. Communication (Radio, PA and IC) Remote Control Head (Master Controller or Communication Key Lock Energized)
17. Sun Visor (Curtain Assembly)
18. Windshield Heater Contact Block
19. Air Horn Cutout Cock
20. Operating Handle Storage Box
21. Windshield Wiper Manual Control Arm
22. Emergency Switch Box Assembly
23. Locomotive Emergency Shutdown Switch (ESS)
24. Generator Field Breaker (GFB)
25. Engine Run Breaker (ER)
26. Electro-pneumatic Brake Breaker (EPB)
27. Radio Channels Sign
28. Car Number Sign



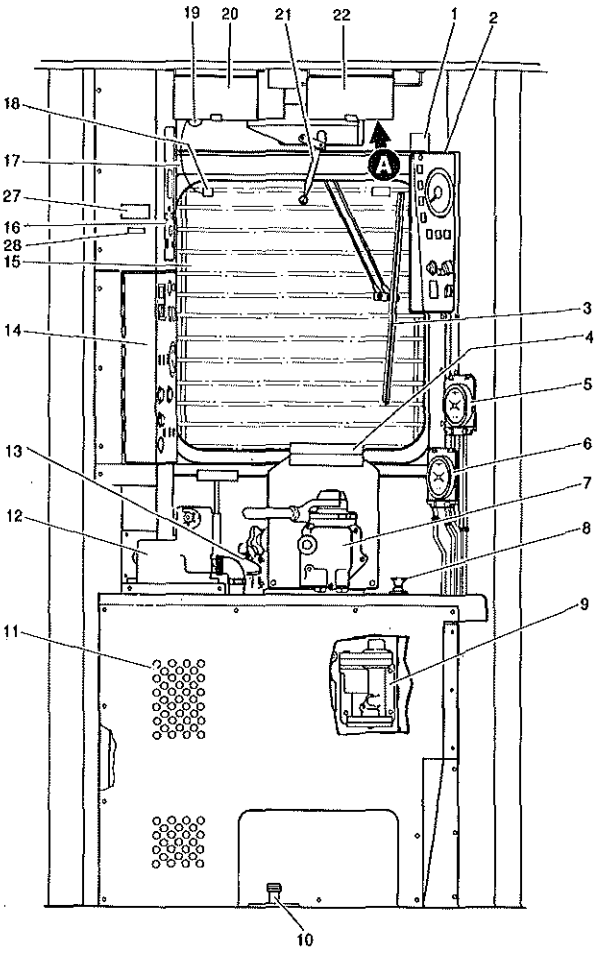


Figure 2-4
Engineman's Control Compartment,
Console Layout — Control Trailer Car

CAUTION: If one of these lights comes ON, the associated heater must be turned OFF immediately to prevent possible equipment damage.

The windshield heater located on the Left Side of the Engineman's control compartment is controlled by a toggle switch labelled WINDSHIELD HEATER, which is located directly above the three-position cab heater switch on the Left Side equipment layout (Fig. 2-2).

The windshield heater located on the Right Side of the Engineman's control compartment is controlled by a toggle switch labelled WINDSHIELD HEATER, located on the Engineman's console Left Hand control panel (switch panel assembly) (Fig. 2-5).

2.7 CEILING HVAC DIFFUSER GRILLES (FIG. 3, 7 AND 8-1)

Conditioned air, cooled or heated as required, is supplied to the Engineman's control compartment through two ceiling-mounted diffuser grilles. They are located near the vestibule rear wall, one each side of the body end door opening. The grilles are equipped with shutter type dampers and a control knob which can be manually adjusted for personal preference.

2.8 ENGINEMAN'S CONTROL COMPARTMENT CONTROLS AND INDICATORS

The majority of the control devices and indicators are grouped in front of the Engineman within easy reach. To facilitate the description of this equipment, they will be discussed under the following headings:

— Engineman's control compartment Overhead Equipment (Fig. 2-4)

— Engineman's control compartment LH Panel Equipment (Fig. 2-5)

— Engineman's control compartment RH Panel Equipment (Fig. 2-6)

— Engineman's control compartment Control Console Equipment (Fig. 2-1, 2-4, 2-7 and 2-8)

— Engineman's control compartment LH Side Equipment (Fig. 2-2)

Since all of these devices will be used at one time or another during operation of the train, a brief description of their individual function is provided. Some control devices associated with the train operation are located in the control trailer car electrical locker, and they are further discussed in Section 3.

WARNING: SOME FAULT CORRECTIVE ACTIONS REQUIRE ACCESS TO THE CONTROL TRAILER CAR ELECTRICAL LOCKER AND TO THE LOCOMOTIVE CAB. IN ALL SUCH CASES, PROPER ACTION MUST BE TAKEN IN COMPLIANCE WITH RAILROAD COMPANY RULES AND PROCEDURES, AND CIRCUMSTANCES MUST BE REPORTED TO THE PROPER AUTHORITY.

2.9 MISCELLANEOUS INDICATING LIGHTS (FIG. 2-2 AND 2-5)

The panels contain lights with colored lenses and legends which serve for indicating the operation of various systems. Except where stated otherwise, the lights have a Push-To-Test feature which allows testing of the lamp alone. This determines if the lamp is working properly, isolated from its operation in the system. When the lens cap is depressed, the supply voltage is applied across the lamp and causes the lamp to go ON.

2.10 MISCELLANEOUS CIRCUIT BREAKERS

Circuit breakers may be ON or OFF as operating conditions require. Breakers directly energize the circuits they protect, and are clearly labelled to identify their respective function. Breakers are of the toggle action type, indicating ON with the toggle in the UP position, and OFF with the toggle DOWN.

Breakers are manual switches that can TRIP and OPEN themselves under overload or short circuit conditions. If any of the 64/74 VDC and 120 VAC breakers should trip, they will be found in the FULL OFF position (not centered position). It may be necessary to wait a few minutes (to allow cooling) before the breaker can be RESET in the ON position. For 480 VAC breaker details, see Paragraph 3.2.5.

2.11 MISCELLANEOUS TOGGLE, PUSH BUTTON, KEY AND ROTARY SWITCHES (FIG. 2-2, 2-4, 2-5, 2-6 AND 2-8)

Switches are included in some circuits for operating various devices and lights. The switches are clearly labelled to identify their respective function. They may be ON or OFF as operating conditions require. Most toggle switches are in the ON position when the toggle is UP, and in the OFF position when DOWN. The CAB HEATER and HEADLIGHTS toggle switches are OFF in the center position. The rotary selector switches have clearly marked positions.

2.12 ENGINEMAN'S CONTROL COMPARTMENT OVERHEAD EQUIPMENT (FIG. 2-4)

The following controls are mounted overhead, directly in front of the Engineman or on the ceiling:

2.12.1 Air Horn Cutout Cock (19)

A cutout cock with locking handle which is installed to the left of the wiper motor, controls the air supply to the horn. The cock is OPEN when the handle is placed perpendicular to the pipe and CLOSED when parallel to the pipe.

2.12.2 Windshield Wiper Air Control Knob (1)

An air valve control knob is mounted at the top right corner of the windshield. It permits regulating the speed of the wiper motor.

2.12.3 Emergency Switch Box Assembly (22)

An emergency switch box assembly is located on the top Right Hand side of the Engineman's control compartment. This box is provided with a cover door designed to remain in the open or closed position.

The panel contains the following:

— LOCOMOTIVE Emergency Shutdown switch (ESS).

— Generator field breaker (GFB) 20A.

— Engine run breaker (ERB) 20A.

— ELECTRO-PNEUMATIC brake breaker (EPB) 10A.

A. Locomotive Emergency Shutdown Switch (ESS)

This RED, mushroom-shaped, spring-loaded, push button, momentary switch permits the locomotive main engine to be shut down should an emergency condition occur. It is necessary to hold it in the pushed in position until the main engine is stopped.

B. Generator Field Breaker (GFB)

This 20A circuit breaker, labelled GEN FIELD, permits excitation of the locomotive main generator field, and applies power to the reverser relay when direction of travel is selected by the reverser key. This breaker must be ON in the active control trailer car to obtain traction power when the master controller throttle handle is moved from the IDLE position. Whenever the control trailer car is in the trailing position, this breaker must be placed in the OFF position.

C. Engine Run Breaker (ER)

This 20A circuit breaker, labelled ENGINE RUN, permits proper setup of traction control circuits in the locomotive. The breaker is placed in the ON position in the Engineman's control compartment for normal operation with the control trailer car leading. If the control trailer car is in the trailing position, the breaker must be placed in the OFF position.

D. Electro-pneumatic Brake Circuit Breaker (EPB)

This 10A circuit breaker, labelled EP BRAKE CONTROL, permits operation of the electro-pneumatic braking circuits including the release and application magnet valves and the emergency magnet valve. This breaker must remain ON when the control trailer car is leading or trailing.

2.13 ENGINEMAN'S CONTROL COMPARTMENT LH PANEL EQUIPMENT (FIG. 2-5)

The following equipment controls and indicators are mounted on the panel located to the left of the Engineman:

2.13.1 Engineman's Communication Remote Control Panel (23)

A communication (radio, PA and IC) remote control panel is mounted on the collision post. A standard AAR two-way train radio control head forms an integral part of the communication panel. The handsetless control head panel and communication system are discussed in Section 7.

The remote control panel is energized as long as the COMMUNICATION SYSTEM breaker (Car Lighting and Control Breaker Panel) and RADIO breaker (Train Control Circuit Breaker Panel) are on. The master controller does not have to be keyed in order for the radio to work.

When the control trailer car is in a trailing position, this remote control head panel can still be energized. However, the conductor's control panel which is located on the vestibule rear wall, is normally used.

2.13.2 Electro-Pneumatic Brake Indicating Light (1)

This WHITE push-to-test indicating light, labelled EP BRAKE, will remain ON unless there is an emergency brake application.

2.13.3 Wheel Slip Indicating Light (6)

This WHITE push-to-test indicating light, labelled WHEEL SLIP, will flash ON if a wheel slip condition is occurring on the locomotive. With the automatic sanding feature activated in the locomotive, the wheel slip will generally be corrected immediately through the locomotive wheel slip control system and the light will go OUT. Sanding tends to prevent wheel slip, thereby causing a reduction of tractive effort or generator field excitation. If wheel slip is minor, the light will not be activated but automatic sanding may take place along with reduction of propulsion power. Refer to Locomotive Operator's Manual.

Key to Figure 2-5

1. Electro-Pneumatic Brake Indicating Light (WHITE)
2. Side Door Closed Indicating Light (BLUE)
3. Brake Released Indicating Light (GREEN)
4. PCS Open Indicating Light (RED)
5. Brake Applied Indicating Light (AMBER)
6. Wheel Slip Indicating Light (WHITE)
7. Dynamic Brake Push-To-Reset Indicating Light (BLUE)
8. Traction Power and Brake ON Indicating Light (RED)
9. Attendant Call Push Button
10. Head End Power Indicating Light (WHITE)
11. Battery Charging Ammeter
12. Cab Heater Fan Failure Indicating Light (AMBER)
13. Fuse Holders, 2A, (to protect Battery Charging Ammeter)
14. Ceiling Fan Switch
15. Cab Heater Switch (Three-position)
16. Headlight Switch (Three-position)
17. Locomotive Sanding Push Button (YELLOW)
18. Train Sanding Push Button (BLACK)
19. Alertor Push-To-Reset Switch with Indicating Light (WHITE)
20. Vestibule Lights Switch
21. Windshield Heater Switch
22. Marker Lights Switch
23. Engineman's Remote Control Head (PA, IC and Radio)

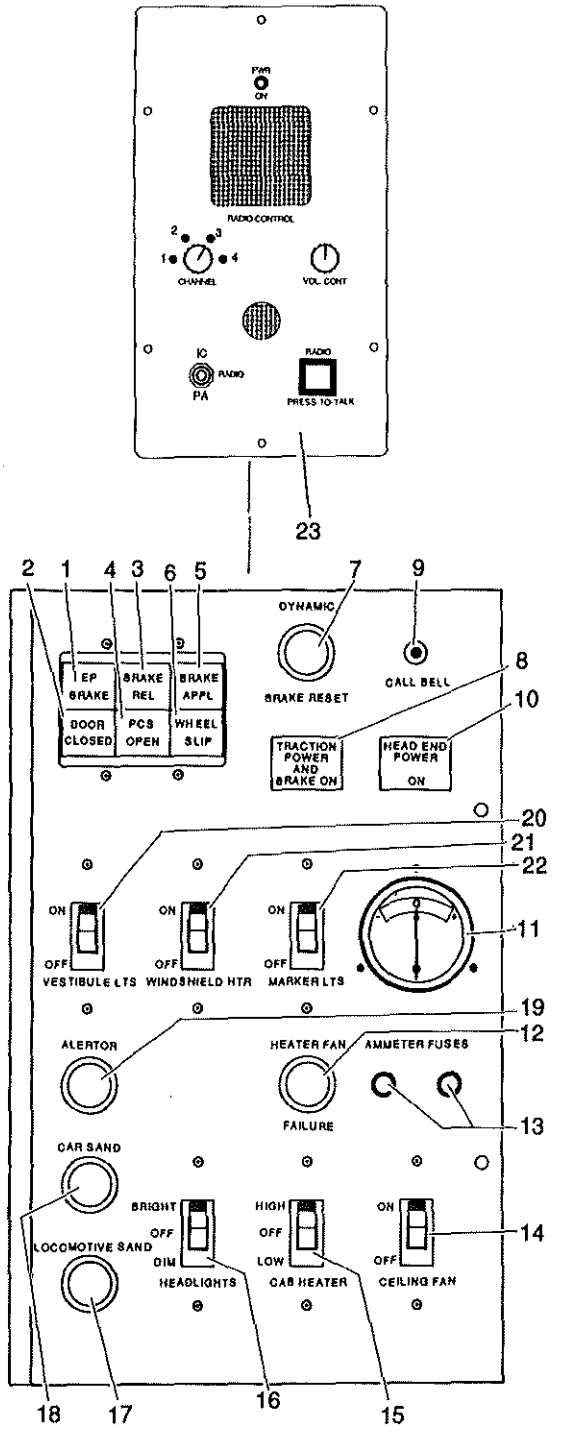


Figure 2-5
Engineman's Control Compartment LH Panel Layout (Controls and Indicators) — Control Trailer Car

2.13.4 Brake Applied Indicating Light (5)

This AMBER push-to-test indicating light, labelled BRAKE APPL, is energized if every brake in the consist is applied. Failure of the light to operate following a brake application may indicate that one or more car pneumatic brakes are not operating, or a handbrake is applied.

2.13.5 Brake Released Indicating Light (3)

This GREEN push-to-test indicating light, labelled BRAKE REL, in addition to indicating the status of the car pneumatic brakes, also monitors the handbrakes. Before a "Brake Released" signal can be received in the control trailer car, all pneumatic brakes and handbrakes in every car of the consist must be in the released condition.

2.13.6 PCS Open Indicating Light (4)

This RED push-to-test indicating light, labelled PCS OPEN, comes ON to indicate a locomotive traction power loss resulting from an emergency brake application (EMERGENCY RATE) or an ATC/Alertness penalty (overspeed or non-acknowledgement) brake application (FULL SERVICE RATE).

This light also comes ON if power-operated trainline or local doors are opened. This results in a locomotive traction power loss.

During manual operation of side doors, this light comes ON if a door is open. There is, however, no loss of locomotive traction power. See paragraph 4.1.2 for details.

The light goes OFF when the door is closed, the appropriate electrical control circuits are reset and /or control of the air brake equipment is recovered.

2.13.7 Side Door Closed Indicating Light (2)

In power door mode, this blue light, labelled door closed, comes ON if ALL side doors in the consist are closed. Remains ON if a side door is opened with THIS DOOR ONLY command, or if a side door is opened with its own trap door raised. Light remains OFF in manual door mode.

2.13.8 Dynamic Brake Reset Indicating Light (7)

This BLUE push-to-reset indicating light has two functions. First, if a dynamic brake fault condition occurs in the locomotive, the light will illuminate. Second, to reset the fault, push the button and the light should extinguish.

2.13.9 Attendant Call Push Button (9)

When this push button is pressed, it activates the attendant bell in every car simultaneously and the engine alarm bell in the locomotive.

2.13.10 Traction Power and Brake ON Indicating Light (8)

This RED indicating light identified "TRACTION POWER AND BRAKE ON", will illuminate and flash if any brake is applied in the consist with the throttle in power position in the control trailer car.

2.13.11 Head End Power Indicating Light (10)

This WHITE indicating light identified "HEAD END POWER ON" will illuminate when 480V is supplied through the consist and the 480/120V circuit breaker is in ON position in the control trailer car.

2.13.12 Vestibule Lights Switch (20)

This two-position toggle switch controls all vestibule ceiling lights in the No. 1 vestibule.

2.13.13 Windshield Heater Switch (21)

This two-position toggle switch controls the windshield heater on the Right Side of the Engineman's control compartment.

2.13.14 Marker Lights Switch (22)

This two-position toggle switch controls the two marker lights located on the No. 1 End.

2.13.15 Battery Charging Ammeter (11)

This battery charging ammeter shows the current in or out of the battery. The arrow on the RED portion of the scale means the battery is supplying power to DC load. If the arrow is on the GREEN portion of the scale, the battery charger is charging the battery.

2.13.16 Alertor Reset Switch (19)

This WHITE Push-To-Reset push button will flash every time an acknowledgement is required of the Engineman. Failure to reset the push button in 15 seconds results in a penalty brake application.

2.13.17 Heater Fan Failure (12)

An AMBER indicating light is connected across a protective thermostat for each heater unit to provide heater fan failure indication. The HEATER FAN FAILURE light (HFFLR) is located on the Engineman's control compartment LH panel, while another heater fan failure light (HFFLL) is on the left cab heater itself. For details, refer to Section 2.6. The HVAC selector switch (HSS) must be in NORMAL position for the cab heaters and fans to be operational. HVAC system is discussed in Section 8.

2.13.18 Fuse Holders (13)

These two fuse holders contain fuses of 2A, to protect the battery charging ammeter.

2.13.19 Train Sanding Push Button (18)

This BLACK push button, when pushed, will energize both sanding magnet valves on the control trailer car and initiate a sanding application. It will also provide a trainline signal to the locomotive for a sanding application.

2.13.20 Locomotive Sanding Push Button (17)

This YELLOW push button, when pushed, will provide a trainline signal only to the locomotive and initiate a sanding application.

2.13.21 Headlight Switch (16)

This three-position switch (BRIGHT/OFF/DIM) provides intensity control of the control trailer car headlights.

2.13.22 Cab Heater Switch (15)

This three-position switch controls the cab heater and fan located on the Right Side of the Engineman's control compartment, directly below the console. For further details, refer to Section 2.6.

Switch positioning provides the following:

OFF (Center) — Heating elements and fan motor not operating.

LOW (Down) — Half heating capacity and fans operating.

HIGH (Up) — Full heating capacity and fans operating.

NOTE: The collision post door MUST BE CLOSED for the heater and fan to operate. When the door is OPEN, the heater cutoff switch mounted on the door jamb prevents the heater from being energized.

2.13.23 Engineman's Control Compartment Ceiling HVAC Fan Switch (14)

A two-position toggle switch, labelled CEILING FAN, controls the fan which supplies ventilation, air conditioning, or heating as required, through the Engineman's control compartment ceiling diffuser. This fan, located above the low ceiling in the No. 1 End only, is connected to the overhead HVAC unit outlet where it taps some of the air discharged by the unit. For HVAC, refer to Section 8.

2.14 ENGINEMAN'S CONTROL COMPARTMENT RH PANEL EQUIPMENT (FIG. 2-6)

The following equipment, controls and indicators are mounted on the panel located to the right of the Engineman.

2.14.1 Aspect Display Unit and Speed Indicator Panel (Fig. 2-6)

The control trailer car is equipped with a Cab Signal/Automatic Train Control system. The Cab Signal/ATC system is capable of enforcing specific speed limits as received from the coded rail when operating in cab signal territory. The Engineman is provided with constantly visible speed and cab signal aspects by means of the Aspect Display Unit. The system continuously monitors the coded information received through the rails, and the cab signal aspect display/speed indicator panel continuously provides corresponding indications. The panel contains various controls, indicators and devices which are briefly described in this Section.

2.14.2 Rotary Dimmer Switch (7)

This WHITE rotary dimmer control switch allows for dimming of the Aspect Display Unit lighting.

2.14.3 "Sonalert" Speed Control Audible Alarm (AA) (11)

This audible alarm, labelled ALARM, will sound during an overspeed condition or when a change to a more restrictive cab signal has been received. Refer to the ATC System in Section 6.

2.14.4 Cab Signal Speed Control Rotary Switch (SCSW) (6)

This black rotary switch, labelled CAB SIGNAL, has two positions: IN and OUT. If the train operates within cab signal territory, the switch must be placed in the IN position and if the train operates in non-cab signal territory, the switch must be placed in the OUT position. Refer to the ATC System in Section 6.

2.14.5 ATC Acknowledging Push Button (10)

This RED push button must be pushed after an overspeed condition or a change to a more restrictive cab signal has been received. Refer to the ATC System in Section 6.

2.14.6 Air Gauge Test Ports (18)

Two air gauge test ports with plugs are located under each air gauge at the lower end of the panel. These are for maintenance use.

2.14.7 Duplex Air Pressure Gauges (13)

Each gauge has two needles, one Red and one White, which correspond to the Red and White lettering inside the gauge.

Key to Figure 2-6

1. Speed Indicator (Speedometer)
2. Velocity Zero Indicator (BLUE)
3. Overspeed Condition Indicator (RED)
4. Speed Control Cutout Switch Indicator (WHITE)
5. Departure Test Indicator (YELLOW)
6. Cab Signal Speed Control Rotary Switch (BLACK)
7. Rotary Dimmer Control
8. Departure Test Selector Switch
9. Lamp Test Switch
10. Acknowledging Push Button (RED)
11. "Sonalert" Speed Control Audible Alarm
12. Cab Signal Speed Aspect Indicators
13. Duplex Air Pressure Gauges
14. RED Needle = Brake Cylinder
15. WHITE Needle = Brake Pipe
16. RED Needle = Main Reservoir
17. WHITE Needle = Equalizing Reservoir
18. Test Ports

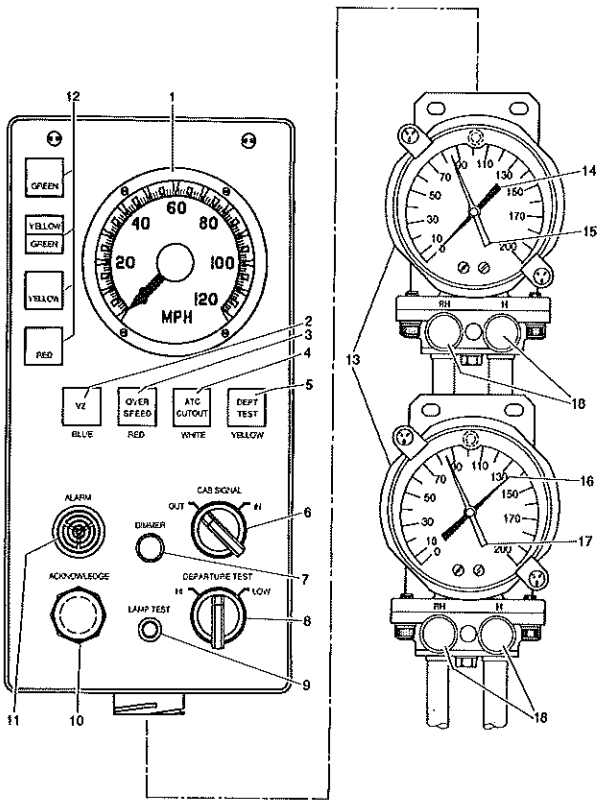
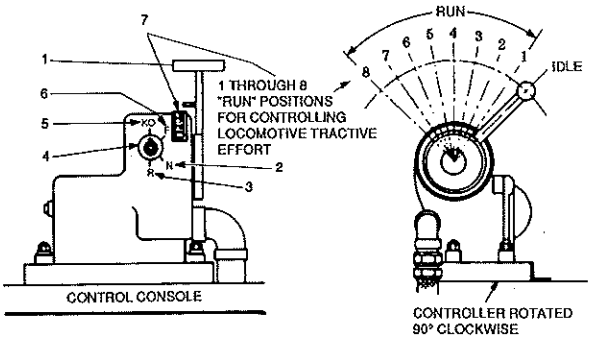


Figure 2-6
Engineman's Control Compartment, RH Panel Layout (Controls and Indicators) — Control Trailer Car



1. Throttle Handle
2. "NEUTRAL" Position
3. "REVERSE" Position
4. Reverser Key Switch
5. "KEY OUT" Position
6. "FORWARD" Position
7. Notch Position Plate

Engineman's Control Compartment Console
(for Location, see Figure 2-1)

Figure 2-7
Locomotive Traction Master Controller
(Engineman's Control Compartment Console)
— Control Trailer Car

A. Lower Gauge (AG1)

The Red needle indicates MAIN RESERVOIR pressure and the White needle indicates EQUALIZING RESERVOIR pressure.

B. Upper Gauge (AG2)

The Red needle indicates BRAKE CYLINDER pressure and the White needle indicates BRAKE PIPE pressure.

The air gauges have an illuminated dial, graduated from 0 to 200 PSIG. Illumination is controlled by the gauge lights, GLB, 5A, circuit breaker located in the train control circuit breaker panel on the front panel of the electrical locker.

2.14.8 Departure Test Selector Switch (DTS) (8)

This rotary snap switch, spring-loaded to center position, allows testing of the ATC Unit circuits. Refer to ATC System in Section 6.

2.14.9 Lamp Test Push Button (LT) (9)

This BLACK momentary push button switch tests the light bulbs of the VZ, OVERSPEED and ATC CUTOUT indicating lights. For complete test procedure refer to Section 6.

2.15 ENGINEMAN'S CONTROL COMPARTMENT CONSOLE EQUIPMENT (FIG. 2-1, 2-4, 2-7 AND 2-8)

The following controls are mounted on the console directly in front of the Engineman:

2.15.1 Locomotive Traction Master Controller (Fig. 2-7)

The master controller, located on the Left Side of the console, is used as a throttle and a reverser to control the locomotive traction power and direction of travel when the locomotive is in the trailing (pushing) position. The master controller cannot control the locomotive unless the Locomotive Control Trainline is connected, and the appropriate circuit breakers are in the ON position in both the locomotive and the control trailer car. The controller includes a reverser key switch and a throttle handle which function as follows:

A. Reverser Key Switch (TKS) (4)

The controller key switch has a cylinder type lock with circular keyway which requires a special tube type key. To activate the master controller, the key is inserted into the key switch and turned to the desired mode of operation position. The switch has four positions:

"KO"— KEY OUT position. Allows key insertion and removal.

"F" — FORWARD position. Direction of travel as determined by the FRONT of the control trailer car. First position clockwise from "KO".

"N" — NEUTRAL position. Second position clockwise from "KO". The throttle handle can be moved, but power will not be applied to the locomotive traction motors.

"R" — REVERSE position. Direction of travel as determined by the FRONT of the control trailer car. Third position clockwise from "KO". In this position, the track receivers will be disconnected from the ATC system: 20 MPH (no code) speed restriction.

The lock requires that the key be pushed IN to turn it to the "F" and "N" positions. Further key movement to "R" position requires that the key be pushed IN again to clear a warning stop that prevents inadvertent movement into REVERSE position. The key switch contains a spring operated key ejector that automatically ejects the key from the switch when it is turned to the "KO" position. When the key is turned to the "F" or "R" position, circuits are set up through integrated switches and the wires of the Locomotive Control Trainline for the train to move in the corresponding direction as locomotive traction power is applied. Direction of travel is determined from the Engineman's control compartment. The front of the control trailer car (Engineman's control compartment) is the front of the train.

WARNING: MAKE SURE THAT THE REVERSER KEY SWITCH POSITION CORRESPONDS WITH OPERATING REQUIREMENTS BEFORE ADVANCING THROTTLE HANDLE.

B. Throttle Handle (TTH) (1)

The throttle handle has the following operating positions:

IDLE — Extreme position of handle outward from Engineman (toward windshield). Allows reverser key switch position change, thus directional change. Position used in conjunction with 26-C brake valve to reset a penalty brake application. ATC system discussed in Section 6. Also allows body end doors in cars to be latched OPEN by train crew.

RUN — Eight numbered detent positions with No. 8 at extreme inward handle position (toward cab seat), control the locomotive tractive effort and, thus, train speed. The throttle is unlocked and free to move when the key switch is set in the "F", "N" or "R" position.

For each throttle position, a definite maximum load current and corresponding traction power are developed. The increase is started immediately but smoothly as the throttle is advanced through the eight positions. Refer to Locomotive Operator's Manual.

C. Controller Mechanical Interlocks

Mechanical interlocking between the throttle and the reverser key switch prevents improper operation of either device. These are interlocked so that:

(1) With reverser key switch in "F", "N" or "R" position:

— Throttle can be moved to any position.

— Key cannot be removed.

(2) Throttle in IDLE position:

— Reverser key switch can be placed in "F", "N", or "R" position.

— Switch can be placed in "KO" position, and key removed.

(3) Throttle above IDLE position:

— Reverser key switch cannot be moved to any position.

CAUTION: Damage to the locomotive traction motors may occur if the reverser switch is moved from FORWARD to REVERSE, or vice versa, while the train is in motion. Therefore, the reverser switch direction must be changed only when the train is completely stopped.

2.15.2 Master Controller Interlock Circuits

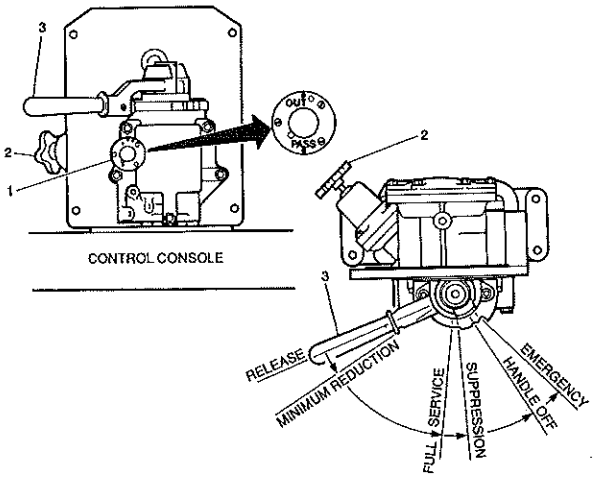
When the master controller is key energized with the reverser key switch in an operating position (FORWARD, NEUTRAL or REVERSE), the following interlock circuits and/or functions are provided:

A. Side Door/Traction Interlock Circuit (DIR Relay)

For power door mode, when any side entrance door is not fully closed and locked, the locomotive will be unable to produce traction power in response to master controller throttle movement.

This interlock circuit can be bypassed by means of a sealed toggle switch (SBDI) located in the electrical locker. The switch is discussed in Section 4, Door System.

The configuration of this circuit is different for manual operation of side doors. This configuration allows the locomotive to produce traction power in response to master controller throttle movement when side doors are open. See paragraph 4.1.2 for details.



1. Pilot Cutoff Valve
2. Pressure Regulating (Feed) Valve
3. Operating Handle

Figure 2-8
26-C Automatic Brake Valve
(Engineman's Control Compartment Console)
— Control Trailer Car

B. Engineman's Control Compartment Side Door Isolation Circuit

With controller engaged, the power operated side doors of the control trailer car Engineman's control compartment becomes isolated from the door system trainline controls. These side doors will not respond to trainline signals originating from other door control panels in the consist. However, it will be possible to operate local and trainlined doors normally from the two control panels in the No. 1 vestibule, provided these are key energized.

2.15.3 Automatic Brake Valve (Fig. 2-8)

The 26-C automatic brake valve is located to the right of the controller. The brake valve provides manual control of the APPLICATION and RELEASE of the train brakes — locomotive and cars in both service and emergency braking situations. This is a self-lapping brake valve designed to provide pneumatic control of Brake Pipe air throughout the train. The automatic brake valve includes the following components:

A. Pilot Cutoff Valve (1)

The pilot cutoff valve is located on the automatic brake valve housing directly beneath the operating handle. The valve has the following two positions:

PASS (PASSENGER) — Position used to operate the control trailer car as the controlling unit of the train, as used in commuter service.

OUT — Position used to operate the control trailer car as a trailing car in the consist.

The valve handle is positioned by pushing in the center pin and rotating the handle to the desired setting.

B. Operating Handle (3)

The automatic brake valve handle which controls the signals to the associated brake systems of the locomotive and cars, may be moved through a zone of five detented positions. Starting at the extreme left of the quadrant and moving the handle to the right, the positions are RELEASE, MINIMUM REDUCTION TO FULL SERVICE, SUPPRESSION, HANDLE OFF and EMERGENCY. The service brake application zone is beyond minimum service position and ends at full service (not a detented position) which is located just before the SUPPRESSION position. The operating positions of the brake valve are further discussed in Section 5.

C. Pressure Regulating (Feed) Valve (2)

The pressure regulating valve is located behind the automatic brake valve. It is used to maintain the Brake Pipe pressure desired and it is manually adjustable by the maintenance personnel only. The automatic brake valve will maintain the selected pressure against overcharge or leakage.

2.15.4 Air Horn Valve (Fig. 2-4)

The roof-mounted air horn is actuated by means of this air valve located between the master controller and the automatic brake valve.

2.15.5 Bell Valve (Fig. 2-4)

This bronze mushroom valve, labelled BELL, controls the pneumatically operated warning bell which is located behind the No. 1 End Truck on the Right Side under the control trailer car. The ON/OFF switch energizes a solenoid valve which controls the air supply to the bell.

2.16 LH SIDE EQUIPMENT (FIG. 2-2)

The following controls are located on the Left Side of the Engineman's control compartment.

2.16.1 Cab Heater Switch

This three-position switch, labelled CAB HEATER, controls the cab heater and fan located on the Left Side of the Engineman's control compartment. For further details, refer to Section 2.6.

Switch positioning provides the following:

OFF (Center) — Heating elements and fan motor not operating.

LOW (Down) — Half heating capacity and fans operating.

HIGH (Up) — Full heating capacity and fans operating.

NOTE: The collision post door must be CLOSED and DOGGED for the heater and fan to operate. When the door is OPEN, the heater cutoff switch mounted on the door jamb prevents the heater from being energized.

2.16.2 Windshield Heater Switch and Wiper Knob

This toggle switch, labelled WINDSHIELD HEATER, has two settings (ON/OFF) and controls the windshield heater on the Left Side of Engineman's control compartment. Located above it is a knob labelled WIPER/OFF/ON which controls the windshield wiper on the Left Side of Engineman's control compartment.

2.16.3 Handbrake and Emergency Brake Valve

A handbrake and an emergency brake valve are also located on the left side and are discussed in detail in Chapter 5.

THIS PAGE LEFT BLANK INTENTIONNALLY

SECTION 3

ELECTRICAL DISTRIBUTION AND LIGHTING SYSTEMS

3.1 GENERAL

The car electrical distribution system and subsystems require 480 VAC three phase 60 Hz power, 120 VAC three phase or double phase 60 Hz power, and 64 VDC power for their operation.

The 480 VAC Head End Power (HEP) is supplied to the car(s) in the form of 480 VAC, three phase, 60 Hz primary power from the electrical power supply in the locomotive. This power is distributed to the cars throughout the train by means of jumper cable trainlines between coupled vehicles. The locomotive HEP source and controls are discussed in Section 3.2.

The 120 VAC, three phase, 60 Hz power is supplied by means of a 480/120 VAC stepdown transformer group which is installed on each car. The transformer arrangement is discussed in Section 3.3.

The 480 VAC power is also reduced and converted to a low voltage DC power system.

3.1.1 Control Trailer Car 64/74 VDC Power Supply Arrangement

On the control trailer car the low voltage DC power system consists of a low voltage power supply/battery charger (LVPS/BC) unit and a fifty cell battery installed underframe. This arrangement provides a regulated power source of 74 VDC during normal operation, and 64 VDC during an emergency situation (HEP source defective). This arrangement is further discussed in Section 3.4.

3.1.2 BLIND TRAILER CAR 64 VDC POWER SUPPLY ARRANGEMENT

On the blind trailer car a low voltage power supply (LVPS) is located underframe and provides a non-regulated power source of 64 VDC. This arrangement is further discussed in Section 3.4.

NOTE: There is no battery on the blind trailer car.

3.2 ELECTRICAL TRAINLINE CONNECTIONS AND ARRANGEMENT (FIG. 1-7, 1-8, 3-1 AND 3-2)

In addition to the mechanical and pneumatic connections between cars, certain electrical jumper cables must be connected between all cars and electrical power supply in the locomotive, or auxiliary power source (shop/wayside power supply).

Electrical jumper cables and receptacles are provided at each end of the cars for the locomotive-to-train, car-to-car and end-of-train electrical connections. When the jumper cables are connected to their corresponding receptacles throughout the train, this forms four continuous trainlines which are explained in Subsection 3.2.1.

3.2.1 Train Consist Configuration (Fig. 3-1)

The following electrical trainline connection instructions apply to the normal push-pull train configuration, where the control trailer car is located at the end of the train farthest away from the locomotive and where "X" number of cars are arranged in the consist.

The four continuous trainline arrangements are as follows:

A. Head End Power Trainlines (Red)

Two (one each side of car) Head End Power trainlines with 6-pin jumper plugs are used for supplying 480 VAC, three phase, 60 Hz power from the locomotive to the cars.

A 480 VAC Head End Power (HEP) trainline jumper is connected to a receptacle coded RED below coupler level, near a mating receptacle coded RED on each side and at both ends of the car, thus making a total of four HEP jumpers and receptacles per car.

A similar arrangement of HEP jumpers and receptacles coded RED is provided at each end of the locomotive.

Shorter cables should be used at the extreme end of consist to provide a loop circuit and to reduce damage caused by debris.

NOTE: Shorter HEP jumper cables are provided with the Control Trailer Car (at No. 1 End). If the control trailer car is at the end of the consist, the free end of the jumper must be inserted into the RED adjacent receptacle (END-OF-TRAIN connection).

WARNING: BEFORE MAKING "HEP" POWER JUMPER CONNECTIONS, VERIFY THAT THE MAIN POWER CIRCUIT BREAKERS ON THE LOCOMOTIVE OR SHOP/WAYSIDE POWER SUPPLY WHICH CONTROL THE 480 VAC POWER TO THE TRAINLINES, ARE "OFF". THE JUMPERS ARE TO BE HANDLED WITH CARE IN ACCORD WITH ALL RAILROAD SAFETY RULES AND REGULATIONS. ANY DAMAGED JUMPER OR RECEPTACLE MUST NOT BE USED, AND THE MATTER REPORTED TO THE PROPER AUTHORITY.

To establish HEP Trainline connections, with the 480 VAC power supply shut off, proceed as follows:

RECEPTACLE COLOR CODE

BK — BLACK, LOCOMOTIVE CONTROL
BL — BLUE, DOOR CONTROL AND COMMUNICATION
RD — RED, 480 VAC HEP

Figure 3-1
Electrical Trainline Connections (Top View)
— Control Trailer Car and Blind Trailer Car

(1) 120 VAC, 74 VDC and 64 VDC Circuit Breakers

(a) Control Trailer Car
Place all 120 VAC and 74 VDC circuit breakers, located on the Car Lighting and Control Breaker Panel and on the Control Panel inside the electrical locker in the OFF position.

(b) Blind Trailer Car
Place all 120 VAC and 64 VDC circuit breakers, located on the Car Lighting and Control Breaker Panel and on the Control Panel inside the electrical locker in the OFF position.

(2) 480 VAC Circuit Breakers

Place all 480 VAC circuit breakers, located on the Car Main Power Breaker Panel in the underframe-mounted box of each car, in the OFF position.

(3) LOCOMOTIVE-TO-TRAIN Connections

Four HEP removable jumper cables which are part of the locomotive equipment are used for the LOCOMOTIVE-TO-TRAIN connections.

— Connect the four removable HEP cables of the locomotive to the RED mating receptacles at the end of the adjacent trailer car.

(4) CAR-TO-CAR Connections

Four HEP jumper cables are also used for the CAR-TO-CAR connections.

— Connect all HEP jumpers to the RED mating receptacles between each pair of coupled vehicles.

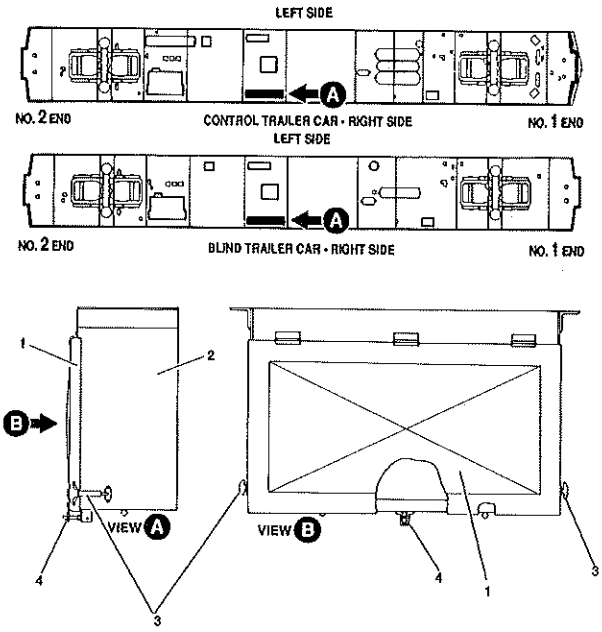
(5) END-OF-TRAIN Connections

The END-OF-TRAIN connections (extreme end of the control trailer car) are made by inserting the free end of each shorter HEP jumper of the No. 1 End into its adjacent RED mating receptacle (loop connection).

— Looping the 480 VAC power trainline control wires closes the return circuit to the Locomotive, thus permitting the power trainlines to become energized.

CAUTION: Verify that the retaining lugs on the receptacle covers and jumper plugs are correctly engaged at all locations.

NOTE: The cars are equipped with an interlock circuit that requires that all jumpers between cars be connected and that the jumpers on the trailing end of the last car be looped to their adjacent receptacle. If any of the 480 VAC jumpers are disconnected, or improperly connected, the power to all cars will be shut off.



1. Jumper Box Hinged Access Door
2. Jumper Box Assembly
3. Door Retainer (shown in retaining position)
4. Spring-loaded Door Safety Latch

Figure 3-2
Jumper and Hose Storage Box, Undercar — Control Trailer Car and Blind Trailer Car

B. Locomotive Control Trainline (Black)

The Locomotive Control trainline is routed along the Right Side of each car with duplicate receptacles at each end.

Two locomotive control trainline (live) receptacles coded black are located at each end of the car, one on each side.

(1) Locomotive-to-Train Connections

To make the LOCOMOTIVE-TO-TRAIN connections, a similar procedure as used for the HEP cables applies for the LCTL cable.

— Connect one jumper end plug to the mating receptacle coded black on the end of the car, and the other end to the mating receptacle coded BLACK on the locomotive.

(2) Car-to-Car Connections

To make the CAR-TO-CAR connections, connect the jumper to the BLACK receptacle at the No. 2 End of one car to the BLACK mating receptacle at the No. 1 End of the adjacent car.

CAUTION: Verify that the retaining lugs on the receptacle covers are correctly engaged in the mating grooves on the jumper cable plugs at all locations.

C. Door Control and Communication Trainline (Blue)

The Door Control and Communication Trainline is routed along the Left Side of each car with duplicate receptacles at each end. This trainline with 27 pin jumper plug also accommodates a number of 64/74 VDC control circuits. Some circuits can be used to provide battery power from the control trailer car in emergency conditions (lack of 480 VAC).

Two door control and communication trainline (live) receptacles coded BLUE are located at each end of car, one on each side.

(1) LOCOMOTIVE-TO-TRAIN Connections

To make the LOCOMOTIVE-TO-TRAIN connections, the procedure is the same as for the other jumper control cable previously described.

— Both cable plugs must be connected in their BLUE mating receptacles on the car end and the locomotive.

(2) CAR-TO-CAR Connections

To make the CAR-TO-CAR connections, connect the jumper to the BLUE receptacle of one car No. 2 End to the BLUE receptacle at the No. 1 End of the adjacent car.

It is also possible to connect No. 1 to No. 1 Ends, and No. 2 to No. 2 Ends.

CAUTION: Verify that the retaining lugs on the receptacle covers are correctly engaged in the mating grooves on the jumper cable plugs at all locations.

3.2.2 Shop/Wayside Power Supply Connection

If the cars or train consist must be powered from a 480 VAC shop/wayside power source, connect the HEP jumpers as shown schematically in Figure 3-3.

3.2.3 Power Distribution Panels and Devices

Power is supplied at the appropriate voltages through circuit breakers, switches, and other control devices which direct it to the various car support systems, subsystems and components. These control devices are grouped with associated indicators in the following panels and/or locations:

A. Battery Charger Panel (control trailer car), Low Voltage Power Supply Unit (blind trailer car) and/or Control Devices located on underframe on control trailer car and blind trailer car. Discussed in this Section.

B. Main Power Breaker Panel located underframe, left side (control trailer car and blind trailer car). Discussed in this Section.

C. Car Lighting and Control Breaker Panel located on the aisle side of the electrical locker (control trailer car and blind trailer car). Discussed in this Section.

D. Train Control Circuit Breaker Panel located inside the electrical locker on the control trailer car only. Discussed in this Section.

E. Door Control Relay Panel located in the No. 2 End vestibule. Discussed in Section 4, Door System.

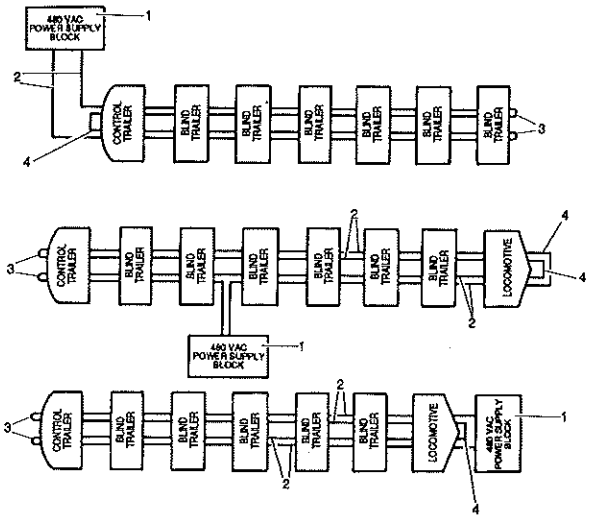
F. Electrical Locker Panel and/or Control devices (inside locker) at No. 1 End of control trailer car. Discussed in this Section.

G. Vestibule Ceiling Panels located at both ends (both types of cars). Discussed in this Section.

H. Engineman's Control Compartment Panels and/or Control Devices located in the No. 1 End vestibule of the control trailer car. Discussed in Section 2, Engineman's control compartment.

I. Side Entrance Door Panels and/or Control Devices located in both vestibules and outside. Discussed in Section 4, Door System.

J. Local Panel and/or Control Devices of Air Conditioning Unit located underframe, right side. Discussed in Section 8, Heating, Ventilation and Air Conditioning System.



1. Typical Location, 480 VAC Power Supply Block
2. Two HEP Jumpers for Trainline (one on each side)
3. HEP Jumpers Coded RED, Looped
4. Special Loop Circuit Jumper

Figure 3-3
Shop/Wayside 480 VAC
Power Supply Connections
— Control Trailer Car and Blind Trailer Car

K. HVAC System Contactor Panel and/or Control Devices located in the electrical locker. Discussed in Section 8, Heating, Ventilation and Air Conditioning System.

L. Local Panel of Wheel Slide Controller located inside the electrical locker. Discussed in Section 5, Brake System and Pneumatic Subsystems.

3.2.4 Major Car Support System Distribution

The major car support systems which utilize electrical power are considered to be the following:

A. Low Voltage Power Supply in blind trailer car control, and Battery/Battery Charger System in control trailer car. Discussed in this Section.

B. Main Passenger Lighting, Emergency Lighting, and Running Light Systems. Discussed in this Section.

C. Door Systems (Side Entrance Doors and Passenger Compartment End Doors). Discussed in Section 4, Door System.

D. Heating, Ventilation and Air Conditioning System. Discussed in Section 8, Heating, Ventilation and Air Conditioning System.

E. Two Way Radio System and PA/IC Interface (control trailer car). Discussed in Section 7, Communication System.

F. Public Address and Intercommunication System. Discussed in Section 7, Communication System.

G. Pneumatic Brake and Wheel Slide Control System and Pneumatic Subsystems. Discussed in Section 5, Brake System and Pneumatic Subsystems.

H. Cab Signal and Automatic Train Control System. Discussed in Section 6, Cab Signal/Automatic Train Control System/Alertness System and Speed Recorder System.

I. Alertness System. Discussed in Section 6, Cab Signal/Automatic Train Control System/Alertness System and Speed Recorder System.

3.2.5 Circuit Breaker Protection

Circuit breakers are used to protect the various 480 VAC, 120 VAC and 64/74 VDC circuits. The breakers are mounted on panels which have a grounded front plate to prevent an operator from coming in contact with live circuitry when operating the devices.

The breakers are clearly labelled in order to identify their respective functions. They are of the toggle action type indicating ON with the toggle in the UP position, and OFF with the toggle DOWN. They operate like manual switches that can TRIP and OPEN themselves under overload or short circuit conditions.

If a 480 VAC breaker should trip, it will be found in its centered position, thus indicating its tripped condition. However, 120 VAC and 64/74 VDC breakers will be found in the OFF position when tripped. When actuated manually like a switch, its toggle travels to either end. In both cases, the breaker will be OFF. It may be necessary to wait a few minutes (to allow cooling) before the breaker can be RESET to ON position. All breakers must be positioned to OFF before being reset to ON.

3.2.6 Control Toggle and Rotary Selector Switches

Some circuits are energized directly by the circuit breakers, but other circuits are further controlled by switches.

The toggle switches are in the ON position when the toggle is UP, and in the OFF position when DOWN. This applies for the vertically operated toggle switches. For any one being horizontally operated, the ON and OFF positions should be indicated. In some cases, functions are indicated. CAB HEATER and HEADLIGHTS toggle switches are OFF in the center position.

The rotary selector switches have clearly identified detent positions which are described in the appropriate Sections.

3.2.7 Indicating Lights and Illuminated Indicators

Some of the panels contain lights with colored lenses or illuminated legend plates which serve for indicating the operation of various systems. The lights are labelled and the legend plates clearly marked to identify their respective functions.

Most of the indicating lights have a PRESS-TO-TEST feature which allows testing of the lamp circuit alone. This determines if the lamp is working properly, isolated from its operation in the power control system. When the lens cap is depressed, the supply voltage is applied across the lamp circuit and causes the lamp to go ON.

3.2.8 HEP Trainline Interlock Circuits

The 480 VAC HEP is supplied to the cars through 4 three phase trainlines. The trainlines are routed along the length of the car, on the underside of the center sill, then diverted to the sides at the ends of the car.

Each HEP jumper cable consists of three power conductors and three control wires. Each jumper end is terminated by a power plug coded red. On the trailing car, the free end of each jumper is simply inserted in the mating receptacle mounted beside it.

The receptacles coded red are equipped with three power pins and three shorter control pins. Control wires connected on those power pins form an interlock circuit in the locomotive which requires that all four jumpers between cars be connected in order to power the consist.

When a power jumper is disconnected, the shorter control pins break contact first, opening a contactor in the electrical power supply car 480 VAC power supply circuit. This prevents the power points from disconnecting under load and eliminates the potential for arcing. If any jumper is disconnected, the power to all cars will be shut off.

The cars are designed so that the locomotive can be coupled and connected to either end of the train.

3.3 480/120 VAC TRANSFORMERS ARRANGEMENT

Three single phase 480/120 VAC transformers (T1, T2 and T3) are mounted on the underframe on both types of cars. This stepdown transformer group, connected in "Delta", reduces the 480V three phase, 60 Hz power to 120V three phase, 60 Hz power as the energy is transferred from the primary windings to the secondary windings. 480 VAC power is applied to the transformers through the MAIN AC POWER breaker MB, 100A, and through the 480/120 VAC three phase transformers input breaker MTB, 15A, located in the Main Power Breaker Panel, undercar (see Section 3.5).

3.4 LOW VOLTAGE POWER SUPPLY (FIG. 3-4 AND 3-5)

Both types of cars are provided with a power supply located underframe (64/74 VDC for control trailer car and 64 VDC for blind trailer car).

A. Control Trailer Car

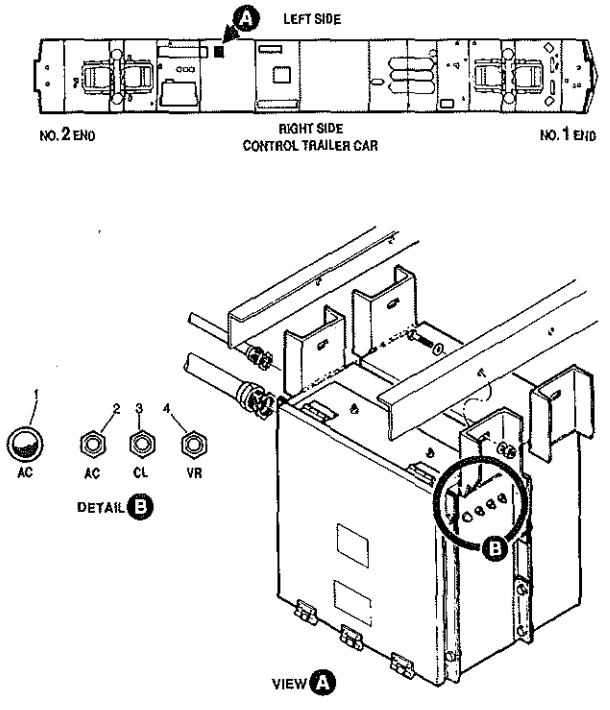
In the control trailer car, DC low voltage is supplied by the battery charger. The battery charger is also used to automatically supply power for recharging the control trailer car battery.

During periods of 480 VAC supply interruption, some essential DC loads are supplied by the battery (64/74 VDC) located on the control trailer car through the battery positive and negative trainlines. When the battery voltage drops to 52 Volts, the loads are disconnected automatically from the Battery by the Load Shed relay (RL1) located in the battery charger.

The knife switch (KS) is in the charging circuit between the battery charger and the battery bank. The KS box comprises 100A fuses, also in circuit. For normal operation, the KS must be ON (closed). The external handle on the KS box permits to isolate the batteries for maintenance, shutdown or malfunction.

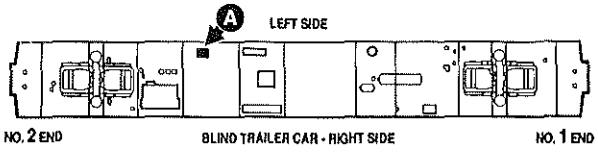
B. Blind Trailer Car

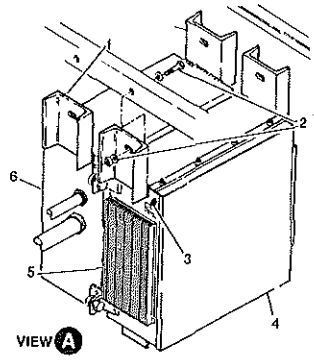
When the 480 VAC power supply is available, the blind trailer car DC circuits are powered by the power supply (64 VDC at 480 VAC input). When the blind trailer car Power Supply (PS) is operating, a GREEN light located at the upper LH section of the power supply box is ON.



1. Battery Charger Status Indicating Light (GREEN)
2. Push Button (AC)
3. Push Button (CL)
4. Push Button (VR)

Figure 3-4
(LVPS) Low Voltage Power Supply, Battery Charger, Installation — Control Trailer Car





1. Mounting Bracket
2. Mounting Hardware
3. Power Indicating LED (Green)
4. Low Power Supply Access Door
5. Cooling Fins
6. Power Supply Assembly

Figure 3-5
Low Voltage Power Supply, Undercar
— Blind Trailer Car

3.4.1 Control Trailer Car Battery Box (BAT) (Fig. 3-6)

The battery box is mounted undercar on the Left Side of the car, between crossbearers XB-1 and XB-2. The box contains a 64 VDC, fifty-cell, nickel-cadmium battery which is made up of 10 five-cell block batteries connected in series. A temperature sensor installed inside the charger allows charging voltage to rise up to a maximum of 80 VDC and then stabilize at low ambient temperature.

3.4.2 Control Trailer Car Battery Charger (BC) Unit (Fig. 3-4)

The battery charger is mounted undercar, on the Left Side of the car, at the BATTERY CHARGER label (between crossbearers XB-2 and XB-3).

Battery charging power is supplied to the battery through the output circuit breaker CB1, 60A, and the BATTERY circuit breaker in battery charger, CB2, 60A.

NOTE: Circuit Breakers CB1, 60A, and CB2, 60A, located in battery charger must always be ON.

Battery charging power is also supplied to the load through the Load Shed relay contact (RL1).

When the battery charger is powered by the locomotive 480 VAC source, the input voltage is connected to the integrated battery charger/transformer which transforms and rectifies the voltage to approximately 74 VDC.

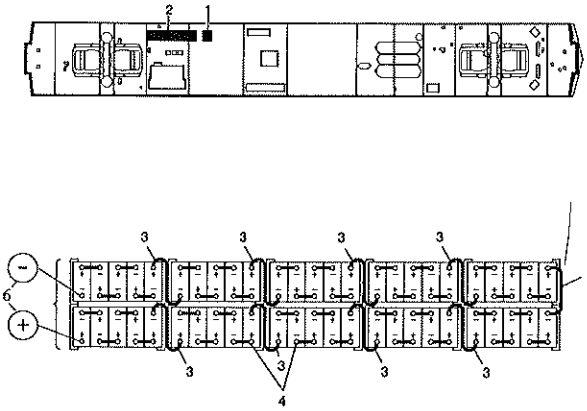
The equipment constitutes a regulated AC-to-DC power supply intended to maintain the battery charge while supplying the load with a constant voltage.

3.4.3 Battery Charger Indicating Light Panel (Fig. 3-4)

A GREEN indicating light, labelled AC, and three sealed (with rubber casings) push buttons are mounted externally on the battery charger housing. These devices are for maintenance use only. The light, however, may be observed to cycle ON and OFF, indicating that certain operating conditions are met..

The first push button, labelled AC, only tests the lamp; pressing this button will turn ON the lamp when input voltage to the charger is present.

The middle push button, labelled CL, simulates a high voltage battery condition. If the current already being drawn from the charger is about 40 amps, pushing this button will force the charger into current limit and turn ON the lamp. Releasing the button returns the charger to normal operation.



1. Battery Charger (BC)
2. Battery Box - 10 Groups of Five Cells (BAT)
3. Row Connecting Jumper
4. Cell Jumper
5. Five Cells Group Jumper
6. Battery Output

Figure 3-6
Battery Box Location,
Cells Installation, Undercar
— Control Trailer Car

The last push button, labelled VR, simulates a low voltage battery condition triggering the charger into a fully charged battery condition. Hence, if the charger is found to have the green lamp already ON, pressing the button should cause the lamp to go OFF.

3.5 480 VAC BREAKER PANEL (BOTH TYPES OF CARS) (FIG. 3-7)

The 480 VAC Breaker Panel on both types of cars is located on the underframe in a weatherproof box, on the Left Side of the car, towards the No. 2 End, adjacent to crossbearer XB-5. All breakers mounted on this panel energize and protect 480 VAC circuits. Unless otherwise indicated in the following text, the breakers are common to both types of cars.

The panel contains the following circuit breakers:

3.5.1 480 VAC Circuit Breakers

A. MAIN AC POWER, MB, 100A
Feeds 480 VAC power from the trainlines to the following circuit breakers:

(1) FLOOR HEAT 1, FH1B, 20A
Stage 1, FLOOR HEATING. Discussed in Section 8, Heating, Ventilation and Air Conditioning System.

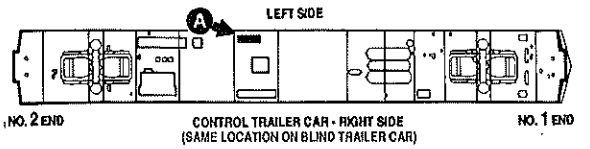
(2) FLOOR HEAT 2, FH2B, 20A
Stage 2, FLOOR HEATING. Discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(3) OVERHEAD HEAT 1, OH1B, 30A (with shunt trip)
Stage 1, OVERHEAD HEAT. Overhead evaporator/ heater/blower unit heating at No. 1 End, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(4) OVERHEAD HEAT 2, OH2B, 30A (with shunt trip)
Stage 2, OVERHEAD HEAT. Overhead evaporator/ heater/blower unit heating at No. 2 End, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(5) A/C COMPRESSOR/CONDENSER NO. 1, CC1B, 50A
Air conditioning unit compressor motor and condenser fan motor No. 1, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(6) CAB HEATER NO. 1, CHRB, 15A
(Control trailer car only)
Control trailer car main breaker panel only. Operating compartment floor heating, discussed in Section 8, Heating, Ventilation and Air Conditioning System.



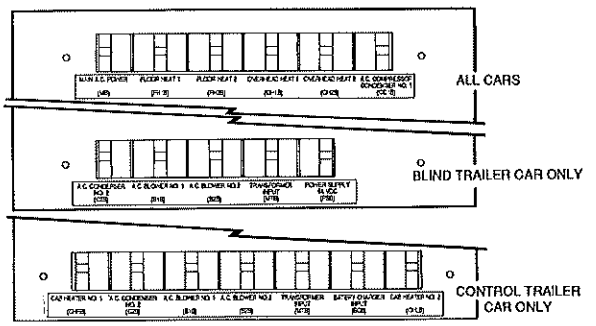


Figure 3-7
480 VAC Breaker Panel —
Control Trailer Car and Blind Trailer Car

(7) A/C CONDENSER NO. 2, C2B, 20A
Air conditioning unit condenser fan motor No. 2, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(8) A/C BLOWER NO. 1, B1B, 15A
Blower motor of overhead evaporator/heater/blower unit at No. 1 End, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(9) A/C BLOWER NO. 2, B2B, 15A
Blower motor of overhead evaporator/heater/blower unit at No. 2 End, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(10) TRANSFORMER INPUT, MTB, 15A
Feeds 480/120 VAC transformer group input power. Discussed in this Section.

(11) BATTERY CHARGER INPUT, BCB, 10A
(Control trailer car only)
Control trailer car main breaker panel only. Battery charger input power, discussed in this Section.

(12) CAB HEATER NO. 2, CHLB, 15A
(Control trailer car only)
Control trailer car main breaker panel only. Engineman's control compartment floor heating, discussed in Section 8, Heating, Ventilation and Air Conditioning System.

(13) POWER SUPPLY, PSB, 10A
(Blind trailer car only)
Power Supply input , discussed in this Section.

3.6 ELECTRICAL LOCKER ARRANGEMENT (FIG. 3-8 AND 3-9)

Electrical lockers are located in the No. 1 End low-ceiling area, on the Right Side of both types of cars. The locker includes most of the controls, switches, relays and breakers required for the operation of the car. Figures 3-8 and 3-9 show the arrangement of the equipment located in the lockers. Some of the devices shown do not require a detailed description within the scope of this manual; they have been included for orientation purposes.

3.6.1 Control Trailer Car Electrical Locker Arrangement (Fig. 3-8, Sheets 1 through 3)

The control trailer car electrical locker contains the following panels and/or components:

A. Cab Signal (ATC) Shelf.

B. Car Lighting and Control Breaker Panel.

C. Pressure Switch Panel.

D. Speed Recorder Box.

E. Door Control Switch Panel.

F. HVAC Relay Panel.

G. Train Control Circuit Breaker Panel.

H. Relay Panel.

I. Alertor Unit.

J. Public Address (PA) Amplifier.

K. Cab Signal (ATC) 32 V Converter Unit.

L. Wheel Slide Control.

M. Radio Transceiver.

3.6.2 Blind Trailer Car Electrical Locker Arrangement (Fig. 3-9, Sheets 1 through 3)

The blind trailer car electrical locker contains the following panels and/or components:

A. Car Lighting and Control Breaker Panel.

B. Pressure Switch Panel.

C. Door Switch Panel.

D. HVAC Relay Panel.

E. Relay Panel.

F. Public Address (PA) Amplifier.

G. Wheel Slide Control Unit.

3.7 CAR LIGHTING AND CONTROL BREAKER PANEL (FIG. 3-10)

On both types of cars, the Car Lighting and Control Breaker Panel is enclosed in a small switch locker which is part of the electrical locker above the cab signal shelf (Control Trailer Car only). Access is by means of a coach key lock.

The Car Lighting and Control Breaker Panel is divided into four sections, as follows:

1. HVAC Control Devices and Indicators.
2. 120 VAC Circuit Breakers.
3. Main Passenger Compartment Lighting Switches.
4. 74/64 VDC Circuit Breakers.

Key to Figure 3-8

VIEW A - Front LH Partition (Car Lighting and Control Breaker Panel and Cab Signal (ATC) Shelf)
VIEW B - Left Side Partition (Pressure Switch Panel and Speed Recorder Box)
VIEW C - Rear Partition (Train Control Circuit Breaker Panel, Door Switch Panel, HVAC Control Panel, and HVAC Relay Auxiliary Panel)
VIEW D - Right Side Partition (Relay Panel, PA Amplifier and Radio)
VIEW E - Front RH Partition (Alertor Control Box)
VIEW F - Electrical Locker Access Door (Blue Card Holder, Wheel Slip Control Unit and Fusees and Torpedoes Box)

1. Switch Panel Terminal Board (TBSP)
2. Pressure Switch Panel
3. Speed Recorder Box
4. Speed Recorder Terminal Block (TBSR)
5. Door Control Switch Panel

5a. HVAC Relay Auxiliary Panel (with 3-phase monitor and blower interlock relay)

6. Thermostat Maintenance Terminal Block (TBTM)
7. Test Module Receptacle (TMR)
8. Train Line Terminal Block (TBTL)
9. Communication Terminal Block
10. HVAC Relay Panel
11. Train Control Circuit Breaker Panel
12. Relay Panel Assembly
13. Blue Card Holder
14. Electrical Locker Light Switch (ELL)
15. Wheel Slide Unit
16. Fusees and Torpedoes Box
17. Radio Transceiver
18. ATC 32 V Converter
19. PA Amplifier
20. Alertor Unit Box
21. Cab Signal (ATC) Shelf
22. Spare Wires Terminal Block (TBSW)
23. No. 2 End HVAC System Fuse (FUS2)
24. No. 1 End HVAC System Fuse (FUS1)
25. Emergency Magnet Valve 3/8 in. Sealed Ball Valve
26. Switch Panel Terminal Block (TBSP 1 - 20)
27. Car Lighting and Control Breaker Panel
28. Switch Panel Terminal Block (TBSP 21 - 35)
29. Layover Heat Thermostat

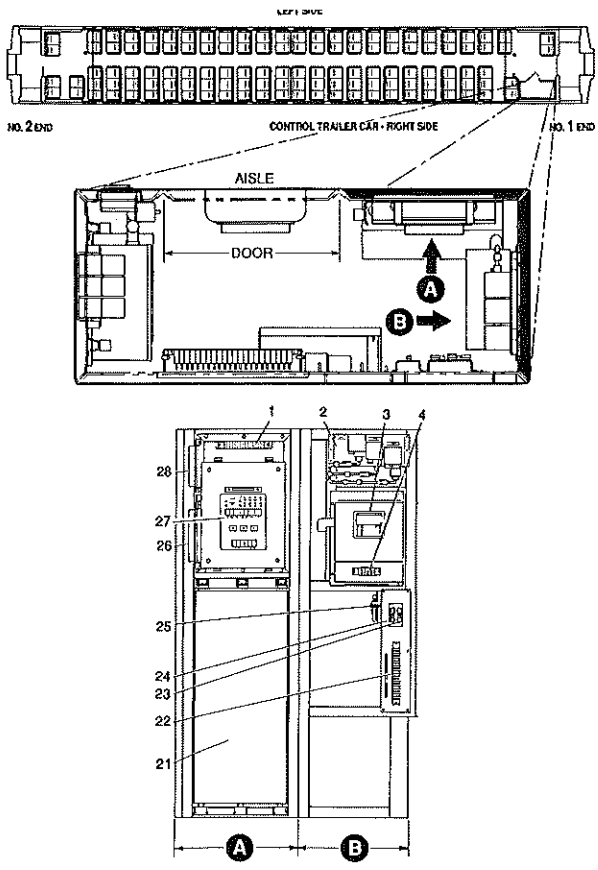


Figure 3-8 (Sheet 1 of 3)
Electrical Locker Equipment Arrangement
(Top View)
— Control Trailer Car

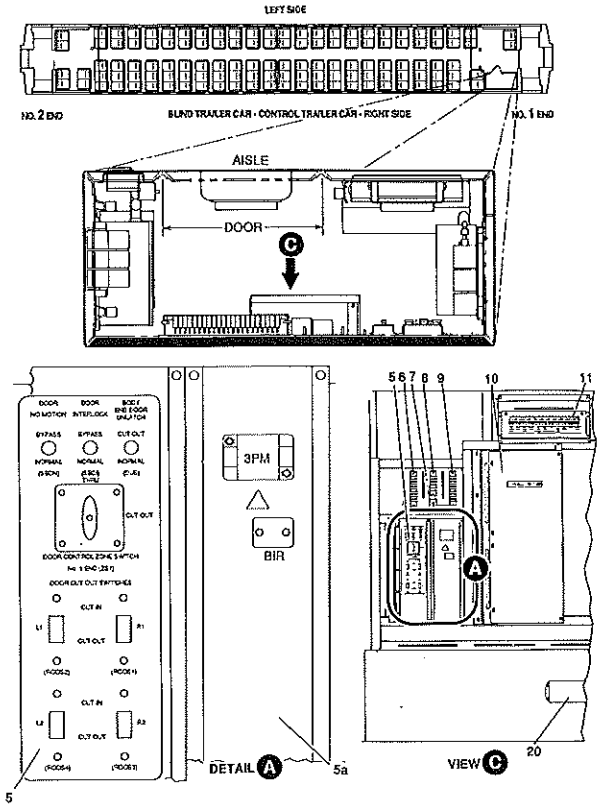


Figure 3-8 (Sheet 2 of 3)
Electrical Locker Equipment Arrangement
(Top View)
— Control Trailer Car

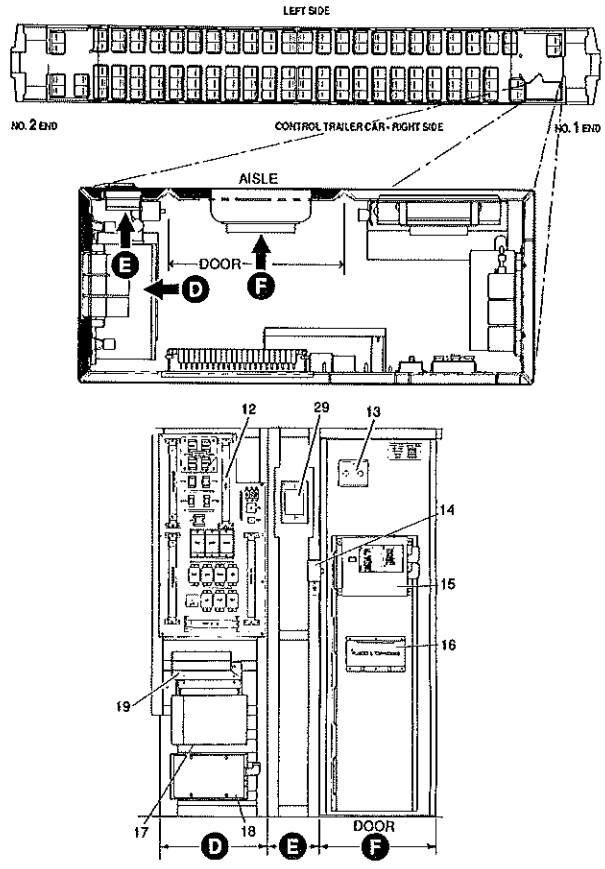


Figure 3-8 (Sheet 3 of 3)
Electrical Locker Equipment Arrangement
(Top View)
— Control Trailer Car

Key to Figure 3-9

VIEW A - Front LH Partition (Car Lighting and Control Breaker Panel)
VIEW B - Left Side Partition (Pressure Switch Panel)
VIEW C - Rear Partition (Door Switch Panel, HVAC Control Panel, and HVAC Relay Auxiliary Panel)
VIEW D - Right Side Partition
VIEW E - Front RH Partition
VIEW F - Electrical Locker Access Door (Wheel Slip Control Unit and Fusees and Torpedoes Box)

1. Switch Panel Terminal Board (TBSP)
2. Pressure Switch Panel
3. Door Control Switch Panel

3a. HVAC Relay Auxiliary Panel (with 3-phase monitor and blower interlock relay)

4. Thermostat Maintenance Terminal Block (TBTM)
5. Test Module Receptacle (TMR)
6. Train Line Terminal Block (TBTL)
7. Communication Terminal Block
8. HVAC Relay Panel
9. Relay Panel Assembly
10. Blue Card Holder
11. Electrical Locker Light Switch (ELL)
12. Wheel Slide Unit
13. Fusees and Torpedoes Box
14. PA Amplifier
15. Spare Wires Terminal Block (TBSW)
16. No. 2 End HVAC System Fuse (FUS2)
17. No. 1 End HVAC System Fuse (FUS1)
18. Switch Panel Terminal Block (TBSP 1 - 20)
19. Car Lighting and Control Breaker Panel
20. Switch Panel Terminal Block (TBSP 21 - 35)
21. Layover Heat Thermostat

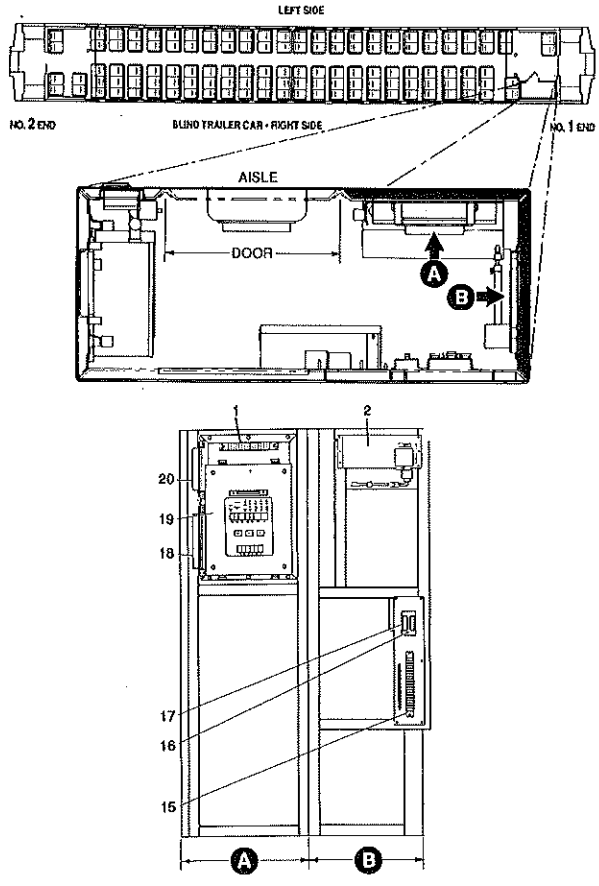


Figure 3-9 (Sheet 1 of 3)
Electrical Locker Equipment Arrangement
(Top View)
— Blind Trailer Car

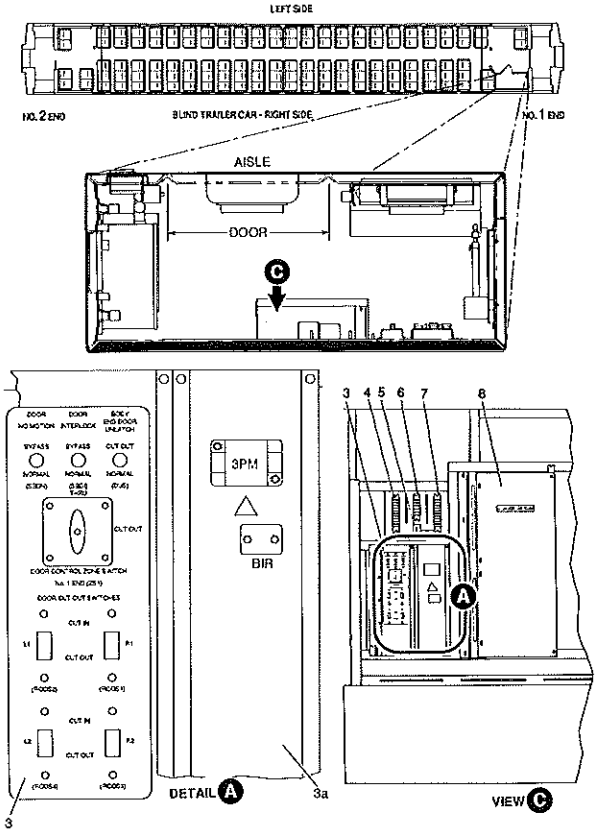


Figure 3-9 (Sheet 2 of 3)
Electrical Locker Equipment Arrangement
(Top View)
— Blind Trailer Car

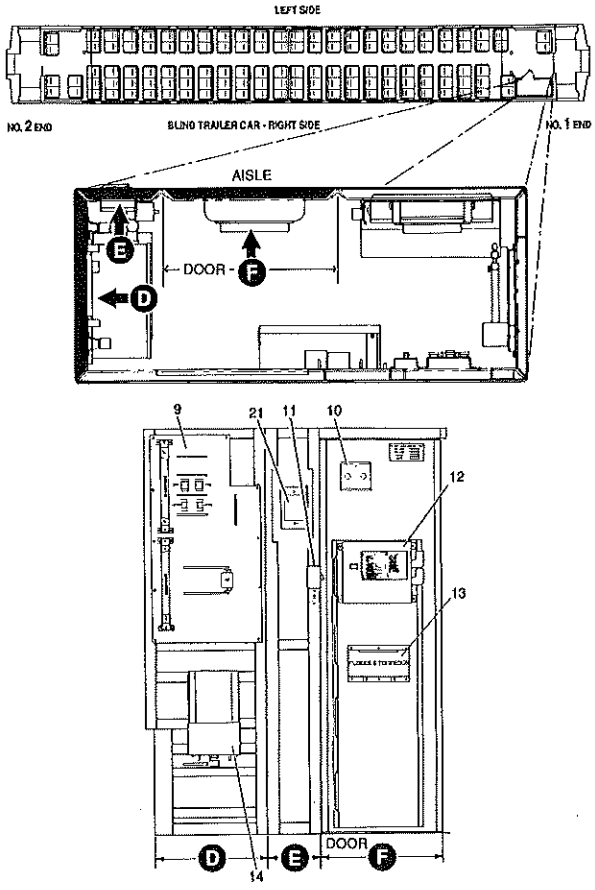


Figure 3-9 (Sheet 3 of 3)
Electrical Locker Equipment Arrangement
(Top View)
— Blind Trailer Car

3.7.1 HVAC Control Devices and Indicators (Fig. 3-10)

A. Indicating Lights

(1) STAGE 1, OVERHEAD HEAT, OHL1 (Ref. item 1)

This indicating light is lit when Stage 1, Overhead Heat should be operating.

(2) PARTIAL COOL, PCL (Ref. item 2)

This indicating light is lit when the HVAC partial cool should be operating.

(3) STAGE 1, FLOOR HEAT, FHL1 (Ref. item 3)

This indicating light is lit when Stage 1, Floor Heat should be operating.

(4) OVER TEMP. No. 1 End, OTL1 (Ref. item 4)

This indicating light is lit when an over temperature condition may exist at No. 1 End.

(5) STAGE 2, OVERHEAD HEAT, OHL2 (Ref. item 18)

This indicating light is lit when Stage 2, Overhead HEAT should be operating.

(6) FULL COOL, FCL (Ref. item 19)

This indicating light is lit when the HVAC full cool should be operating.

(7) STAGE 2, FLOOR HEAT, FHL2 (Ref. item 17)

This indicating light is lit when Stage 2, Floor Heat should be operating.

(8) OVER TEMP. No. 2 End, OTL2 (Ref. item 16)

This indicating light is lit when an over temperature condition may exist at No. 2 End.

NOTE: An indicating light is ON only when that particular function is called for by the control system. This does not, however, indicate that the function is actually being provided.

B. Switches

(1) OVER TEMP. LAMP RESET, OTRS (Ref. item 5)

This toggle switch (spring return) is used to reset an over temperature condition that has occurred (at either end of car).

(2) LAMP TEST, HSPB (Ref. item 6)

This push button switch is used to test the condition of the HVAC indicating lights described in subsection A, preceding.

(3) HVAC SELECTOR SWITCH, HSS (Ref. item 7)

This four position rotary selector switch controls HVAC system mode of operation circuit.

(4) BLOWER, BLS (Ref. item 8)

This toggle switch controls the blower motors separately when only ventilation or normal operating mode is selected.

3.7.2 120 VAC Circuit Breakers (Fig. 3-10)

A. MAIN PASSENGER LIGHTING, PLB, 20A (Ref. item 15)

Controls and protects the main passenger area lighting circuits (3 main circuits).

B. VESTIBULE AND PLATFORM LIGHTS, VPLB, 10A (Ref. item 14)

Controls and protects the vestibule and platform lighting circuit.

C. HVAC CONTROL, HCB, 10A (Ref. item 13)

Controls and protects the Heating, Ventilation and Air Conditioning Control circuits.

D. OVERHEAD BLOWER CONTACTOR, OBCB, 10A (Ref. item 12)

Controls and protects the circuits of the blower motor of overhead evaporator/heater/blower units.

E. PROTECTIVE HEATERS, PHB, 20A (Ref. item 11)

Controls and protects the circuit for the heating tapes located in the door tracks for the sliding side doors. Each trap door forms part of the (side) door track arrangement.

F. CONVENIENCE OUTLETS (LEFT) COLB, 15A (Ref. item 10)

Controls and protects the two convenience outlet (CO1 and CO3) circuits located on the Left Side of the car.

G. CONVENIENCE OUTLETS (RIGHT) COLR, 15A (Ref. item 9)

Blind trailer car: Controls and protects the two convenience outlets (CO2 and CO5) circuits located on the Right Side of the car.

Control trailer car: Controls and protects the three convenience outlets (CO2, CO5 and CO4) circuits located on the Right Side of the car.

3.7.3 Main Passenger Compartment Light Switches (Fig. 3-10)

A. MAIN PASSENGER LIGHT SWITCH NO. 1, MLP1 (Ref. item 20)

This two position toggle switch controls the passenger compartment lighting circuit No. 1.

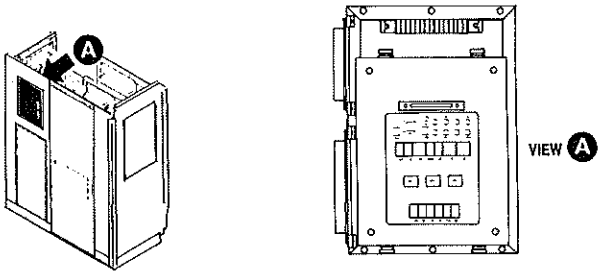
B. MAIN PASSENGER LIGHT SWITCH NO. 2, MLP2 (Ref. item 21)

This two position toggle switch controls the passenger compartment lighting circuit No. 2.

C. MAIN PASSENGER LIGHT SWITCH NO. 3, MLP3 (Ref. item 22)

This two position toggle switch controls the passenger compartment lighting circuit No. 3.

Key to figure 3-10



1. Stage 1, OVERHEAD HEAT Indicating Light (OHL1)
2. PARTIAL COOL Indicating Light (PCL)
3. Stage 1, FLOOR HEAT Indicating Light (FHL1)
4. No. 1 End Over Temperature Indicating Light (OTL1)
5. Over Temperature Lamp Reset Toggle Switch, self return (OTRS)
6. Lamp Test Pushbutton Switch (HSPB)
7. HVAC Selector Switch (HSS)
8. Blower Toggle Switch (BLS)
9. RH Side Convenience Outlets Circuit Breaker, 15A (CORB)
10. LH Side Convenience Outlets Circuit Breaker, 15A (COLB)
11. Protective Heaters Circuit Breaker, 20A (PHB)
12. Overhead Blower Contactors Circuit Breaker, 10A (OBCB)
13. HVAC Controls Circuit Breaker, 10A (HCB)
14. Vestibule and Platform Lights Circuit Breaker, 10A (VPLB)
15. Main Passenger Lighting Circuit Breaker (PLB)
16. No. 2 End Over Temperature Indicating Light (OTL2)
17. Stage 2, FLOOR HEAT Indicating Light (FHL2)
18. Stage 2, OVERHEAT HEAT Indicating Light (OHL2)
19. Full Cool Indicating Light (FCL)
20. No. 1 Main Passenger Compartment Lighting Toggle Switch (MPL1)
21. No. 2 Main Passenger Compartment Lighting Toggle Switch (MPL2)
22. No. 3 Main Passenger Compartment Lighting Toggle Switch (MPL3)
23. Compressor Crankcase Heater Circuit Breaker, 5A (CCHB)
24. Door Operator Circuit Breaker, 20A (DOB)
25. Door Control Circuit Breaker, 10A (DCB)
26. Communication System Circuit Breaker, 10A (CSB)
27. Wheel Slide System Circuit Breaker, 10A (WSB)
28. Brake Indicating Lights Circuit Breaker, 10A (BIB)

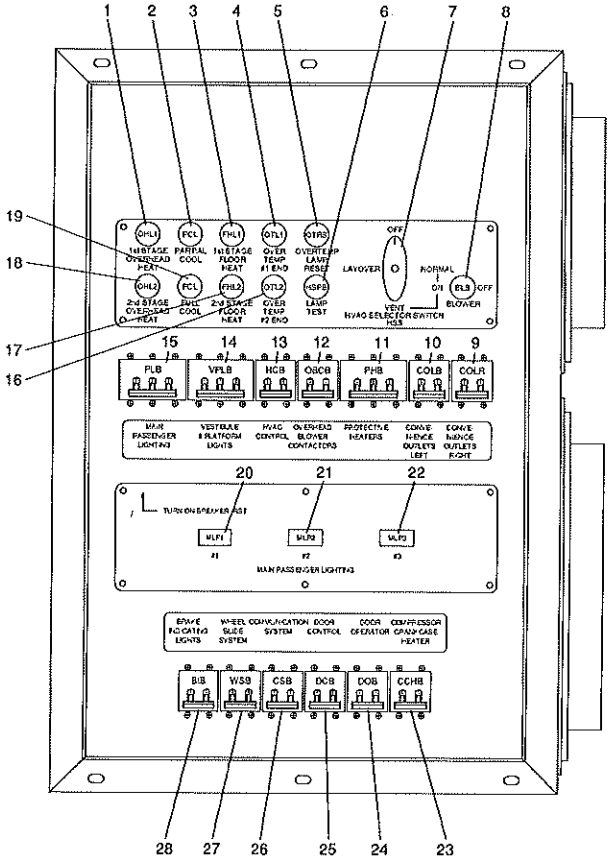


Figure 3-10
Car Lighting and Control Breaker Panel
(Electrical Locker)
— Control Trailer Car and Blind Trailer Car

3.7.4 74/64 VDC Circuit Breakers (Fig. 3-10)

A. BRAKE INDICATING LIGHTS, BIB, 10A (Ref. item 28)
Controls and protects the operation of three brake indicating lights.

B. WHEEL SLIDE SYSTEM, WSB, 10A (Ref. item 27)
Controls and protects the Wheel Slide Control equipment circuits including controller, control valve and cutoff switch.

C. COMMUNICATION SYSTEM, CSB, 10A (Ref. item 26)
Controls and protects the Public Address and Intercommunication system and signalling bell circuits.

D. DOOR CONTROL, DCB, 20A (Ref. item 25)
Controls and protects the door system control circuits.

E. DOOR OPERATOR, DOB, 20A (Ref. item 24)
Controls and protects the door operator unit (in each door).

F. COMPRESSOR CRANKCASE HEATER, CCHB, 20A (Ref. item 23)
Controls and protects the heater pad used to reheat the crankcase oil of the air conditioning compressor.

3.8 TRAIN CONTROL CIRCUIT BREAKER PANEL (FIG. 3-11)

The Train Control Circuit Breaker Panel is located inside the electrical locker on the control trailer car only. The panel contains the following circuit breakers:

A. CAB HEATING CONTROL, CHB, 20A (Ref. item 1)
Controls and protects the operating compartment heating circuits.

B. NUMBER BOARDS, CNB, 5A (Ref. item 2)
Controls and protects the control trailer car number board circuits.

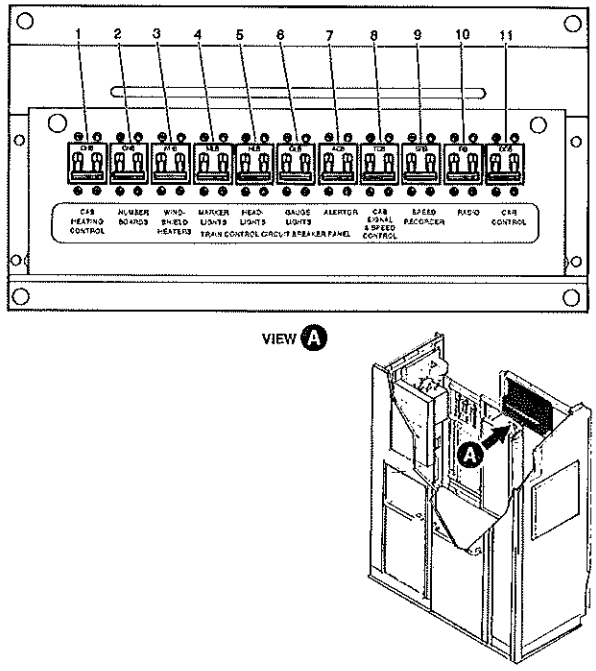
C. WINDSHIELD HEATERS, WHB, 15A (Ref. item 3)
Controls and protects the operating compartment windshield heaters circuits.

D. MARKER LIGHTS, MLB, 10A (Ref. item 4)
Controls and protects the exterior marker light circuits.

E. HEADLIGHTS, HLB, 20A (Ref. item 5)
Controls and protects the headlight circuits.

F. GAUGE LIGHTS, GLB, 5A (Ref. item 6)
Controls and protects the gauge light circuits.

G. ALERTOR, ACB, 10A (Ref. item 7)
Controls and supplies power to the Alertor circuits.



1. Cab Heating Control Circuit Breaker, 20A (CHB)
2. Car Number Board Circuit, 5A (CNB)
3. Windshield Heaters Circuit Breaker, 15A (WHB)
4. Marker Lights Circuit Breaker, 10A (MLB)
5. Headlights Circuit Breaker, 20A (HLB)
6. Gauge Lights Circuit Breaker, 5A (GLB)
7. Alertor Circuit Breaker, 10A (ACB)
8. Cab Signal and Speed Control Breaker, 10A (TCB)
9. Speed Recorder Circuit Breaker, 10A (SRB)
10. Radio Circuit Breaker, 10A (RB)
11. Car Control Circuit Breaker, 30A (CCB)

Figure 3-11
Train Control Circuit Breaker Panel
— Control Trailer Car

H. CAB SIGNAL AND SPEED CONTROL, TCB, 10A (Ref. item 8)
Controls and supplies power to the cab signal and speed control circuits.

I. SPEED RECORDER, SRB, 10A (Ref. item 9)
Controls and supplies power to the speed recorder circuits.

J. RADIO, RB, 10A (Ref. item 10)
Controls and supplies power to the radio system circuits.

K. CAR CONTROL, CCB, 30A (Ref. item 11)
Protects the Essential Load (during an emergency condition) trainlines.

3.9 GENERAL ARRANGEMENT OF BELLS AND SIGNALLING PUSH BUTTON SWITCHES

A bell is mounted in the ceiling of each vestibule (two per car) and ten signalling push button switches (CSB1 through CSB10) are located as follows:

— One push button switch is mounted in each vestibule on each door switch panel (four per car).

— Two other push button switches in square mounting plates are also installed in the high ceiling of the passenger section in line with the longitudinal center line of the car and at approximately one third of the car length. These two push button switch mounting plates are also labelled CONDUCTOR SIGNAL (two per car).

— The other four push button switches are installed outside, one at each corner of the car, near the stepwells. They are installed on each platform light mounting panel in a recessed aperture and are protected with a rubber cap.

The push buttons are used by the train crew for signalling the Engineer. When a crew member actuates any of the ten push buttons, the bells will sound in all vestibules and in the Engineman's control compartment of the control trailer car and also in the locomotive. This permits monitoring the operation of the circuit. All bell circuits are interconnected through the Door Control and Communication Trainline and operate from the 64/74 VDC power source. Diodes are used to prevent discharging current, if two push buttons of different cars are pressed at the same time.

3.10 GENERAL ARRANGEMENT OF CONVENIENCE OUTLETS

Electrical (convenience) outlets supplying 120 VAC power through the CONV. OUTLETS, COLB and CORB, 15A, circuit breakers which are located on the Car Lighting and Control Breaker Panel (electrical locker), are provided at the following locations:

— Two, (CO3 and CO5), are located on the passenger compartment/vestibule partition walls.

— Two are mounted on seat pedestals in the high ceiling passenger area. (CO1) is at seat R7, (CO2) is at seat L17. (Refer to Figure 2 and Figure 6.)

— One, (CO4), is mounted on the vestibule partition behind the Engineman's control compartment console in the control trailer car only.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 4

DOOR SYSTEM

4.1 GENERAL ARRANGEMENT OF DOOR SYSTEM EQUIPMENT

Section 1 provides a description of the physical arrangement of side doors, trap doors and end doors. Section 2 provides a description of the operating compartment side doors with sliding sash and the No. 1 End collision post door in the control trailer car.

4.1.1 Side Door Orientation

The numbering sequence for side doors and components starts at the No. 1 End, consecutively from 1R on the RIGHT SIDE and 1L on the LEFT SIDE. Right and Left sides are determined standing at the No. 2 End, facing the No. 1 End. Refer to Figure 4-1. Signs are provided above each side door.

4.1.2 Side Door Manual Operation

All the equipment required for power door operation is present, but the cars are wired and prepared for manual operation of all side doors. Door handles, latches and manual locks are provided. Blanking plates mask Master Door Control Panels, exterior side door crew switches and emergency handle assemblies. Conductor's signal pushbuttons on the Master Door Control Panels are still accessible.

WARNING: THE DOORS CAN BE OPERATED MANUALLY AT ALL TIMES WITH SBDI IN NORMAL MODE. SIDE DOORS CAN THUS BE UNLOCKED AND OPENED WHEN THE TRAIN IS IN MOTION. MOVING ABOUT IN END VESTIBULE AND STAIRWELLS IS DANGEROUS WITH SIDE DOORS OPEN. THEREFORE, AT ALL TIMES, THE DOOR CONTROL BREAKER (DCB) MUST BE IN THE "ON" POSITION IN ORDER TO FORWARD TO THE OPERATOR A SIGNAL (RED LIGHT - PCS OPEN) NOTIFYING THAT A DOOR IS OPEN. OPERATOR MUST REMAIN AWARE AT ALL TIMES OF THIS LIGHT, IN PARTICULAR, WHEN THE TRAIN IS IN MOTION.

FURTHERMORE, PLEASE NOTE THAT THERE IS NO INTERFACING BETWEEN THE DOOR CONTROL SYSTEM AND THE WHEEL SLIDE CONTROL EQUIPMENT OF THE BRAKE SYSTEM. THEREFORE, NO SIGNAL OF A FAULTY OPERATION WILL BE REGISTERED IN THE WHEEL SLIDE CONTROL EQUIPMENT IF THE DOORS ARE OPENED WHILE THE TRAIN IS IN MOTION.

4.1.3 Side Door System Power Supply

The side entrance door equipment control and system circuits operate from the car 64 VDC power source for the blind trailer car and 74 VDC battery charger for the control trailer car.

Key for Figure 4-1

1. LH Type Side Door Operator Assembly
2. Exterior Side Door Emergency Handle
3. Panel Sensing Switch
4. Exterior Side Door Crew Key Switch
5. Passenger Compartment Door Hold Open Latch/Catch Assembly with Unlatch Solenoid
6. Side Door Mechanical Lock Assembly
7. Side Entrance Sliding Door
8. Side Entrance Sliding Door Manual Latch and Handle
9. Master Side Door Control Panel
10. Trap Door Closed Switch
11. Body End Door Closer and Check Assembly
12. Body End Door
13. Side Door Control Relay Panel with Control Zone Switch
14. RH Type Side Door Operator Assembly
15. Emergency Reset Handle (behind hinged door)
16. Side Door Operator Cutout Switch (behind hinged door)
17. Vestibule Side Door Emergency Release (in ceiling)
18. Collision Post Door (Control Trailer Car only)
19. Electrical Locker
20. Door Control Switch Panel

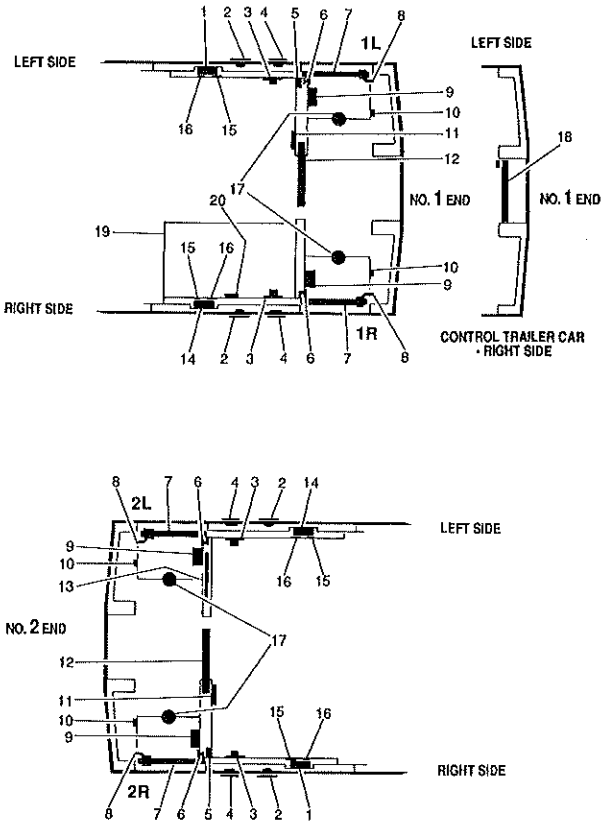


Figure 4-1
General Arrangement of Door System Equipment and Controls, Top View — Control Trailer Car and Blind Trailer Car

These circuits are powered and protected by the DOB, 20A, circuit breaker labelled DOOR OPERATOR, and the DCB, 10A, circuit breaker labelled DOOR CONTROL, which are mounted on the Car Lighting and Control Breaker Panel on the aisle side of the electrical locker.

The car door system is arranged for local or remote control and is trainlined through Master Side Door Control Panels which are located on both sides of each vestibule. The complete system is therefore capable of functioning within each car, or in a group of cars (of several types) coupled to form a train and connected through the Door Control and Communication Trainline. All door control circuits for one side of the car and/or train are separate and distinct from those for the opposite side. However, only one Master Side Door Control Panel should be activated at any one time.

The trainlining of door operation will work only when:

1. Local Door is opened first.
2. Remote Doors are opened.
3. Remote Doors are closed.
4. Local Door is closed last.

NOTE: Sections 4.2 to 4.11 are applicable to the power mode only.

4.2 SIDE DOOR OPERATOR ASSEMBLIES (FIG. 4-1 AND 4-2)

Each side entrance door is actuated by a 74 VDC electro-mechanical operator which OPENS and CLOSES the door panel by means of an extension arm assembly, in accordance with the signal received at the operator. Each operator assembly (except for the 1R position door operator located in the electrical panel behind a bolted HVAC panel) is accessible through a hinged panel which is located in the side door pocket extension inside the passenger compartment. Refer to Section 1.

4.2.1 Side Door Operator Configurations (Fig. 4-1 and 4-2)

Four door operators are used per car, one at each side door location. There are two door operator assembly configurations; a Right Hand operator and a Left Hand operator. Doors No. 1R and 2L have RH operator arrangements, and doors No. 1L and 2R have LH arrangements. The motor is identical for Left and Right Hand door operator.

4.2.2 Operator Locking Feature

The mechanical design of the door operator linkage is such that it provides a locking feature when the door panel is moved to the CLOSED position. This prevents the door panel from being OPENED manually or accidentally unless the lock is released either electrically through rotation of the operator motor, or mechanically through action of the emergency operating lever handle.

4.2.3 Operator Motor Control and OverloadProtection

The door operator power is controlled by an electronic chopper unit which limits the door closing speed and force through voltage/current regulating devices. The door operator is thus protected against overload without any degradation of the operator motor. A 6A fuse, mounted on the door control card, is used to protect this system in case of failure of the current limiter.

4.2.4 Operator Cutout Switch (Fig. 4-2)

Each door operator is equipped with a two position, NORMAL/CUTOUT, toggle switch which, in the CUTOUT position, electrically disconnects the door OPEN signal and the operator when a malfunction occurs at that door location, or when it is necessary to service the operator.

During normal system operation, the cutout switch is set in the NORMAL position at all door operators. For procedure, refer to Section 12.

4.2.5 Operator Remote Cutout Switch

Each door operator is also equipped with a remote cutout switch which has the same function as described in subsection 4..2.4, with switches for all four doors positioned on one Door Control Switch Panel which is located on the car RH wall inside the electrical locker.

4.2.6 Pushback Feature

The door operator extension assembly is designed to allow for a four inch backward movement of the door panel against an obstruction to protect passengers against being caught by the closing door and to allow for withdrawal of objects from the closed door.

4.2.7 Operator Emergency Switch (Fig. 4-2)

Each door operator is provided with an emergency switch (ES). The switch is positioned so that it will be actuated by pulling downward on either (interior or exterior) emergency handle.

The switch is maintained in the CLOSED position by the emergency lever when the latter is in its normal UP position. The switch is actuated as the emergency lever is moved DOWN, and its contacts are thus OPENED to remove the normally applied 74/64 VDC power from the operator. This feature prevents the operator motor from starting and attempting to RECLOSE the door under power as it is being OPENED manually.

4.3 SIDE DOOR EMERGENCY HANDLES (FIG. 4-2 AND 4-3)

The side doors can be manually opened (except when mechanically locked) from inside or outside the car in the event of an electrical power failure or in the event that an emergency exit is required. Both the interior and exterior emergency handles are coded RED and suitably marked. These handles are covered by blanking plates when the car is set up for manual door operation.

CAUTION: Do not attempt OPENING side door by either means while the associated key operated mechanical lock has been placed in the locked position.

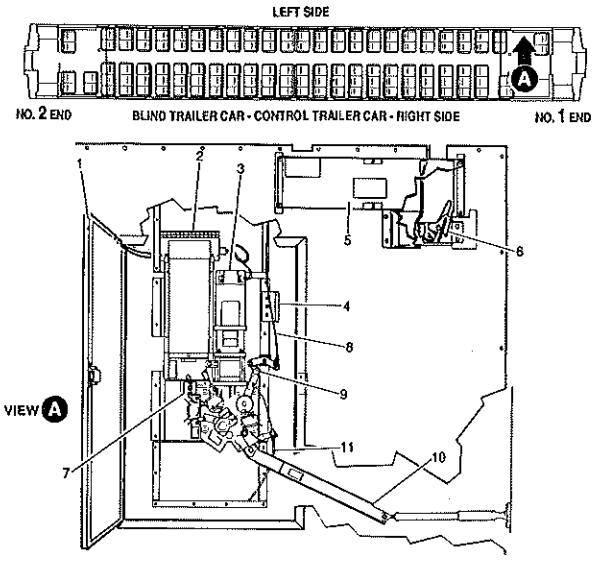
NOTE: The handle(s) once pulled, will not return to the NORMAL operating position. The door MUST BE CLOSED manually and the emergency lever RESET in the UP position (with exterior handle IN) before the door can be OPENED again under power.

4.3.1 Interior Emergency Handles (Fig. 4-2)

An emergency cable assembly is attached to the emergency lever at each operator location. The cable is routed so that its operating handle terminates in an enclosure cutout provided in the vestibule ceiling above the adjacent trap door. When the cable handle is pulled, the cable moves the operator emergency lever DOWN by means of a linkage, and partially opens the side door so that it can be fully opened manually.

4.3.2 Exterior Emergency Handles (Fig. 4-2 and 4-3)

An emergency cable assembly is attached to the emergency lever at each operator location. The cable is routed so that its operating handle terminates in an enclosure cutout provided in the exterior carbody skin. The handle is accessible through a breakable glass, marked with RED lettering, near each side door. When the exterior handle is pulled, the cable moves the operator emergency lever DOWN and partially opens the side door so that it can be fully opened manually.



1. Side Door Operator Access Panel
2. Motor Electronic Control Unit
3. Motor
4. Door Open Stopper
5. Door Hanger Access Panel
6. Panel Sensing Switch
7. Door Operator (Normal/Cutout) Toggle Switch
8. Interior Vestibule Side Door Emergency Release
9. Emergency Reset Handle
10. Actuating Arm Shown in Door Closed Position and Automatic Mode
11. Exterior Emergency Handle Cable

Figure 4-2
Side Door Operator Arrangement
— Control Trailer Car and Blind Trailer Car

4.4 EXTERIOR SIDE DOOR CREW KEY SWITCHES (FIG. 4-3)

A key switch assembly is located near each side door, outside the car. The switch, which is protected by a spring-closed, weatherproof cover, provides either OPENING or CLOSING power to the associated door operator motor. The switch can be actuated by means of the MBTA standard coach key while standing on a LOW LEVEL or HIGH LEVEL station platform.

This switch, which permits operating the adjacent side door only, has two operating positions with spring return to the OFF position. The key positions are as follows:

— Turning key clockwise from OFF: DOOR OPEN position.

— Turning key counterclockwise from OFF: DOOR CLOSE position.

The key may be returned to the OFF (inserting) position and removed, and the door will remain OPEN. When a door has been left OPEN in this manner, it can be CLOSED from a vestibule Master Side Door Control Panel on that side of the car (or train).

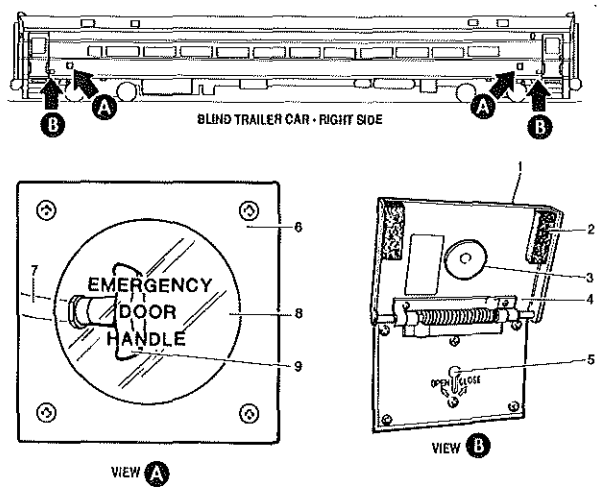
Also, when a single door has been OPENED from any Door Control Switch Panel, it can be CLOSED by actuating the exterior crew key switch at that location, when leaving the car. For procedure, refer to Section 12.

4.5 VESTIBULE MASTER SIDE DOOR CONTROL PANELS/ DOOR CONTROL SWITCH PANELS (FIG. 4-4)

A Master Side Door Control Panel (DSP1 to DSP4) is located on the rear vestibule wall, near the ceiling, at each side door location. This key-energized control panel allows the crew member to actuate the controls while standing at the doorway. Each panel is energized from a key switch located near the center of the Master Side Door Control Panel.

4.5.1 Trainline Orientation of Doors

The orientation of the trainline doors is established with the crew member standing on the trap door/platform while facing outboard towards the station platform. The doors located to the LEFT of the person are the LEFT trainline doors which are operated by the push buttons on the LEFT of the panel. The doors located to the RIGHT of the person are the RIGHT trainline doors which are operated by the push buttons on the RIGHT of the panel.



1. Exterior Side Door Crew Key Switch (Typical Four Corners)
2. Cover Bumper
3. Coach Key Hole Sealing Device
4. Spring Closed Cover
5. Key Hole for Coach Key
6. Glass Retaining Cover
7. Cable Leading to Interior Emergency Handle at Door Operator
8. Breakable Glass (covered by blanking plate during manual operation)
9. Red "T" Handle

Figure 4-3
Side Door Exterior Crew Key Switch and Emergency Handle — Control Trailer Car and Blind Trailer Car

Key to Figure 4-4

1. GREEN indicating light is ON when the LEFT trainline doors (facing outboard) are closed and locked
2. RED momentary push button switch used for opening LEFT trainline doors to Left of user
3. GREEN momentary push button switch used for closing LEFT trainline doors to Left of user
4. GREEN indicating light is ON when adjacent (local) door is closed and locked on that side of vestibule
5. RED momentary push button switch used for opening adjacent (local) door
6. GREEN momentary push button switch used for closing adjacent (local) door
7. GREEN indicating light is ON when the RIGHT trainline doors (facing outboard) are closed and locked
8. RED momentary push button switch used for opening RIGHT trainline doors to Right of user
9. GREEN momentary push button switch used for closing RIGHT trainline doors to Right of user
10. BLACK momentary push button switch is used for signalling throughout the train
11. GREEN indicating light is ON when the LEFT trainline doors (facing outboard) are closed and locked
12. RED momentary push button switch used for opening LEFT trainline doors to Left of user
13. GREEN momentary push button switch used for closing LEFT trainline doors to Left of user
14. GREEN indicating light is ON when adjacent (local) door is closed and locked on that side of vestibule
15. RED momentary push button switch used for opening adjacent (local) door
16. GREEN momentary push button switch used for closing adjacent (local) door
17. GREEN indicating light is ON when the RIGHT trainline doors (facing outboard) are closed and locked
18. RED momentary push button switch used for opening RIGHT trainline doors to Right of user
19. GREEN momentary push button switch used for closing RIGHT trainline doors to Right of user
20. BLACK momentary push button switch is used for testing lamps of the three indicating lights on top portion of panel
21. Key switch used for energizing door control panel. Controls and indicating lights are inoperative when panel is not key energized

NOTE: LEFT and RIGHT are determined by standing on the trap door and facing outboard towards the station platform.

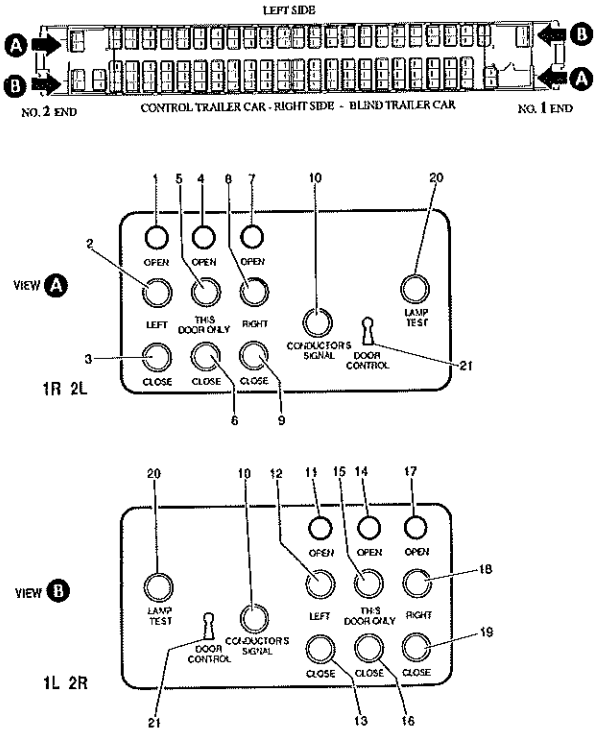


Figure 4-4
Vestibule Master Side Door Control Panels and Key Switch — Control Trailer Car and Blind Trailer Car

4.5.2 Door Control Key Switch

This switch labelled DOOR CONTROL is actuated by means of the standard coach key. When the key is turned clockwise, the panel is energized, and the controls are rendered operative. This permits controlling the LOCAL adjacent door as well as all LEFT and RIGHT trainline doors within that control zone, on that side of the train. The controls are inoperative when the key is not inserted and turned.

NOTE: In this description, an ACTIVE CONTROL LOCATION (ACL) is any Master Side Door Control Panel which has been key energized. A TRAINLINE LOCATION (TLL) is all side doors other than the ACL within a control zone, on the same side of the train.

It is possible to remove the key from the switch panel while the LOCAL and/or TRAINLINE doors remain OPEN. The doors can then be CLOSED from a different ACL on the same side of the train with the zoning (LEFT, LOCAL and RIGHT) being reestablished at the new ACL. The key can only be removed from the panel after it is returned to the OFF position. The corresponding Master Side Door Control Panel will be deenergized simultaneously even though the door(s) is (are) left OPEN.

4.5.3 Indicating Light Test Push Button

This BLACK momentary push button switch labelled LAMP TEST is used for testing the lamp circuits of the panel. Depressing this push button illuminates all the indicating lights at that key-energized panel.

4.5.4 Door Status Indicating Lights

Three indicating lights are arranged immediately above the three vertical rows of two push buttons each.

CENTER LIGHT (GREEN) — This light is mounted above the center pair of push buttons. When the light comes ON, it indicates that the local door is CLOSED and LOCKED condition in that vestibule, on that side of the car.

LEFT AND RIGHT LIGHTS (GREEN) — One of these lights is mounted above each outboard and inboard pair of push buttons. When these lights come ON, this indicates that the LEFT or RIGHT trainline doors are CLOSED and LOCKED.

4.5.5 Door Control Push Buttons

The three pairs of RED/GREEN push button switches have momentary type contacts with circuitry arranged so that once the button is depressed, the operating cycle will be completed even if the push button is released immediately. The top horizontal row of three RED push buttons serve for originating door OPENING signals and the bottom row of three GREEN push buttons for CLOSING signals.

The center vertical pair, marked with the words THIS DOOR ONLY, control the OPENING and CLOSING power of the local door adjacent to the ACL.

The LEFT vertical pair control all TRAINLINE doors LEFT of the ACL (facing outboard) in that control zone, on the same side of the train.

The RIGHT vertical pair control all TRAINLINE doors RIGHT of the ACL (facing outboard) in that control zone, on the same side of the train.

4.6 OPERATING COMPARTMENT SIDE DOOR "CLOSED" LIGHT

This BLUE light, labelled DOOR CLOSED, is provided only on the control trailer car. It is located on the Engineman's control compartment LH panel, and comes ON when ALL side doors of ALL cars in the consist are closed. It remains ON even if a "local" side door is opened from its associated Master Side Door Control Panel, or a side door and its associated trap door are in the OPEN position.

4.7 SIDE DOOR CONTROL RELAY PANEL

Components of the door control and signalling system are wired into a relay panel assembly which is located in the No. 2 End vestibule. The panel is mounted in a small switch locker which is built into the inboard vestibule partition wall, on the Left Side of the car.

4.8 PUSHBACK FEATURE

The door operators and extension arm assemblies are designed to allow the door to be pushed back at least four inches at the end of the closing cycle.

The extension arm is equipped with a pushback rod assembly of the pneumatic shock absorber type. If a person or an object is caught in the doorway at the end of the closing cycle, the pushback rod assembly will allow the door to be pushed back without interrupting the door operator closing cycle. Once the doorway is clear, the pushback cylinder pressure will ensure that the door closes fully.

4.9 TRAP DOOR PROXIMITY SWITCHES

A switch is mounted near the foot-operated latch of each trap door. With DOB ON for electrical door operation, this switch, interconnected with the side door closing circuit, prevents electrical door closing if the trap door is not latched down.

If the trap door is lowered when the train speed is above 3 MPH, and the associated Master Side Door Control Panel is not energized by means of its key switch, the door will CLOSE if "DOOR CLOSED" has been previously selected.

4.10 SIDE DOOR CONTROL ZONE SWITCHES (FIG. 4-5)

Two rotary type zone switches are provided in each car. The first is located in the electrical locker at the No. 1 End, and the second is located with the door control relay panel at the No. 2 End. These switches control the zoning of the OPEN and CLOSE signal trainline wires. Each switch has two positions:

THRU — This is the normal operating position of the switch. In this position, the switch contacts, which are CLOSED, permit the OPEN and CLOSE signals to continue along their respective trainline wires.

CUTOUT — This position is used when it is desired to divide the door operation of the train into two or more independent control zones. In this position, the switch contacts are OPEN and prevent the signals from continuing to the next vestibule and/or car(s).

This control zone preselection makes it possible to open only the doors required at station platforms that cannot accommodate all the cars of the train, or to isolate cars being deadheaded (cars inoperative in the train).

The zone switches control the OPEN and CLOSE signal trainline wires for both sides of the vestibule (or car). The trainline circuits of the cab signalling push buttons, door status indication, and operating compartment side door override switch are not interrupted regardless of switch positioning. When the switch is used for zoning purposes, the doors in each independent zone can be operated from any ACTIVE CONTROL LOCATION (ACL) within that zone.

4.11 SIDE DOOR NO MOTION CIRCUIT AND BYPASS SWITCH (FIG. 4-5)

For electric door operation, if the train is moving at 3 MPH or more, a normally connected no motion relay (NMR) circuit prevents the trainline side doors from being opened.

If the no motion circuit malfunctions and prevents side doors opening below 3 MPH, the circuit can be bypassed. The bypass is accomplished by breaking the lead and wire seal and switching the two position toggle switch (SBDN) to the bypass (ON) position up from the normal (OFF) position. This sealed bypass switch, labelled DOOR NO MOTION, is located in the electrical locker on the Door Control Switch Panel. In manual operation mode, SBDN is in the bypass position.

4.12 SIDE DOOR TRACTION INTERLOCK CIRCUIT BYPASS SWITCH (SBDI) (FIG. 4-5)

Also for electric door operation, if the train is moving at 3 MPH or more, any side door opened, when the train is moving, signals a DOOR OPEN condition via the PCS OPEN light (see 2.13.6) and causes a loss of traction power through a normally connected relay interlock.

If the traction interlock circuit malfunctions and prevents application of traction power despite conditions of both a stopped consist and locked/closed side doors, the circuit can be bypassed. The bypass is accomplished by breaking the lead and wire seal on switch SBDI of the Door Control Switch Panel, and moving the switch toggle, labelled DOOR INTERLOCK to the BYPASS position.

The DOOR CLOSED trainlined signal in the operating cab is not turned OFF by any of the following open side door conditions and no power loss occurs:

1. The side door and its associated trap door are open.

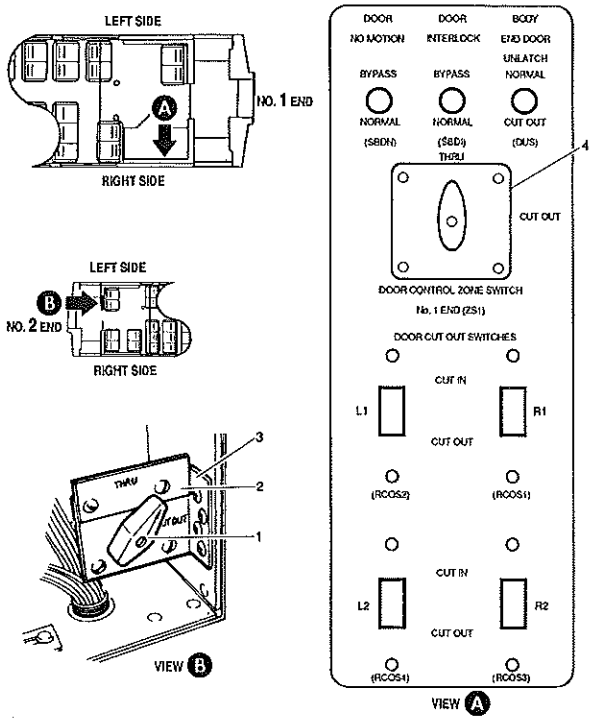
2. The "Local" side door is open and its associated control panel is key-energized.

3. The associated side door operator cutout switch is in the CUTOUT position.

4. The side door mechanical lock is in the LOCKED position and its switch is CLOSED.

5. The side door is closing and its trap door is lowered while the train is traveling at a speed in excess of 3 mph (delay of approximately 6 seconds on dropout of door interlock relay).

6. The side doors are in the manual operation mode.



1. Rotary Selector Switch
   (Shown in Isolated Control Zone Position)
2. Identification Plate
3. Switch Mounting Bracket
4. Rotary Selector Switch
   (Shown in Normal Trainline Operating Position)

Figure 4-5
Trainline Side Door Control Zone Switches
— Control Trailer Car and Blind Trailer Car

NOTE: In manual door operation mode, a consist in service may travel with open side doors. To allow this, SBDN is disconnected and the zero speed door relay circuits are always energized to prevent the issue of unnecessary signal codings at the wheel slide control unit. SBDI remains sealed in normal position.

WARNING: WHENEVER A SEAL IS BROKEN TO REMEDY A MALFUNCTION, THE CIRCUMSTANCES MUST BE REPORTED TO THE AUTHORIZED PERSONNEL.

4.13 SIDE DOOR MECHANICAL LOCK ASSEMBLIES (FIG. 4-6)

The side door mechanical lock arrangement, one at each door location, is a key operated device which consists mainly of a spring-loaded bar assembly. The locks are actuated with the MBTA coach key, and are held by spring pressure in both LOCKED and UNLOCKED positions. Each lock incorporates a switch that cuts out power to the door operator motor when the lock is placed in the LOCKED position and provides a door close signal.

WARNING: THE MECHANICAL LOCK MUST BE PLACED IN THE LOCKED POSITION WHENEVER A DOOR OPERATOR IS ISOLATED AND/OR THE OPERATOR CUTOUT SWITCH IS PLACED IN THE CUTOUT POSITION IN RESPONSE TO A MALFUNCTION.

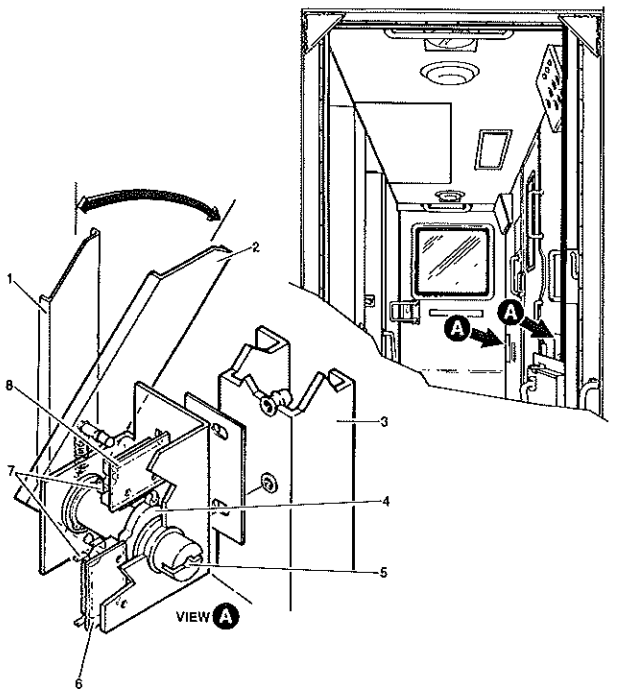
4.14 SIDE DOOR THRESHOLD HEATERS

The side door thresholds (track recessed into hinged trap) are prevented from freezing by means of heating tapes. These heating elements, which work off the car 120 VAC power source, are protected and energized directly by the PHB, 20A, circuit breaker labelled PROTECTIVE HEATERS, which is located on the Car Lighting and Control Breaker Panel in the electrical locker. There is no ON/OFF switch.

The circuit is further controlled by an ambient 41°F thermostat located outside the car on the underframe, and which is discussed in Section 8.

4.15 INTERIOR SLIDING DOOR CLOSER AND CHECK ASSEMBLIES

The two passenger compartment body end doors are sliding doors, and each is equipped with a door closer and check assembly. This arrangement allows the doors to be easily opened manually, and also provides a self-closing feature which closes the door safety and without slamming.



1. Lock Lever (Shown in Unlocked Position)
2. Lock Lever (Shown in Locked Position)
3. Vestibule Wall Corner Post
4. Switch Actuating Cam
5. Coach Key Operated Lock Pin
6. Switch Insulating Plate
7. Door Lock/Door Unlock Limit Switches
8. Switch Insulating Plate

NOTE: Escutcheon Plate removed for clarity.

Figure 4-6
Side Entrance Door Mechanical Lock Assemblies
— Control Trailer Car and Blind Trailer Car

4.16 BODY END DOOR ELECTRO-MAGNETIC LATCH AND CATCH ASSEMBLIES (FIG. 4-6)

An electro-magnetic latch and catch assembly is installed in the door pocket of the body end sliding door at the FULLY OPEN location near the carbody sidewall. The assembly includes a mechanical latch and catch which will HOLD the door panel when the door is manually pushed ALL THE WAY OPEN. The latch and catch can be manually released by pulling the door panel with sufficient force.

The latch and catch assembly also includes an electromagnet (solenoid) which permits remote release of the door latch and catch when the circuit is energized. The circuit is energized when the train is moving above 3 MPH and the door unlatch switch is in the ON position.

This function is provided when side doors are arranged for power or manual operation.

4.17 BODY END DOOR UNLATCH SWITCH (FIG. 4-5)

A two position, NORMAL/CUTOUT, toggle switch labelled DOOR UNLATCH (DUS) is mounted on the RH wall inside the electrical locker.

For normal operation of the body end door latch and catch assemblies, the switch must be placed in the NORMAL position, and the doors will be released upon application of traction power as discussed in the preceding text.

NOTE: The Engineman should return the throttle handle to the **IDLE** position as soon as possible when the train is entering a station. This will enable the train crew or passengers to latch the body end doors open. The Engineman should not open the throttle until the starting signal is given.

The body end doors can be held in the OPEN position, if desired, while the train is moving. The door unlatch circuit is interrupted by placing the DOOR UNLATCH switch in the CUTOUT position. Turn switch back to NORMAL position as soon as possible.

This function is provided when side doors are arranged for power or manual operation.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 5

BRAKE SYSTEM AND PNEUMATIC SUBSYSTEMS

5.1 GENERAL DESCRIPTION

The train utilizes pneumatic and electro-pneumatic equipment to control the air brake operation of the locomotive, control trailer car and blind trailer cars. The electro-pneumatic operation features the addition of certain electrical elements which permit the transmission of electrical signals through trainline wires on the locomotive and control trailer car. In its basic form this system consists of an air compressor which is driven by the locomotive, two continuous pipes (Main Reservoir Equalizing Pipe and Brake Pipe) which are trainlined by means of flexible end hoses, a number of electrical wires which are trainlined by means of jumper cables, plus various reservoirs, valves, and associated devices.

NOTE: In the present text, no reference to the locomotive equipment is made unless necessary. The train consist configuration is assumed to be with the control trailer car leading and the locomotive trailing (pushing).

The Main Reservoir Equalizing Pipe (MR/EP) trainline air is also used to supply the following subsystems:

1. Control trailer car and blind trailer car pneumatic suspension system with air springs and leveling valves. (Refer to Section 10.)

2. Control trailer car air horn, undercar bell, and windshield wiper motor. (Refer to this Section.)

3. Control trailer car sanding valves. (Refer to this Section.)

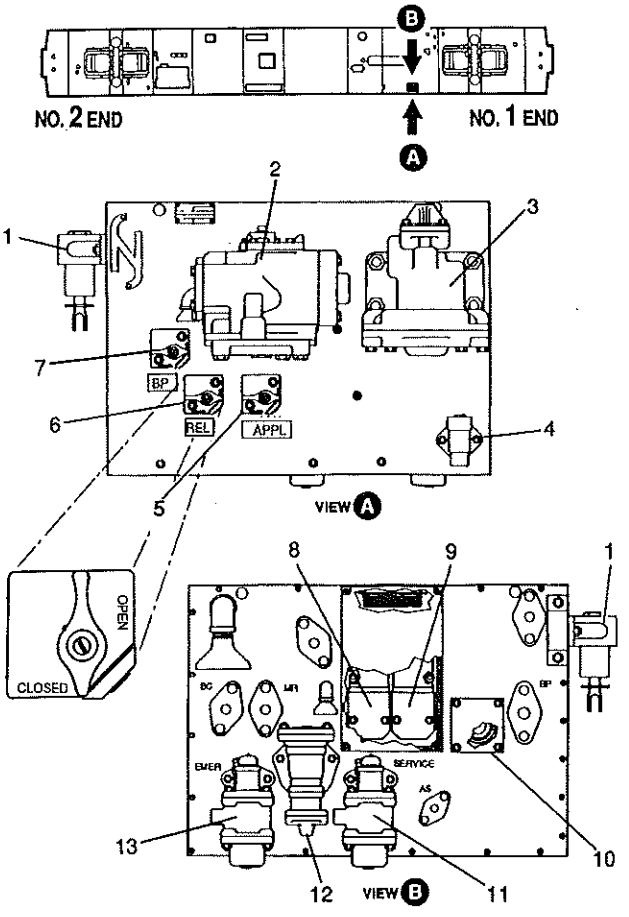
The blind trailer car equipment is the same as the control trailer car except for the omission of the components which are directly associated with the Engineman's control compartment equipment of the control trailer car.

5.2 IMPORTANT FEATURES OF THE BRAKE SYSTEM

The system features include:

A. Undercar control valves installed on a brake control unit (manifold) under Right Side of car.

B. Fast application and release of friction brakes through operation of the apply and release magnet valves, controlled by the triple control switch portion of the brake valve control unit.



1. Reservoir Release Valve
2. 26-C Control Valve Service Portion
3. J-1 Relay Valve
4. Double Check Valve
5. Application Magnet Valve Cutout Cock
6. Release Magnet Valve Cutout Cock
7. Brake Pipe Cutout Cock
8. Application Magnet Valve
9. Release Magnet Valve
10. Filter
11. Service Variable Load Valve
12. Emergency Application H-5 Relayair Valve
13. Emergency Variable Load Valve

Figure 5-1
Brake Control Unit
—Control Trailer Car and Blind Trailer Car

The magnet valves are connected to trainline wires and serve in parallel with the pneumatic signal generated at the brake valve to initiate pneumatic activity instantaneously.

C. "Pneumatic only" brake operation is available in the event of failure of the electro-pneumatic brake controls.

D. Automatic emergency brake system applies the brakes in the event of a component failure or a safety control application. Emergency brake applications are controlled by the trainlined brake pipe. Emergency brake applications can be made with the 26-C brake valve, the B-3-B emergency brake valve, emergency magnet valve, train becoming uncoupled, or ruptured brake pipe.

E. To maintain a predetermined rate of reduction in train speed during braking, a "load-weigh" pneumatic signal to the brake control unit causes adjustment of brake pressure according to car weight (passenger load). This feature applies to both service and emergency brake applications.

5.3 BRAKE SYSTEM EQUIPMENT

The 26-C Type Brake Equipment for "Push-Pull" passenger service is a pneumatic system consisting of the standard 26-type automatic pneumatic brake equipment. This equipment provides a very rapid car brake APPLICATION and RELEASE response within specified train lengths as a result of manual movement of the Engineman's automatic brake valve handle.

Brake valve (Figure 2-8) handle movement controls brake release, graduated service brake application, suppression, handle off, and emergency functions by initiating a pneumatic Brake Pipe signal. The 26-type control valve located at the Brake Control Unit on each car throughout the train then functions according to the pneumatic signal received (Figure 5-1).

The blind trailer car equipment is the same as the control trailer car equipment LESS the following: the brake valve details, the equalizing reservoir details, the safety control details, the penalty brake details, and the train control details. Also, some variations exist in the details and attachments of the Brake Pipe line, the Brake Cylinder Application Pipe line and the Air Storage line.

5.4 BRAKE SYSTEM EQUIPMENT GROUPS

The brake equipment can be divided into three major separate functional groups as follows: Brake Control, Brake Pipe Control and Air Supply. These equipment groups are described as follows:

5.4.1 Brake Control Equipment Group

The function of the brake control equipment is to provide a controlled friction brake delivery pressure to the tread brake units in response to brake pipe control, air spring pressure and wheel slide control. The brake control function is achieved by the 26-C automatic brake valve (control trailer car only), the train control suppression and stop insuring unit (control trailer car only), the brake control unit (control trailer car and blind trailer car), and other electrical and pneumatic devices. The brake control unit provides control for the service brake, emergency brake, brake release, and electro-pneumatic brake. The wheel slide controller and dump magnet valve equipment provide wheel slide control.

A. Service Brake Components

A Service Application is a brake application that results from a controlled BP pressure reduction resulting in the development of BC pressure.

The service brake function relies on the Brake Pipe as a means of control. BP pressure must be maintained at approximately 110 PSI for the friction brake to be RELEASED. During a SERVICE brake application, the 26–C control valve service portion directs Brake Cylinder Application Pipe (BCAP) air to the variable load valve and the J-1 Relay valve in direct proportion to the Brake Pipe pressure reduction. The variable load valve in conjunction with the J-1 relay valve portion limits the BCAP pressure during a FULL SERVICE brake application in proportion to the car air spring pressure present at the time. A lightly loaded car requires a lower BCAP pressure than a heavily loaded car.

B. Emergency Brake Components

An Emergency Application is a brake application that results from a rapid BP pressure reduction to approximately zero initiated by an Emergency Brake valve (B-3-B), the 26-C Brake valve or a Break-in-two. Maximum braking force is therefore built up at a faster rate than for a Service Application. The EMERGENCY brake is provided by almost the same components and devices that provide a SERVICE brake application but it functions in a slightly different manner. Propagation of the emergency rate of BP pressure is assured by the No. 8 vent valve portion of the Reduction Relay valve as well as the No. 8 vent valve, both of which are installed on every car.

The BCAP pressure which is initiated by the 26-C control valve service portion is achieved in the same manner as for the SERVICE delivery pressure except that during an EMERGENCY brake application, the Brake Pipe pressure is exhausted to approximately ZERO. When this occurs, the 26-C control valve service portion provides a BCAP pressure up to 67 to 69 PSI (maximum) as controlled by

the emergency variable load valve.

C. Brake Release Components

In direct pneumatic brake operation, a brake RELEASE can be initiated when the Brake Pipe pressure is recharged to 110 PSI. While in the graduated release mode, the 26-C control valve service portion controls the BCAP pressure in accordance with the INCREASE or DECREASE in Brake Pipe pressure. A reservoir release valve on the brake control unit permits the RELEASE of the control reservoir pressure in the event of an overcharge condition or a possible stuck brake.

D. Electro-Pneumatic Brake Components

This type of brake equipment is often referred to as a Pneumatic Brake with Electrical Assist. The system can perform all train braking functions pneumatically without electric current by control of pressure in the trainlined Brake Pipe. With the addition of electric trainline wires and electro-pneumatic interface devices, changes to brake pipe pressure are transmitted nearly simultaneously on each vehicle in the train. Therefore, the brake system of each vehicle responds in unison to apply or release the brakes with very little time delay between the lead and trailing units. An additional trainline pipe, the Main Reservoir Equalizing Pipe, assures that an adequate supply of air is stored at all times in the Main Reservoirs of each vehicle. The air for these reservoirs is supplied by the locomotive air supply system.

The Electro-pneumatic Control Unit operates application and release magnet valves on all brake control units, operates emergency magnet valves on locomotive and control trailer cars and includes the changing ends protection circuits.

In order to initiate a SERVICE brake application from either the control trailer car or locomotive, the controlling brake valve must be moved manually to the service quadrant. The pressure in a small control volume, called the Equalizing Reservoir, is reduced, causing this sequence of events to occur:

(1) Equalizing Reservoir pressure lowered below brake pipe pressure causes:

(a) brake valve to vent trainlined brake pipe air pressure.

(b) electro-pneumatic control unit to energize all application magnet valves, which will also vent trainlined brake pipe air pressure at each vehicle.

(c) brake control unit on each vehicle to respond and pressurize brake cylinder(s).

(2) Equalizing Reservoir pressure reduces to a value proportional to the degree of brake valve handle movement, then maintains the desired pressure

automatically.

(a) Brake pipe pressure stops exhausting automatically when equal to Equalizing Reservoir pressure.

(b) Electro-pneumatic control unit then deenergizes the application magnet valves at each vehicle.

(c) Control valve maintains brake cylinder pressure proportional to brake pipe pressure reduction on each vehicle.

(3) With supplemental applications, the preceding process is repeated.

E. Train Control Suppression and Stop Insuring System (Control Trailer Car)

The Train Control Penalty Application provides a penalty service brake application in the event that the Engineman fails to acknowledge a more restrictive signal.

The Engineman has the opportunity to suppress a penalty service brake application by applying the service brakes and reducing train speed to the required limit before timing systems automatically make a penalty service brake application.

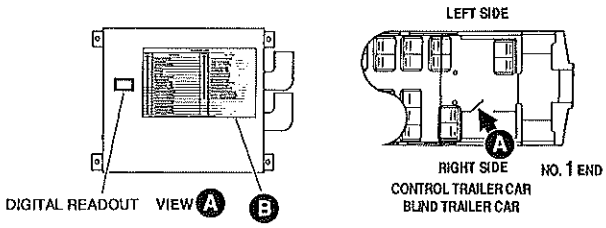
If a penalty brake application does occur, the A-1 charging cutoff pilot valve prevents release of the brakes until the train has come to a complete stop.

F. Wheel Slide Control Components (Fig. 5-2)

Wheel slide control equipment functions to correct a condition where there is a lack of adhesion between the wheel and rail surfaces. This condition exists when the deceleration of the car(s) is different from the deceleration of the wheels themselves during braking. The Wheel Slide Controller provides the means to recognize a wheel slide condition which may be developing during braking on one or both trucks of the car and initiate, through the dump valve assemblies, corrective brake RELEASES and REAPPLICATIONS at a rapid rate until wheel rail adhesion is fully restored. This results in a high level of wheel protection against flat spotting and other wheel tread damages, and ensures minimum stopping distances. Wheel slide control has provisions for not functioning during EMERGENCY braking when a Brake Pipe pressure reduction below 25 PSI actuates the Wheel Slide Controller cutoff switch which in turn, deactivates the dump valves, thus cutting out the wheel slide function.

5.4.2 Brake Pipe Control Equipment Group

The function of the Brake Pipe is to provide a pneumatic control medium. The reduction of BP pressure results in the initiation of a SERVICE or EMERGENCY brake



DIAGNOSTIC CODE			
FAULT CODE	FAULT MODE	FAULT CODE	FAULT MODE
00	NORMAL OPERATION	33	A DUMP VALVE FAILED OFF
01	INITIALIZATION	34	A DUMP MISSING
02	NOVRAM INITIALIZATION	35	A DUMP VALVE STUCK ON
03	CPU FAULT	40	SPEED SENSOR 4 BAD
04	ROM FAULT	41	I / O BOARD AXLE 4 BAD
05	RAM FAULT	70	0-MPH RELAY FAILED OFF
06	REAL TIME CLOCK FAULT	71	0-MPH RELAY FAILED ON
07	NOVRAM USED UP	82	CONFIGURATION FAULT
10	SPEED SENSOR 1 BAD	84	BRAKE RELEASE SWITCH BAD
11	I/O BOARD AXLE 1 BAD	85	WATCHDOG D/DP OUT
12	B DUMP VALVE TIME OUT	86	NO WATCHDOG INTERRUPT
13	B DUMP VALVE FAILED OFF	87	WATCHDOG RELAY DISABLE FLT.
14	B DUMP VALVE MISSING	88	MULTI FLT. WITH SLIP OPERATION
15	B DUMP VALVE STUCK ON	89	MULTI FLT. NO SLIP OPERATION
20	SPEED SENSOR 2 FAULT		
21	I/O BOARD AXLE 2 BAD		
30	SPEED SENSOR 3 FAULT		
31	I/O BOARD AXLE 3 BAD		
32	A DUMP VALVE TIME OUT		
NOTE: REFER TO INSTRUMENTAL PAMPHLET NO. 133 FOR FURTHER INFORMATION			

VIEW B

Figure 5-2
Wheel Slide Controller
— Control Trailer Car and Blind Trailer Car

application depending on the rate of the reduction.

This feature of BP control allows the car or consist to go automatically to the "Brakes On" mode in the event of an adverse air loss operating condition such as a "Break-In-Two". Since a reduction of BP pressure results in the initiation of a brake application, the BP must be charged and maintained at a pressure of 110 PSI nominally for normal running operation. The BP control function on all types of cars is performed essentially by the interactions of a number of components. The BP control equipment uses a combination of trainline and car interfaces to perform its function. The trainline interfaces are the Brake Pipe, air supply, 64/74 VDC battery power and ATC signal. Safety control (Alertness System feature) brake equipment is provided for initiating a PENALTY (FULL SERVICE) brake application when a breach in safety control occurs on a control trailer car being used as the leading unit. Automatic Train Control (ATC) equipment is provided on the control trailer car for initiating a PENALTY (FULL SERVICE) brake application when a violation in Train Control (overspeed or non-acknowledgement) occurs.

A. BP Charging and Maintaining Components (Control Trailer Car)

The Charging of BP air is required for a RELEASE of the brakes. The 26-C brake valve provides this function. Equalizing Reservoir is charged by the Main Reservoir pressure when the brake valve handle is placed in the RELEASE position. The BP is charged until the BP pressure becomes the same as the ER pressure. BP charging is prevented during EMERGENCY as well as PENALTY brake applications.

B. BP Pressure Reduction Components

(1) BP Reduction Caused by 26-C Brake Valve

A service BP pressure reduction is initiated on the control trailer car when the 26-C brake valve handle is moved into the SERVICE zone. When the brake valve handle is moved to the RELEASE position, the reduction of ER and BP air is stopped.

(2) BP Reduction Caused by ATC System

A service BP pressure reduction is also initiated by the control trailer car P-2-A brake application valve during a cab signal penalty application. ER air pressure is first reduced, followed by a reduction in BP pressure which initiates a FULL SERVICE brake application. To prevent a PENALTY (FULL SERVICE) brake application from being initiated by OVERSPEED, the 26-C brake valve handle must be moved into the SERVICE brake position for a PERMANENT SUPPRESSION. If the ATC violation

(OVERSPEED) is not corrected by this action, the handle must be moved to the FULL SERVICE position with the throttle handle in IDLE position to permanently suppress the ATC equipment. (Refer to Section 6). Permanent suppression is not achieved until BP air is reduced by a value of 17 PSI or more. In the event of failure to make a required acknowledgement, the train must come to a FULL STOP before the system can be RESET.

(3) BP Reduction Caused by Pneumatic Safety Control

Safety control brake components are used in conjunction with the train control penalty components to initiate a FULL SERVICE brake application when the Engineman does not acknowledge the in-cab, audible warning signal by actuating the push button acknowledging switch or by actuating the throttle control valve within 6 to 8 seconds as prescribed. In the event of failure to make a required acknowledgement, the P-2-A brake application valve initiates a FULL SERVICE application, and the train must come to a FULL STOP before the system can be RESET.

(4) BP Reduction Caused by a 26-C Brake Valve Initiated Emergency

An emergency BP pressure reduction can be initiated by the control trailer car 26-C brake valve when its handle is placed in the EMERGENCY position to cause an emergency brake application. As the BP air is exhausted at an EMERGENCY rate, both the No. 8 vent valve and reduction relay air valve operate to vent BP air to atmosphere. The additional venting by the No. 8 vent valve and reduction relay air valve aid in the propagation of the BP air reduction to the other cars in the consist. When the 26-C brake valve is actuated as described above, the A-1 charging cutoff pilot valve responds and its action ensures that the car(s) and/or train come to a FULL STOP before the brakes can be RELEASED by placing the 26-C brake valve handle in the RELEASE position. At the same time, the TRACTION CUTOUT (SANDING) and POWER KNOCK OUT pressure switches are actuated. The A-1 charging cutoff valve does RESET automatically after a predetermined delay (approximately one minute) and will permit BP charging; however, the brake valve handle must stay in the EMERGENCY position until the A-1 charging cutoff valve has reset.

(5) BP Reduction Caused by a B-3-B Emergency Brake Valve

An emergency BP pressure reduction can also be initiated by means of any B-3-B emergency brake valve (Figure 5-5), by a rupture in brake pipe line or by parted hoses. The EMERGENCY brake application can be manually initiated from any time or stage of a service brake APPLICATION

or RELEASE condition preexisting in the train. To operate the B-3-B valve, the valve operating lever handle must be pulled DOWNWARD. This causes BP air pressure to be vented to atmosphere at an EMERGENCY rate. The handle must REMAIN in the DOWN position until the EMERGENCY brake application has been fully propagated. Once the emergency situation has been attended to, the B-3-B valve handle must be RESET in the CLOSED position (handle pushed UPWARD) to permit RECOVERY from the EMERGENCY application.

RECOVERY requires that the car brake system equipment be RESET by first placing the handle of the 26-C brake valve in the Engineman's operating compartment to the EMERGENCY position, then following the same procedure for RESETTING the equipment as described in paragraph (4), preceding.

5.4.3 Air Supply Equipment Group

The function of the air supply equipment is to store compressed air for use by the car system and subsystem components. The air supply equipment includes air reservoirs with drain cocks, air filter, strainers, cutout cocks, etc.

A. Pneumatic Trainline Connections (Fig. 1-7 and 1-8)

Two flexible end hoses are located just below the coupler at each car end. The Brake Pipe (BP) line has the larger diameter hose, and the Main Reservoir/Equalizing Pipe (MR/EP) line has the smaller hose. Two dummy hose couplings with retaining chains are also provided.

B. Pneumatic Cutout Cock and Drain Cock Positions (Fig. 5-3 and 5-4)

Refer to Figures 5-3 and 5-4 to locate and identify all undercar pneumatic cutout cocks and drain cocks. The key for each figure indicates whether the cocks are OPEN or CLOSED for normal operation.

(1) Ball Type Cocks

With the exception of the combined dirt collector/BP cutout cock and the reservoir release valve which are discussed separately, the cutout cocks consist of a vented or non-vented ball type valve with a straight, rotating, locking or non-locking handle. They OPEN and CLOSE with one-quarter turn of handle rotation. Most handles have a "Flow Direction Bar" to indicate whether the cock is OPEN or CLOSED. The locking handle is rotated by first squeezing the handle levers together to unlock it, and then rotating the assembly through 90 degrees.

1. Control/Selector Reservoir Drain Plug
2. Truck Brake (Isolation) Cutout Cock
   (NO, Vented with Locking Handle)
3. Main Reservoir Drain Cock (NC, with Locking Handle)
4. MR/EP Air (To Filter/Main Reservoirs) Cutout Cock
   (NO, Non-Vented with Locking Handle)
5. Air Filter Drain Cock (NC)
6. BP Air Cutout Cock (NC, Vented with Locking Handle)
7. Pneumatic Suspension (Isolation) Cutout Cock
8. Sand Box with Fill Cover (NO, Vented with Locking Handle)
9. Brake Pipe End Angle Cutout Cock
   (Open or Closed as Required, Vented with Locking Handle)
10. Main Reservoir/Equalizing Pipe End Cutout Cock
    (Open or Closed as Required, Vented with Locking Handle)
11. Reservoir Release Valve (Spring Return to Closed Position)
12. Brake Control Unit; incorporating Brake Pipe Cutout Cock,
    Application Cutout Cock and Release Cutout Cock

NO - Normally Open NC - Normally Closed

NOTE: For Brake Control Unit, see Figure 5-1

Figure 5-3
Undercar Fill, Drain and Cutout Locations
— Control Trailer Car

1. Control/Selector Reservoir Drain Plug
2. Truck Brake (Isolation) Cutout Cock (NO, Vented with Locking Handle)
3. Main Reservoir Drain Cock (NC, with Locking Handle)
4. MR/EP Air (To Filter/Main Reservoirs) Cutout Cock (NO, Non-Vented with Locking Handle)
5. Air Filter Drain Cock (NC)
6. BP Air Cutout Cock (NC, Vented with Locking Handle)
7. Pneumatic Suspension (Isolation) Cutout Cock
8. Brake Pipe End Angle Cutout Cock (Open or Closed as Required, Vented with Locking Handle)
9. Main Reservoir/Equalizing Pipe End Cutout Cock (Open or Closed as Required, Vented with Locking Handle)
10. Reservoir Release Valve (Spring Return to Closed Position)
11. Brake Control Unit; incorporating Brake Pipe Cutout Cock, Application Cutout Cock and Release Cutout Cock

NO - Normally Open NC - Normally Closed

NOTE: For Brake Control Unit, see Figure 5-1

Figure 5-4
Undercar Fill, Drain and Cutout Locations — Blind Trailer Car

All cutout cocks with vented body have the vent orifice on the downstream side when CLOSED, and serve for isolating and venting subsystems. These cutout cocks have the following handle positions:

OPEN — Handle perpendicular to pipe with "Flow Bar" parallel to pipe.

CLOSED — Handle parallel to pipe with "Flow Bar" perpendicular to pipe.

(2) Car End Cutout Cocks

The Main Reservoir/Equalizing Pipe end cutout cock has a vented body with the vent orifice on the hose side when CLOSED. Its locking handle positions are as described above in paragraph B. (1), preceding.

The Brake Pipe end cutout cock has a vented body with the vent orifice on the hose side when CLOSED. Its locking handle positions are as follows:

OPEN — Handle parallel to pipe with "Flow Bar" parallel to pipe.

CLOSED — Handle perpendicular to pipe with "Flow Bar" perpendicular to pipe.

(3) BP Cutout Cock (Fig. 5-1)

The BP cutout cock on the brake control unit provides a means of manually opening or closing the Brake Pipe air passage at that location and cutting out the brakes on that car when necessary. The cutout cock is OPEN when the handle is horizontal, and CLOSED when vertical. The cock must be OPEN for normal operation.

(4) Reservoir Release Valve (Fig. 5-1)

The reservoir release valve portion of the brake control unit provides a means of manually venting the control reservoir air pressure to atmosphere. It can be used to release brake cylinder pressure on the car.

WARNING: BEFORE THE RESERVOIR RELEASE VALVE IS ACTUATED ON A "SET-OUT" (SINGLE) CAR, THE HANDBRAKE MUST BE APPLIED AND/OR THE WHEELS BLOCKED AT BOTH ENDS OF THE CAR TO PREVENT ACCIDENTAL MOVEMENT.

5.5 IMPORTANT COMPONENTS AND THEIR FUNCTIONS

5.5.1 Control Trailer Car 26-C Brake Valve (Fig. 2-4 and 2-8)

Manual control of the pneumatic brake equipment is accomplished by means of the 26-C brake valve which was previously described in Section 2. Movement of the brake valve handle through the five externally detented

positions provides the following functions:

A. Release (Running) Position

This position is obtained with the handle at the extreme left of the quadrant. It is used for charging the equipment and releasing the brakes by exhausting air from the brake cylinder line after an automatic brake application. In normal pneumatic operation, it is expected that the automatic brake valve handle remain in the RELEASE position to initiate a brake release. In this instance Brake Pipe air should be either fully recharged, or in the process of recharging.

B. Service Zone

This SERVICE zone consists of the "Initial (minimum) Reduction" (detented position), the Service zone itself and the FULL SERVICE position at the right end of that zone. As the brake valve handle is moved through this sector, Brake Pipe pressure reduces gradually and the degree of brake application increases proportionally. When the handle is in the FULL SERVICE position, a total service Brake Pipe reduction is obtained and a full service brake application results.

Movement of the brake valve handle to "Initial reduction" position provides a reduction of nominally (approx.) 6 PSI pressure in the Equalizing Reservoir and Brake Pipe.

CAUTION: A minimum reduction of less than 5 PSI may cause the train brake to release and is not recommended

When the brake valve handle is moved to an intermediate position in the SERVICE zone, the Brake Pipe and Equalizing Reservoir pressures are reduced by the same amount and stabilize at a certain degree between the minimum reduction and the maximum FULL SERVICE 25 PSI reduction; this is due to the self-lapping characteristics of the 26-C brake valve. Depletion of Brake Pipe air pressure below 45 PSI does not result in any higher Brake Cylinder pressure. In fact, SERVICE reductions below 45 PSI are not recommended (see WARNING).

WARNING: UNDER NO CIRCUMSTANCES SHOULD A TRAIN BE PERMITTED TO CONTINUE IN OPERATION IF BRAKE PIPE AIR FALLS BELOW 45 PSI. IN SUCH CASES, THE TRAIN IS TO BE STOPPED AND THE BP AIR RECHARGED TO THE PRESCRIBED SETTING BEFORE PROCEEDING. FAILURE TO COMPLY WITH THIS WARNING MAY RESULT IN THE INABILITY TO CONTROL OR STOP THE TRAIN.

C. Suppression Position

The 26-C brake valve SUPPRESSION position can be used to reset the P-2-A valve to release the brakes after a penalty brake application. At 0 MPH the ATC controls resets,

automatically reenergizing the Penalty Brake Magnet valve.

D. Handle Off Position

The HANDLE OFF position is located to the right of the SUPPRESSION position. The handle is removable in this position by lifting it upward. When not in use, the handle is stored in an overhead box.

WARNING: BEFORE REMOVING THE BRAKE VALVE HANDLE, SPECIAL ATTENTION IS REQUIRED TO MAKE SURE THAT THE BRAKE PIPE PRESSURE IS DEPLETED TO "0" PSI, THAT THE BRAKE CYLINDER PRESSURE IS APPLIED TO THE LOCOMOTIVE, AND THAT THE PROPER PROCEDURES ARE FOLLOWED FOR CUTTING OUT BRAKE OPERATION CONTROL ON THE CONTROL TRAILER CAR. FAILURE TO COMPLY WITH THESE INSTRUCTIONS MAY RESULT IN UNINTENTIONAL CAR OR TRAIN MOVEMENT WHICH COULD POSSIBLY CAUSE DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL.

E. Emergency Position

The EMERGENCY position is located at the extreme right of the quadrant. This position immediately initiates an EMERGENCY brake application. The movement of the 26-C Brake Valve handle to the EMERGENCY position causes the 26-C valve to exhaust Brake Pipe air directly to atmosphere (pneumatic function).

The train brakes are not intended to be RELEASED following an EMERGENCY brake application, initiated from whatever source, until the appropriate devices have been RESET. This is accomplished by placing the handle in the RELEASE position after the train has come to a FULL STOP. If an EMERGENCY brake application was initiated by a device other than the automatic brake valve handle, or as the result of a "break-in-two", the handle must first be moved into the EMERGENCY position. After waiting approximately one minute, the handle must then be moved into the RELEASE position to RESET the equipment as discussed in the preceding text.

5.5.2 B-3-B Emergency Brake Valve (Fig. 5-5)

There are two of these valves in each blind trailer car and three on each control trailer car. This valve allows crew members to initiate an EMERGENCY brake application. Manual operation DOWNWARD of the valve handle and HOLDING it in the FULLY APPLIED position will vent air from the Brake Pipe at the E-3 brake application valve to atmosphere. This device must be RESET manually.

5.5.3 ATC System Acknowledging Push Button (Fig. 6-3)

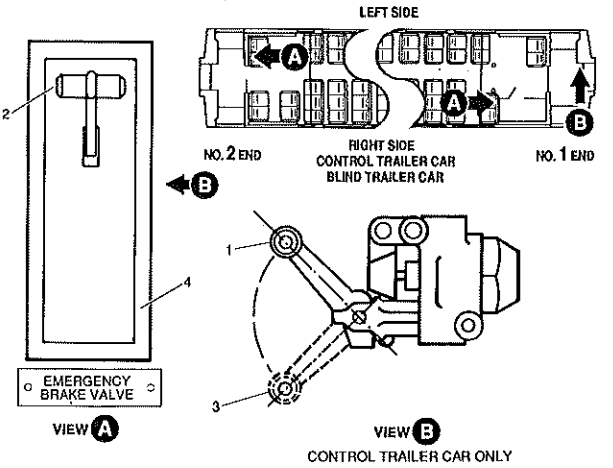
When the cab signal changes to a more restrictive indication, an audible in-cab warning signal sounds until acknowledged by actuating the acknowledging push button on the Aspect Display Unit. If the downward speed request is not acknowledged within the specified time of 6 to 8 seconds, an irretrievable (full stop) penalty brake application, at full service rate with loss of propulsion, is automatically initiated by the ATC system.

5.5.4 P-2-A Brake Application Valve (Fig. 2-4)

The P-2-A brake application valve, in conjunction with other components, is designed to reduce Equalizing Reservoir pressure to a FULL SERVICE brake application level, after a pre-determined delay period has elapsed, should an ATC or safety control violation be present. With the 26-C brake valve in the CUTOUT mode (cutoff pilot valve) and the control trailer car trailing, the P-2-A internal suppression valve isolates the penalty brake application valve (ATC System) and the Alertor magnet valve (Alertness System). This prevents the initiation of a Penalty Brake application by these devices. The P-2-A valve provides permanent pneumatic SUPPRESSION of impending PENALTY brake applications, and generates a pneumatic power knockout signal from Main Reservoir air pressure during PENALTY brake applications. The valve is located below the Engineman's control compartment console.

5.5.5 Penalty Brake and Alertor Magnet Valves and Cutout Cocks (Fig. 5-6)

The penalty brake and Alertor magnet valves and cutout cocks are used in this piping arrangement to pilot the operation of the P-2-A brake application valve in the event of a train control violation. The penalty brake and Alertor magnet valves are normally energized and act as the pneumatic/electrical interface between the train control circuitry and P-2-A brake application valve. The penalty brake valve and cutout cock is governed by the ATC system equipment while the Alertor magnet valve is governed by the Alertness system. Both trigger the operation of the P-2-A valve as discussed in the preceding text. The valves are located above the Engineman in the control compartment ceiling. A cutout cock with a RED, non-locking handle, sealed (lead and wire) in the OPEN position is installed in the piping to each magnet valve. The function of the cutout cocks is to provide a means for cutting out the pneumatic stop assurance equipment when required.

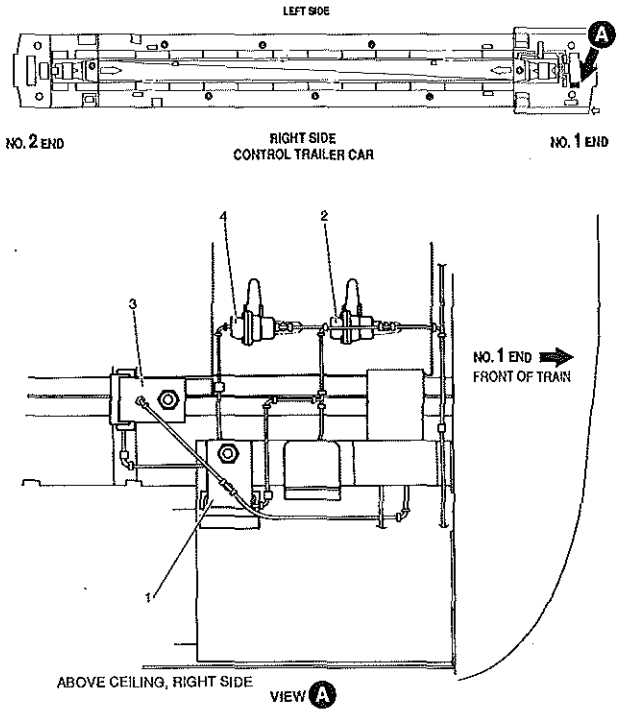


1. Release and/or Reset Position
2. Emergency Handle Coded Red
3. Handle Pulled and Held to apply Brakes
4. Enclosure Recessed into Partition Wall

CONTROL TRAILER CAR ONLY

NOTE: Location of emergency brake valve at No. 2 End is typical for all types of cars. An emergency brake valve is located in the No. 1 End vestibule on control trailer cars only.

Figure 5-5
B-3-B Emergency Brake Valves
— Control Trailer Car and Blind Trailer Car



1. Penalty Brake Magnet Valve
2. Penalty Brake Magnet Valve Cutout Cock (shown in Open position)
3. Alertor Magnet Valve
4. Alertor Magnet Valve Cutout Cock (shown in Open position)

Figure 5-6
Penalty Brake and Alertor Magnet Valves and Cutout Cocks — Vestibule Ceiling, Engineman's Control Compartment, No. 1 End — Control Trailer Car

5.5.6 Penalty Brake Application Pressure Switch (APS) (Fig. 5-7)

This pressure switch is located in the electrical locker of the control trailer car, on the forward wall above the Speed Recorder Box. It is used to light the Red PENALTY APPLICATION indicating light located on the Engineman's control compartment console. When ON, this light indicates that a train control PENALTY (FULL SERVICE) brake application has been initiated by the Cab Signal/ATC equipment.

5.5.7 ATC Suppression Indicator Pressure Switch (SPS) (Fig. 5-7)

This pressure switch is located in the electrical locker of the control trailer car, on the forward wall above the Speed Recorder Box. It is used in the PENALTY brake portion of the equipment as a pneumatic/electrical interface between the FULL SERVICE indication signal and the electrical train control. This switch lights the White SUPPRESSION indicating light, located below the ATC Aspect Display Unit on the Engineman's control compartment console, when the 26-C brake valve is moved to FULL SERVICE to prevent the penalty brake. (Refer to Section 6).

5.5.8 Traction Cutout (Sanding) Switch (TCSPS)

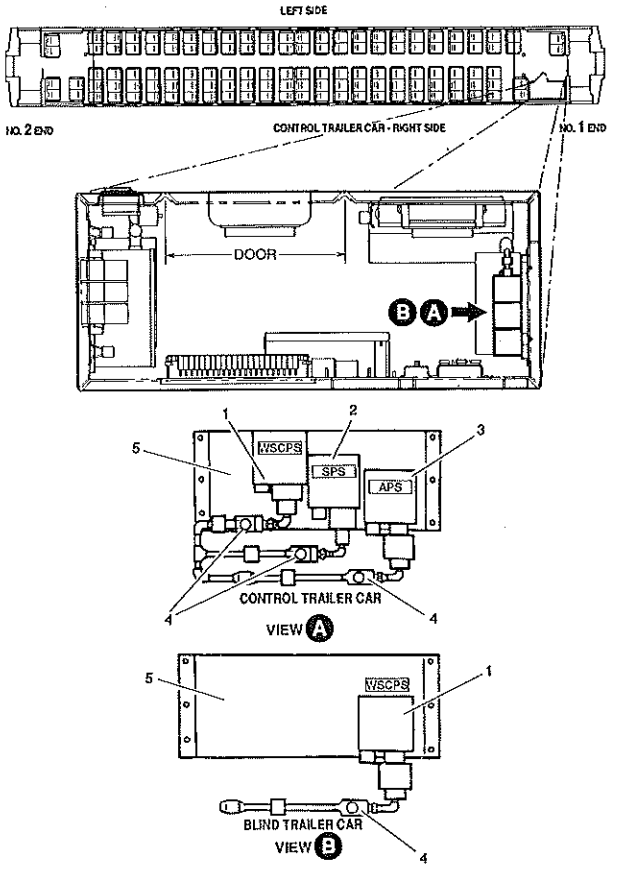
This pressure switch is located on the manifold under the Engineman's control compartment console. This pressure switch functions to CUT OFF locomotive traction power and actuate sanding devices when triggered by any EMERGENCY brake application.

5.5.9 Power Knockout Pressure Switch (PKOPS)

This pressure switch is located on the manifold under the Engineman's control compartment console. It is actuated in the event of an EMERGENCY brake application or a PENALTY brake application, and functions to CUT OFF locomotive traction power and light the PCS OPEN warning light on the console left hand panel.

5.5.10 Brake Control Unit (Fig. 4, 8 and 5-1)

The brake control unit is mounted undercar, between the XB-6 and XB-7 crossbearers, on the right side of all cars. The unit consists of a number of standard air brake devices, mounted on a common laminated manifold, acting as an interface between pneumatic and electrical control input and subsequent pneumatic output commands to the tread brake units. The electrical input is that required for electro-pneumatic brake operation. The pneumatic inputs are the Brake Pipe pressure, the Main Reservoir pressure, and the air spring pipe pressure. The principal devices which are mounted on the Brake Control unit are the 26-C control valve



1. Wheel Slide Calibration Pressure Switch (WSCPS)
2. Suppression Pressure Switch (SPS)
3. Alertor Pressure Switch (APS)
4. Test Fitting
5. Pressure Switch Panel

Figure 5-7
Wheel Slide Calibration Pressure Switch, Suppression Pressure Switch and Alertor Pressure Switch — Electrical Locker, Control Trailer Car and Blind Trailer Car

service portion, service and emergency variable load valves, emergency H-5 Relayair valve, J-1 relay valve, electro-pneumatic controller magnet valves, reservoir release valve, three cutout cocks, etc. For normal operation all cutout cocks must be OPEN (IN position).

5.5.11 Wheel Slide Controller (Fig. 5-2)

The Wheel Slide Controller and associated dump valve assemblies are the main components of the Wheel Slide control equipment. On these cars, the equipment is arranged to operate in both SERVICE and EMERGENCY applications as determined by the Wheel Slide cutoff pressure switch. The controller circuits are fed 74 VDC through the WSB, 10A, circuit breaker labelled WHEEL SLIDE, on the Car Lighting and Control Breaker Panel and are further controlled by the POWER toggle switch located inside the controller.

The Wheel Slide controller is located in the electrical locker at the No. 1 End, on the inside of the access door. A window located on the upper left corner of the top-hinged cover, next to the diagnostic code chart decal, allows a view of the digital readout. This readout constantly monitors the operation of the Wheel Slide controller. Under normal operating conditions, when the POWER toggle switch is placed in the ON position, the digital readout shows that the controller is going through an initial check routine. After the check, the readout should read "00" (zero/zero) to indicate that the controller is ready to operate.

5.5.12 Dump Valve (Fig. 4 and 8)

There is one dump valve located undercar in proximity of each truck, two per car. The valve, which is installed in the Brake Cylinder Application Pipe leading to the truck tread brake units, consists of an electrically operated magnet valve portion and a relatively high capacity venting portion, both of which are mounted on a common pipe bracket. The control valves respond to signals from the Wheel Slide controller to vent brake cylinder pressure as required.

5.5.13 Wheel Slide Cutoff Pressure Switch (EDCO) (Fig. 4 and 8)

This pressure switch is located undercar, between crossbearers XB-6 and XB-7, on the Right Side of all cars. The Wheel Slide cutoff pressure switch has provision to CUTOUT the wheel slide protection during an EMERGENCY brake application. For more details, refer to Running Maintenance Manual.

5.5.14 No. 8 Vent Valve and Reduction Relayair Valve (Fig. 4 and 8)

The No. 8 vent valve is located undercar at the No. 2 End of all cars. This valve is designed to operate during an EMERGENCY rate Brake Pipe reduction at the valve. It is designed to locally vent Brake Pipe air to atmosphere on each car, and thus assist in the propagation of an EMERGENCY rate of Brake Pipe air reduction throughout the train. The reduction relayair valve is located at the No. 1 End of all cars, and it is designed with the same purpose as the No. 8 vent valve. It is also used to improve Brake pipe exhaust in normal service braking condition.

5.5.15 A-1 Charging Cut-Off Pilot Valve (Control Trailer Car)

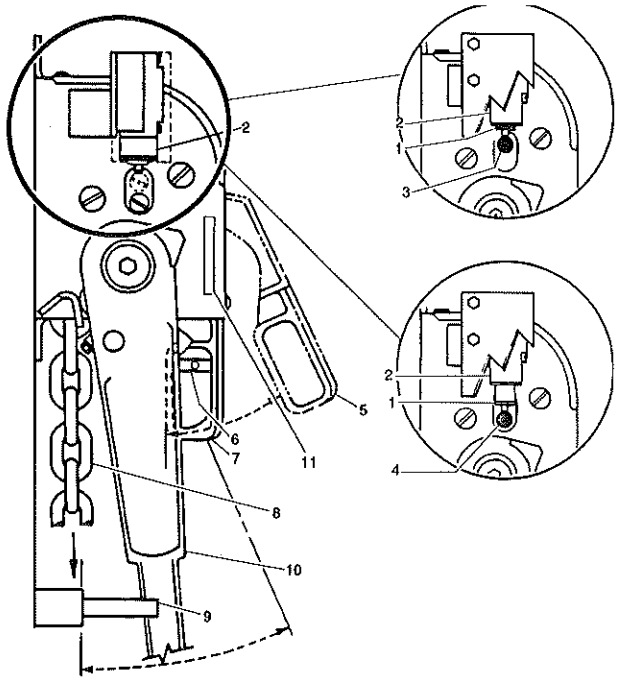
The A-1 charging cut-off pilot valve ensures emergency brake applications for all vehicles in the train. The valve is used on the control trailer car only. This valve cuts off brake charging at the 26-Type brake valve during any emergency or penalty brake application and sends a pneumatic signal to the Traction Cut Out (sanding) pressure switch. The A-1 charging cutoff pilot valve prevents release of the brakes until the train has come to a complete stop.

5.5.16 Brake Pipe Air Cutout Cock, "Dead Engine" (Car) Fixture (Fig. 5-3 and 5-4)

A C-1-3-8 combination strainer and check valve, as well as a cutout cock, are installed in a BP branch pipe leading to the air filter line which, in turn, is coming from the 2nd main reservoir. These components are accessible undercar, near the center line of the control trailer car, between the XB-6 and XB-7 crossbearers. The cutout cock with locking handle and the associated components constitute the "dead engine" (car) fixture. The fixture is provided to allow operation in a consist should there be no Main Reservoir air supply and/or for hauling "dead". With the brake equipment CUT OUT in the Engineman's control compartment and the undercar fixture cutout cock OPEN, the control trailer car can be used in a train consist using only Brake Pipe pressure. For normal operation, the fixture cutout cock must be kept CLOSED.

5.5.17 Handbrake Unit (Fig. 1-5 and 5-8)

A handbrake unit is mounted on the collision post on the Left Side of the No. 1 End vestibule of all types of cars. This is a gear/chain type handbrake which operates in harmony with the tread brake units equipped with a handbrake lever assembly. It is capable of delivering a force equal to or greater than the service air brake. The braking force which is produced by operating the APPLY lever on the handbrake unit, is exerted on two tread brake



1. Switch Plunger
2. Brake "Applied" Switch
   (Protection Cover Not Shown for Clarity)
3. Pin in Upper "Applied" Position
4. Pin in Lower "Released" Position
5. Trip Lever Lifted in "Release" Position
6. Chain Weight and Rubber Snubber in "Released" Position
7. Trip Lever in "Apply" Position
8. Chain
9. Lever Retaining Spring Clip
10. Handbrake Apply Lever
11. Inspection Label

Figure 5-8
Chain Type Handbrake with Indicator Switch — Control Trailer Car and Blind Trailer Car

shoes (Wheels No. 1L and 2L) of the No. 1 End truck through a steel chain and pullrod combination. A limit switch is mounted on the handbrake unit housing. When the handbrake is APPLIED, the switch is actuated by the holding pawl pin. With the latter in its uppermost position, the switch contacts CLOSE a trainline circuit provided for energizing the AMBER brake applied lights, on each side of the car, as well as preventing the Brakes Released signal from reaching the control trailer car.

The handbrake is APPLIED by operating the largest of the two levers on the unit. The APPLY lever is pulled upward (pumping action) until the resistance felt indicates the handbrake is APPLIED. The smaller RELEASE lever must not be manipulated in any way while the handbrake is being set.

WARNING: IF HANDBRAKE APPLICATION CANNOT BE ASSURED, AND ACCIDENTAL MOVEMENT OF THE CAR MUST BE PREVENTED: USE WHEEL CHOCKS.

The handbrake is RELEASED by pulling on the small RELEASE lever after the large APPLY lever has been returned to its retainer spring clip position, as far as it goes. The handbrake is FULLY RELEASED when the chain weight and its rubber snubber come up against the bottom of the handbrake housing.

CAUTION: Since a car must NEVER be operated with the handbrake PARTIALLY APPLIED, make sure the chain weight/rubber snubber are up against the bottom of the housing. If not, the handbrake must again be FULLY SET and then RELEASED. If FULL RELEASE cannot be assured, damage may result from car operation.

5.5.18 Brake Status Lights (Fig. 1 and 5)

Two triple light fixtures with AMBER, GREEN & WHITE lenses are externally mounted at diagonally opposed corners of the car.

The AMBER Brakes Applied signal light is energized when both the No. 1 End and No. 2 End pneumatic brakes or the handbrake on that car are applied.

The GREEN Brakes Released signal light is energized when all the brakes including the handbrake on that car are released.

The WHITE Electro-pneumatic Brakes Applied signal light is energized when the electro-pneumatic braking is in effect.

5.6 AUXILIARIES

The control trailer car is equipped with several auxiliary devices operating from the brake system air supply. They are presented in Sections 1 and 2 of this manual and consist of the following:

— Pneumatic air horn and associated components.
(Refer to Sections 1 and 2)

— Pneumatic bell undercar and associated components.
(Refer to Section 2)

— Pneumatic windshield wiper motor and associated components.
(Refer to Section 2)

— Sanding traps and associated components.
(Refer to Section 2)

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 6

CAB SIGNAL/ AUTOMATIC TRAIN CONTROL SYSTEM/ ALERTNESS SYSTEM AND SPEED RECORDER SYSTEM

6.1 ATC SYSTEM GENERAL DESCRIPTION

The control trailer car is equipped with Cab Signal and Speed Control System equipment. This equipment constitutes a train (locomotive and control trailer car) carried system which is capable of enforcing specific speed limits as received from the coded rail current when operating in cab signal territory. The system continuously monitors the coded information received through the rails and continuously displays the corresponding signal aspect. This system also allows operation in non-cab signal territory and incorporates a departure test set capable of insuring the operational integrity of the equipment. This system is commonly called ATC System (Automatic Train Control).

6.1.1 Operational Features of ATC System

The complete integrated Cab Signal/Automatic Train Control system provides for the following:

A. A continuously controlled and constantly visible speed aspect cab signal, displaying the coded information transmitted through the rails by the wayside signal system and a visible display of the train speed.

B. The requirement that the Engineman "acknowledge" whenever the cab signal aspect changes to a more restrictive condition and take action to reduce the train speed whenever it exceeds the speed required by the cab signal system.

C. Locomotive power removal and automatic brake application (by the ATC) if the Engineman acknowledges a downward signal change, but fails to manually initiate braking (by means of the 26-C brake valve) after a preset period of time, if train speed exceeds the limit required by the new cab signal aspect.

D. Loss of propulsion and an irretrievable full stop (penalty) brake application if the Engineman fails to acknowledge a more restrictive cab signal indication within a preset time (6 to 8 seconds).

E. Cancellation of the brake application order, initiated by the ATC system, when train speed is at or below the level required by the cab signal aspect displayed, provided the proper actions have been taken by the Engineman.

F. An audible warning when the cab signal changes to a more restrictive aspect irrespective of train speed. This alarm also sounds when the train speed exceeds the speed required by the cab signal system.

G. A Red OVERSPEED light indication when the train speed exceeds the speed required by the cab signal. The light flashes when a penalty brake application has been initiated.

H. Manual initiation of the automatic departure test procedure from the control trailer car Engineman's control compartment.

6.1.2 SPEED LIMITS (FIG. 6-1)

The speeds authorized by the NORAC Operating Rules, displayed by the cab signals, and enforced by the ATC equipment are as follows:

A. Normal Speed (GREEN aspect)

The maximum authorized speed.

B. Limited Speed (YELLOW over GREEN aspect)

For passenger trains, not exceeding forty-five (45) miles per hour; for freight trains, not exceeding forty (40) miles per hour.

C. Medium Speed (YELLOW aspect)

Not exceeding thirty (30) miles per hour.

D. Restricted Speed (RED aspect)

Prepared to stop within one-half the range of vision, short of train, obstruction, or switch improperly lined, looking out for broken rail, but not exceeding twenty (20) miles per hour outside interlocking limits, nor fifteen (15) miles per hour within interlocking limits. Speeds applies to entire movement.

6.1.3 Restrictive Signal Indication and Alarm

When the cab signal changes to a more restrictive indication, an audible in-cab warning signal sounds until the Engineman acknowledges the signal change by actuating the acknowledging push button on the Aspect Display Unit. If the downward speed request is not acknowledged within a specified time (6 to 8 seconds), an irretrievable (full stop) penalty brake application at full service rate with loss of propulsion is automatically initiated by the ATC system.

CODE NAME	ASPECT DISPLAY	CODE RATE	MAXIMUM OPERATING SPEED
NORMAL	GREEN	180	90 MPH
LIMITED	YELLOW GREEN	120	40 or 45 MPH
MEDIUM	YELLOW	75	30 MPH
RESTRICTED	RED	NO CODE	15 or 20 MPH

NOTE : These cab signal aspects are displayed on the Engineman's controlcompartment combined cab signal and speed indicator panel (Aspect Display Unit).

Figure 6-1
Cab Signal Aspect and Speed Limits
— Control Trailer Car

6.1.4 Overspeed Detection and Alarm

An audible in-cab alarm automatically sounds and the OVERSPEED indicating light illuminates when train speed exceeds the authorized speed of the cab signal Aspect Display Unit (ADU).

Failure by the Engineman to lower the speed within a specific period of time results in an automatic penalty brake (FULL SERVICE rate) application. The time allowed for the Engineman to comply is from 6 to 8 seconds.

The OVERSPEED aspect light flashes in the event of a penalty brake application and extinguishes when the vehicle reaches zero speed. The alarm shuts off once train speed is below the cab signal indicated speed.

Once a penalty brake is initiated, the train is brought to a full stop. The failsafe zero speed signal is effective during a train velocity ATC initiated penalty and prevents reenergization of the penalty brake magnet valve until the train has stopped. This feature is known as "Stop Insuring". The master controller throttle handle must also be moved to the IDLE position to recover from this penalty. These two conditions will permit reenergization of the penalty brake magnet valve.

To restart, the brake system (P-2-A valve) must be reset. This can be initiated provided the 26-C brake valve handle is first moved to the SUPPRESSION position (P-2-A will reset). Then, the 26-C brake valve handle must be placed in the RELEASE position to restore brake pipe pressure and regain propulsion power using the master controller.

6.1.5 System Power Supply

The Cab Signal/ATC System operates from the 74 VDC (52 to 80 VDC) power source of the control trailer car. The system equipment is protected and energized by the train control, TCB, 10A, circuit breaker which is located on the Train Control Circuit Breaker Panel.

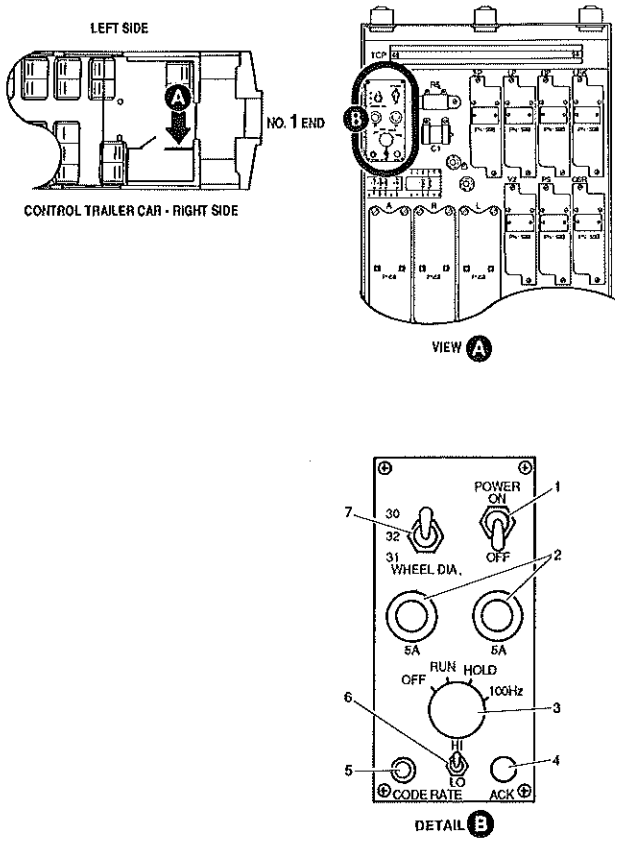
The battery charger, BCB, 10A, input circuit breaker located in the Main Power Breaker Panel undercar, must also be ON.

6.2 CAB SIGNAL AND SPEED CONTROL SYSTEM EQUIPMENT ARRANGEMENT

The cab signal and speed control system equipment, which is found in separate units, consists of the ATC Equipment Shelf, F42 Converter, Aspect Display Unit and Control Trailer Car Interface equipment.

6.2.1 ATC Equipment Shelf (Fig. 6-2)

The ATC Equipment Shelf is located in the electrical locker and is accessible from the key operated door of the lower left access door in the passenger compartment.



1. ATC Equipment Shelf "POWER ON" Switch
2. Fuses, 5A
3. Local Test Rotary Switch
4. Acknowledging Test Switch
5. Code Rate Indicating Light (LED)
6. Departure Test Selector Switch
7. Wheel Wear Switch (WWS)

Figure 6-2
Wheel Wear Switch/Local Test Switch
on ATC Equipment Shelf
— Control Trailer Car

It contains all the relays and solid state circuitry necessary for the cab signal and speed control system operation. The shelf is supported at the top, rear and bottom by compression type rubber mountings to protect the equipment from shock and vibration.

6.2.2 Wheel Wear Switch (WWS) — Maintenance Use Only (Fig. 6-2)

The wheel wear switch is a three-position toggle switch located in the top Left Side of the shelf directly above the resistor board. The top position is for 30 in. wheel diameter, the center position is for 32 in. wheel (plus or minus) and the bottom position is for a 31 in. diameter wheel.

This switch, in conjunction with its associated speed governor circuit, provides a means for correcting the effect of wheel diameter differences due to wear or grinding.

6.2.3 Local Test Switch on ATC Equipment Shelf — Maintenance Use Only (Fig. 6-2)

The operation of the switch is shown through this test sequence:

A. Ensure that vehicle is fully stopped.

B. Place brake handle in FULL SERVICE position.

C. Place Reverser key to the FORWARD position.

D. Place the LOCAL TEST switch to the RUN position and check that the CODE RATE indicator flashes at successively higher code rates and, upon reaching 180 code rate, then flashes at successively lower code rates until the indicator is on steady. The ACK push button must be depressed for each more restrictive (lower) code rate to continue.

NOTE: Failure to depress the ACK push button at each more restrictive code rate will result in a penalty brake application.

E. Place the LOCAL TEST switch to OFF and then back to ON.

F. As the code rate changes, ensure that placing the switch in the HOLD position causes the code rate to remain at its current value.

G. Always return the LOCAL TEST switch to the OFF position when test is complete.

H. Place the local test switch at the 100 Hz position. The presence of a continuous 100 Hz signal is indicated by the CODE RATE indicator not flashing.

6.3 CONTROL TRAILER CAR INTERFACE EQUIPMENT

This consists of all the external connections and devices on the control trailer car that interface with the ATC Equipment Shelf. All external connections are made to the undercar equipment box via terminal blocks.

6.3.1 Track Receivers (TR1-TR2)

The track receivers are mounted, one above each rail, in front of the leading wheels of the No. 1 End truck. The receivers are made up of a pair of laminated iron bars, on each of which is a molded coil and a fiberglass protector. They are arranged with the core parallel to the plane of the tracks and perpendicular to the rails. The mounting arrangement is such that the centerline of the core is located between 6-1/2 in. to 9-1/2 in. above the top of the rail. The track receivers are disconnected when the Cab Signal Control Switch, on the left side of the shelf, is in the OUT position.

6.3.2 Wheel Speed Sensor (SS5)

The ATC System wheel speed sensor is an electromechanical device which is coupled to the No. 1 End Truck, Wheel 2R, in such a manner that an AC waveform is produced, the frequency of which is proportional to the rotational speed of the axle (and, thus, to speed of car). The alternating voltage is produced by rotating a steel gear (toothed ring) past the sensor stationary coil which is wound on a permanent magnet, the rotating gear being coupled directly to the axle.

A speed signal conditioning circuit processes the magnetic pickup signals to provide exact noise free output pulses which are used by the Shaper Limiter/Velocity Zero/Flasher PC board and the Speed Governor PC board circuits.

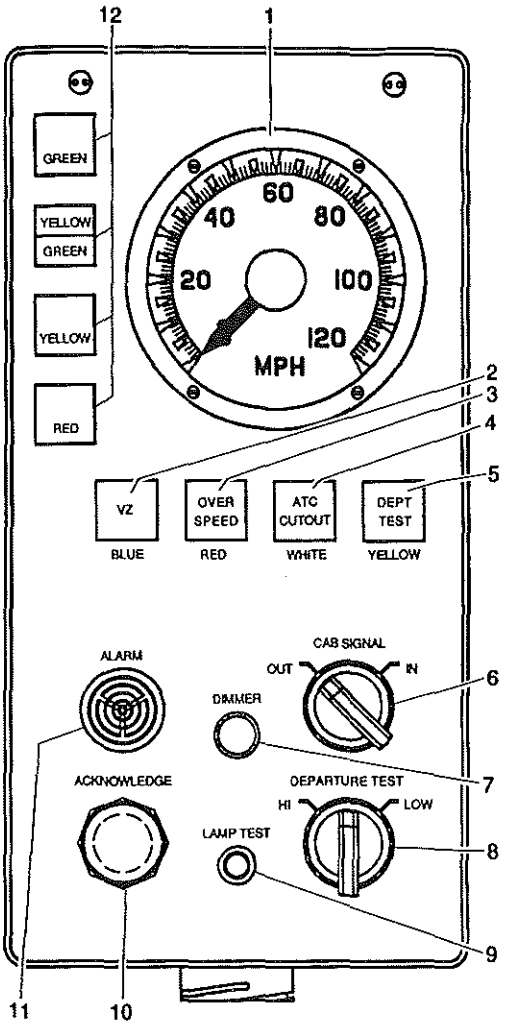
6.3.3 Aspect Display Unit (ADU) (Fig. 6-3)

The Engineman is provided with constantly visible speed and cab signal aspects by means of the display unit which includes a speed indicator (speedometer) and speed aspect indicator lights, four status indicators, dimmer, alarm and test circuit controls.

The Engineman's control compartment Aspect Display Unit panel contains the following devices:

A. Speed Indicator Dial Face

The speed indicator (speedometer) is a pointer type indicator with an illuminated round dial face. This dial face is graduated from 0 to 120 MPH, with numerals in 20 MPH increments and graduations in 2 MPH increments.



1. Speed Indicator (Speedometer)
2. Velocity Zero Indicator (BLUE)
3. Overspeed Condition Indicator (RED)
4. Speed Control Cutout Switch Indicator (WHITE)
5. Departure Test Indicator (YELLOW)
6. Cab Signal Speed Control Rotary Switch (BLACK)
7. Rotary Dimmer Control
8. Departure Test Selector Switch
9. Lamp Test Switch
10. Acknowledging Push Button (RED)
11. "Sonalert" Speed Control Audible Alarm
12. Cab Signal Speed Aspect Indicators

Figure 6-3
Cab Signal Aspect Display Unit/Speedometer Unit and Auxiliary Controls, Engineman's Control Compartment, RH Panel — Control Trailer Car

B. Cab Signal Speed Aspect Indicators

Four cab signal speed aspect indicators are located at the left of the speedometer. These consist of symbols which physically correspond to the permitted speeds as shown in Figure 6-1. These four indicators are illuminated (one at a time) to indicate the authorized speed limit.

These indicators are as follows:

RED: Indicates RESTRICTED speed: 15 or 20 MPH.

YELLOW: Indicates MEDIUM speed: 30 MPH.

YELLOW/GREEN: Indicates LIMITED speed: 40 or 45 MPH.

GREEN: Indicates NORMAL speed: 90 MPH. Faster speeds will result in an automatic brake application.

C. Status Indicators and Lamp Test Button (Fig. 6-3)

Four status indicators and one push button switch, labelled LAMP TEST, are located below the speed indicator dial.

VZ: Indicates velocity zero. This BLUE indicator is ON when the train is not moving and will go OFF at train speeds in excess of 3 MPH.

ATC CUTOUT: This WHITE indicator is ON when the Speed Control Cutout Switch is in the OUT position.

OVERSPEED: This RED indicator is ON when an overspeed condition exists, and it will go into the flashing mode upon initiation of an automatic penalty brake application.

DEPT TEST: This YELLOW indicator is ON when the DEPARTURE TEST switch is held in the LO or HI position.

LAMP TEST: This switch is used to test the lamp of the VZ, ATC CUTOUT and OVERSPEED indicating lights only.

D. Dimmer Control

This rotary dimmer control is located above the lamp test switch of the Aspect Display Unit front panel, and is used to reduce the brilliance of the speed indicator lighting. The dimmer control does not, however, extinguish the speed indicator lighting.

E. Cab Signal Speed Control Switch (SCSW)

This rotary selector switch has two maintained positions labelled IN and OUT. When the train operates in cab signal territory, the switch must be placed to IN position and when train operates in a non-cab signal territory, the track receivers are to be disconnected and the switch must be placed to OUT position. When the train is entering cab signal territory an alarm sounds, and the switch must be turned from OUT to IN and the acknowledging push button (AS) must be actuated within 6 to 8 seconds to avoid an automatic penalty brake application. In an overspeed condition, the train speed must be reduced below the cab signal speed requirement within the allowed time to avoid an automatic penalty brake application.

F. "Sonalert" Speed Audible Alarm (AA)

This audible alarm located to the left of the CAB SIGNAL territory mode switch, sounds during an overspeed condition or when cab signal changes to a more restrictive speed. The alarm continues to sound until the speed falls within the acceptable limits.

G. Acknowledging Red Push Button (AS)

This RED push button acknowledging switch must be pushed after a change to a more restrictive speed to suppress the alarm and extinguish its internal flashing light.

6.3.4 Track Receivers Interface Circuit with the ATC Equipment Box

Placing the traction key switch (TKS) in the F (forward) position energizes the FOR relay coil, connecting the two ATC pickup coils (TR1-TR2) to the 100 Hz filter in the ATC control box. When the master controller throttle handle is moved to #1 or higher position to start the train, the FOR relay remains energized only if the forward direction is chosen and the GENERATOR FIELD, GFB, 20A, circuit breaker is ON.

NOTE: The cab signal simulation test circuit output signal is also coupled to the same input of the 100 Hz filter. Note that the track receiver pickup coils are not tested during the simulation test.

6.3.5 Automatic Cab Signal/ATC Departure Test Set (On-Board)

The ATC system is supplied with an on-board automatic cab signal departure test circuit which permits operational checks of the Cab Signal/ATC system. For normal departure test, train must be stopped and the 26-C brake valve handle moved to the FULL SERVICE or SUPPRESSION position. To activate the test set, the departure set switch must be held either in the LO or HI position.

In the HI position, the test automatically cycles through each aspect in the order of less restrictive indications. At each code rate, the test set simulates overspeed and underspeed conditions that are reflected by the flashing speed aspect lights (indicators) on the Aspect Display Unit of the control trailer car Engineman's control compartment.

After reaching the highest aspect, the test set reverses and generates speed aspect signals in the order of more restrictive indications. No speed signals are generated at this time. As each more restrictive indication is displayed, the Engineman must acknowledge to stop the alarm. At the last signal change, from MEDIUM to RESTRICTED the brake valve must be moved to RELEASE to test the penalty brake application feature. At the LO position, no overspeed condition is simulated, only the yellow DEPT TEST light flashes at the simulated code rate. (Figure 6-3).

6.3.6 Control Trailer Car Interface

The forward relay (FOR), located in the electrical locker, insures the functioning of all controls when the control trailer car is leading with the reverser key in forward position.

6.3.7 Suppression Pressure Switch (SPS) (Fig. 5-7)

This switch is located in the electrical locker of the control trailer car. A NORMALLY OPEN contact on this pneumatically controlled switch CLOSES to complete the circuit of the ATC onboard test circuit when a full service brake application has been initiated by the 26-C brake valve. (The contacts close at 40 PSI on rising pressure and open at 35 PSI on falling pressure). A NORMALLY CLOSED contact on this pneumatically controlled switch OPENS the alarm circuit on an overspeed condition when a full service brake application has been initiated by the 26-C brake valve.

6.3.8 Power Knockout Pressure Switch (PKOPS)

This pressure switch is installed on the air manifold under the Engineman's control compartment console and is accessible after removal of an access panel. The contact arrangement of this pneumatically controlled switch cuts off locomotive traction power when an emergency brake application is initiated by the 26-C brake valve or a penalty brake application. The switch contacts open at 50 PSI on rising pressure and close at 46 PSI on falling pressure.

6.3.9 ATC Penalty Brake Pressure Switch (PBPS)

This pressure switch is located in the ceiling above the No. 1 End vestibule, to the right of the car centerline. The contacts of this pneumatically controlled switch open at 60 PSI on falling pressure and close at 66 PSI on rising pressure. The opening of the contacts deenergizes the penalty brake magnet valve when a penalty brake has been initiated. This circuit is used to keep the penalty brake magnet valve deenergized as long as the pneumatic system has not been reset.

6.3.10 Penalty Brake Magnet Valve FA4 (PBMV) and Cutout Cock (Fig. 6-4)

The magnet valve is located in the No. 1 End ceiling, to the right of the car center line. This NORMALLY ENERGIZED magnet valve acts as the pneumatic/electrical interface to initiate a penalty (full service) brake application as governed by the cab signal/speed control equipment. When the magnet valve is deenergized, the air escaping through it pilots the operation of the P-2-A brake application valve.

A cutout cock, installed upstream of the penalty brake magnet valve, permits isolation of the pneumatic brake system from the cab signal speed control system. The cutout cock non-locking type handle is sealed (lead and wire) in the OPEN position for normal operation.

6.4 GENERAL FUNCTIONAL DESCRIPTION OF SYSTEM

6.4.1 Automatic Train Control Due to Overspeed in Cab Signal Territory

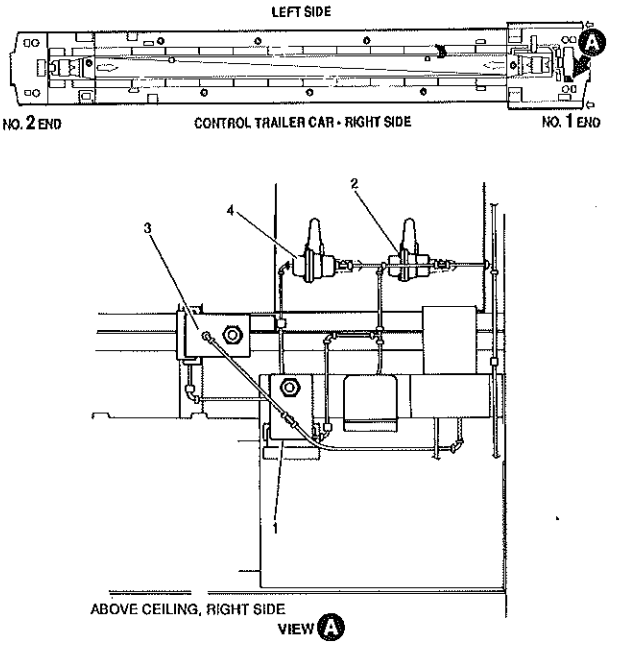
When operating with the Cab Signal Speed Control switch (SCSW) placed in the IN position, a maximum speed is imposed by the system for each signal aspect. If the train speed is over the value that is allowed by the indication being displayed, the audible alarm sounds and the Red OVERSPEED indicator comes ON.

An impending train control PENALTY (FULL SERVICE) application can be forestalled and/or suppressed by the Engineman taking the following actions:

A. Acknowledge (push button) if a more restrictive code was just received.

B. Move the 26-C brake valve in proper time (6 to 8 seconds) to the Suppression position (alarm stops) and move the throttle handle to a lower position for a train speed reduction and release of the brake application.

C. After the train speed is reduced below the overspeed point, the Red OVERSPEED indicator goes OFF, and the brake suppression circuit can be deactivated by placing the brake valve handle in the RELEASE position.



1. Penalty Brake Magnet Valve
2. Penalty Brake Magnet Valve Cutout Cock (shown in Open position)
3. Alertor Magnet Valve
4. Alertor Magnet Valve Cutout Cock (shown in Open position)

Figure 6-4
Penalty Brake and Alertor Magnet Valves and Cutout Cocks — Vestibule Ceiling, Engineman's Control Compartment, No. 1 End — Control Trailer Car

NOTE: If the brake valve is moved to the RELEASE position before the train control impending PENALTY brake situation clears up, the ATC equipment initiates a FULL SERVICE reduction in BP pressure (PENALTY brake application).

In the event the response to the ATC system request was not adequate (failure to obtain brake application within 6 to 8 seconds and/or failure to place the master controller handle in the IDLE position), an automatic PENALTY brake application is initiated. The Red OVERSPEED indicator starts to flash, and the Red TRACTION CUTOUT goes ON. The alarm sounds until the locomotive is underspeed. It is necessary to reset the speed control system and the air brake system after reaching zero speed. The speed control system is reset at 0 MPH provided the master controller throttle handle is moved to the IDLE position. The brake system resets when the 26-C brake valve handle is moved to the SUPPRESSION position. P-2-A valve must reset before placing 26-C brake valve handle to RELEASE position.

The flashing Red OVERSPEED indicator goes OFF after the Cab signal equipment has been reset. Also, the Red TRACTION CUTOUT light goes OFF once the air brake system has been reset. Normal train operation can then resume and propulsion power can be applied by means of the master controller.

6.4.2 Automatic Train Stop Due to Non-Acknowledgement in Cab Signal Territory

When a more restrictive code is received by the Cab signal equipment, the audible alarm sounds and the acknowledging push button flashes and it is necessary to acknowledge this downward change by depressing the acknowledging push button (AS).

Acknowledgement of the more restrictive cab signal must be made within the warning time of 6 to 8 seconds. A service brake application must also be made within that time limit if the changing code places the train in an overspeed condition. If the Engineman acknowledges the audible alarm, but does not perform the braking operation (brake valve handle in FULL SERVICE position, if required) an automatic PENALTY brake application is initiated with loss of propulsion. Audible alarm sounds until train speed falls within acceptable limits.

If the Engineman fails to acknowledge the changing codes within 6 to 8 seconds, an IRRETRIEVABLE application of the train brakes occurs at a FULL SERVICE rate (not EMERGENCY rate) accompanied by loss of propulsion. Upon initiation of the brake application, the Red OVERSPEED indicator starts to flash, and the Red TRACTION CUTOUT light goes ON. In order to reset both the cab signal and air brake system equipment, the train has to come to a FULL STOP even though the suppressing operations have been performed.

NOTE: Moving the 26-C brake valve handle to the SUPPRESSION position without depressing the push button is not considered as an acknowledgement.

6.4.3 En Route Failure Corrections

In the event of a malfunction occurring en route, the following procedure can be followed to allow the train to continue.

A. Isolating Brake System From Cab Signal Control System (Fig. 6-4)

This is accomplished by CLOSING (handle parallel to pipe) the penalty brake magnet valve cutout cock located in the No. 1 End ceiling over the Engineman's control compartment.

NOTE: Whenever a seal is broken to remedy a malfunction, the circumstances must be reported to the authorized personnel.

6.4.4 Attempting Pre-Acknowledgement

If the Engineman attempts to pre-acknowledge any lower speed aspect changes by holding the Acknowledging Switch (AS) depressed, this results in an overspeed type PENALTY brake application after 6 seconds. There is no way (mechanical or electrical) to pre-acknowledge a lower speed change.

6.4.5 Operating in Non-Cab Signal Territory (Fig. 6-3)

Provisions have been incorporated for operating the train in non-cab signal territory.

Upon leaving the cab signal territory, no signals are transmitted to the track receiver from the track circuits of the wayside. A restricting indication appears on the Aspect Display Unit (ADU) and the alarm sounds. The Engineman must place the Cab Signal Speed Control switch (SCSW) in the OUT position to prevent a penalty brake. The ADU cab signal indications will extinguish and the White ATC CUTOUT indicator light on the ADU turns ON.

Having the CAB SIGNAL switch in its OUT position while operating in a non-cab signal territory imposes a new speed limit of 70 MPH.

When the train reenters cab signal territory and again receives coded signals, the alarm sounds. The SCSW switch must be turned from OUT to IN and the acknowledging push button (AS) must be actuated within 6 to 8 seconds to avoid an automatic penalty brake application. In an overspeed condition, the train speed must be reduced under the incoming cab signal speed limit within the allowed time to avoid an automatic penalty brake application.

6.5 ALERTNESS CONTROL SYSTEM GENERAL DESCRIPTION

The Alertness Control System is designed to attract the Engineman's attention by a flashing light and an audible alarm. If no acknowledgement is detected within a preset time, a visual warning is given, and, if it is not acknowledged, an audible warning is given with the visual. If the system is not reset, the control deenergizes the magnet valve in order to apply the brake. This system is used to protect the train in the event the Engineman is incapacitated for any reason.

NOTE: These alarms do NOT operate when the Control Trailer Car is in the trailing position.

6.5.1 Operation

The Alertness Control System is designed to operate as follows:

A. It alerts the Engineman any time the brakes are released.

B. The timing cycle of the alertness control system is as follows:

(1) Total time between acknowledgements does not exceed 45 seconds.

(2) Within approximately 5 seconds after the reset switch light indicator starts to flash, it must be acknowledged, otherwise an audible alarm will sound.

(3) Within approximately 10 seconds after the alarm sounds, it must be acknowledged, otherwise a penalty brake application will occur.

C. For penalty brake application, the following conditions apply:

(1) A penalty brake application consists of a full service brake application.

(2) Penalty induced brake pipe reduction is limited to 20-24 PSI by a reduction limiting reservoir to the P-2-A valve.

(3) Once a penalty brake application has been initiated, a penalty (stop insured) stop is made.

(4) The system resets when the train has completed a full stop.

After the train has reached zero speed, a brake release is initiated provided the 26-C brake handle is first moved to the FULL SERVICE position to reset the P-2-A valve. Propulsion power can be reapplied, after stop, by first moving the master controller throttle to the IDLE position.

6.5.2 Control

The Alertness Control System has the following features:

A. Brake cylinder pressure above 30 PSI resets and forestalls the alertness control activation.

B. An illuminated, manual, Engineman-operated, acknowledge switch resets the alertness control.

C. A change of notch on the master controller throttle handle resets the alertness control.

6.5.3 On-Board Testing

The Alertness Control System can be tested using the following procedure:

A. Release the brakes.

B. The control box starts its timing sequence, and after 30 seconds the light in the alarm box starts to flash.

C. After 5 seconds, an alarm sounds and gradually increases in volume while the light continues to flash.

D. During this cycle, push the Alertor Reset Switch (ARS). Doing so resets the system.

E. Allow another cycle to begin, and wait until the alarm is once again increasing in volume. Then move the throttle handle to notch 1 and bring it back to IDLE. This once again resets the system.

F. Allow another cycle to begin. For this last step, no acknowledgement is to be made, and after approximately 45 seconds, a penalty brake application is initiated as a result of the deenergization of the magnet valve.

6.6 CONTROL BOX ASSEMBLY

The control box is located on the back panel of the electrical locker. The control box assembly contains all electronic controls, printed circuits and relays to receive reset inputs, distribute all power, perform the timing sequence and govern the magnet valve used for penalty application. It also contains its own internal input protection. The control system is operational between 55 VDC and 80 VDC.

6.6.1 Alarm Box Assembly

The alarm box is located on the No. 1 End vestibule ceiling, to the right of the center line of the car. The alarm box assembly contains the alarm circuitry, including a flashing light (not visible since it is located inside the ceiling) and an audible alarm. The alarm sound increases in both pitch and volume for a period of approximately 10 seconds. The audible alarm is consistent with safe operations under high noise level conditions. The alarm box energizes an external light (reset button), which works in conjunction with its own internal light.

6.6.2 Alertor Magnet Valve (VMV) and Cutout Cock (Fig. 6-4)

This magnet valve operates at 74 VDC and is located in the vestibule ceiling at the No. 1 End of the control trailer car.

A cutout cock is also provided near the alertor magnet valve to isolate the pneumatic brake system from the Alertor System in case of problems in the electrical system. The cutout cock handle is sealed (lead and wire) in the OPEN position for normal operation.

6.6.3 Alertor Pressure Switch (APS) (Fig. 5-7)

This pressure switch is located on the left panel of the electrical locker. The APS is on the brake cylinder pressure line and permits the 64/74 VDC input to feed the control box through its normally closed contact. The normally open contact should interrupt the 64/74 VDC feed to the alertor magnet valve (VMV). This switch, when applied, prevents a penalty application from the output of the control box to a direct feed when the brakes are applied.

6.6.4 Alertor Reset Switch (ARS) (Fig. 2-5)

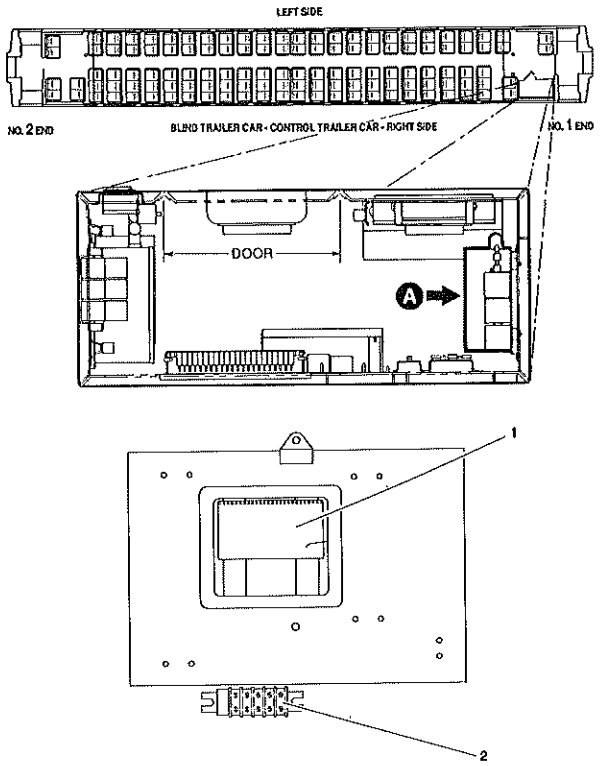
This WHITE, illuminated, Push-To-Reset switch is located on the console Left Hand panel and, when pushed, prevents a penalty brake.

6.7 SPEED RECORDER SYSTEM GENERAL DESCRIPTION

The purpose of the S1S-401 Speed Recorder System is to provide a permanent record of the train speed over a given distance.

The system accepts a varying frequency AC signal generated by a magnetic pickup mounted in close proximity to a rotating gear, and converts the signal electronically into a proportional DC which is used to power an electrical meter (speed indicator), operate a servo mechanism (speed stylus), and drive a stepper motor (tape advance in the recorder).

A 100-tooth gear ring is mounted on the car axle and turns at the same number of revolutions per minute as the axle. The magnetic pickup is mounted close to the gear ring so that the gear teeth pass through the magnetic field generated by the pole piece of the pickup. As each gear tooth passes through the pickup magnetic field, one complete cycle AC voltage is induced in the coil windings of the magnetic pickup. The faster the car wheel, axle and ring gear turn, the faster the gear teeth pass through the pickup magnetic field and the higher the frequency of the AC voltage induced in the pickup. The signal voltage is directly proportional to the car ground speed with signal frequency being increased by 17.5 Hz for every one mile per hour increase in car speed.



1. Speed Recorder Box
2. Speed Recorder Terminal Block

Figure 6-5
Alertness Control System and Speed Recorder System — Control Trailer Car, Electrical Locker, No. 1 End

6.7.1 Operating Controls and Indicators (Fig. 6-5)

SPEED RECORDER, SRB, 10A, circuit breaker controls power to the SIS-401 speed recorder. Placing the circuit breaker in the ON position turns the system ON. No further operation of controls is necessary in order for the system to function.

NOTE: The speed indicator does function when cab signal is cut out on the cab panel. The speed indicator and speed recorder system are designed to also function in non-cab signal territory.

6.7.2 Preparation for Use — Maintenance Use Only (Fig. 6-5)

Make sure that the Speed Recorder cable assembly is plugged into the receptacle marked INTERNAL CONTROL on the Left Side of the SIS-401 speed recorder.

Open the Speed Recorder by turning the four cover clamps to their extended position. Swing the clamps out of the way and open the recorder cover downward.

Install a roll of Speed Recorder tape according to the procedure outlined on the tape installation instruction chart mounted inside the recorder. Disregard Step 8 which calls for the application of a speed signal in order to provide two wraps of tape around the tape takeup spool unless speed signal generating test equipment is available.

Close the Speed Recorder cover and swing the cover clamps into position so that clamp hooks grasp the sides and top of the recorder cover. Turn the clamps to retract the clamp hooks, drawing the cover tightly against the speed recorder housing.

Turn SPEED RECORDER, SRB, 10A, circuit breaker ON to apply power to the speed recorder and indicator system.

Power to the system may be left ON continuously except when exchanging system components as outlined in Maintenance Instructions.

6.7.3 Speed Recorder System Equipment

The Speed Recorder System comprises the following equipment:

A. SIS-401 Speed Recorder.

This box is installed on the Left Hand panel in the electrical locker under the pressure switches. The speed range is 0 to 94 mph and the operating voltage is 55 to 80 VDC.

B. Speed Sensor (SS3).

The speed sensor SS3 is located on No. 1 End Truck, Axle No. 1, Wheel 1R.

SECTION 7

COMMUNICATION SYSTEM

7.1 GENERAL

The communication system consists of control trailer car and blind trailer car equipment which provide the following services:

1. Two-way communication between wayside stations and the Engineman or the Train Crew by means of the control trailer car radio system.

2. One-way communication from the Engineman or the Train Crew to the Passengers by means of the control trailer car and blind trailer car public address system.

3. Two-way private communication between the Engineman and the Train Crew by means of the control trailer car and blind trailer car intercommunication system.

7.1.1 Power Supply (Fig. 3-10 and 3-11)

All three systems operate from the 64/74 VDC power source of the cars, and their respective components are protected by the following circuit breakers which are located in the electrical locker:

— PUBLIC ADDRESS AND COMMUNICATION SYSTEM, CSB, 10A. On Car Lighting and Control Breaker Panel in control trailer car and blind trailer car. Includes intercommunication circuits.

— RADIO, RB, 10A. On Train Control Circuit Breaker Panel located in control trailer car only.

These breakers will be assumed to be in the ON position in the present text. The equipment circuits are further controlled by other devices which are described in Subsections 7.2.3 and 7.3.2.

7.1.2 Arrangement of Control Trailer Car and Blind Trailer Car Control Panels (Fig. 7-1 and Fig. 7-2)

All car configurations have a public address and intercom control panel which is recessed into the rear vestibule wall on the Right Side at the No. 1 End.

In the control trailer car, an additional remote control head is mounted on the Engineman's control compartment LH panel in the No. 1 End vestibule.

7.1.3 Arrangement of PA Speakers — Control Trailer Car and Blind Trailer Car (Fig. 3 and 7)

A total of eight, ceiling-mounted, public address speakers are provided in the passenger compartment of both types of cars. The speakers are evenly spaced longitudinally and alternately on both sides of the main air duct, with one installed in each low-ceiling area.

The volume of the PA speakers is preset and cannot be adjusted.

7.2 CONTROL TRAILER CAR RADIO SYSTEM EQUIPMENT

The control trailer car radio system equipment consists basically of a railroad type two-way FM radio set, an AAR radio adapter tray, an AAR mounting rack, a remote control head, and a roof-mounted antenna.

7.2.1 Radio Set Mounting Arrangement

The two-way FM radio set is a solid state unit, incorporating integrated circuits, which is secured to a mounting tray designed for mounting on an AAR mounting rack.

The adapter tray provides a means for affecting electrical connections between the radio unit and mounting base, physical securement of unit to the mounting base, and also provides a hook up for the radio antenna.

The radio unit front panel includes a PROM module which is factory programmed for the MBTA transmit/receive frequencies. A male connector is provided at the front of the radio set to mate with its female counterpart on the mounting rack.

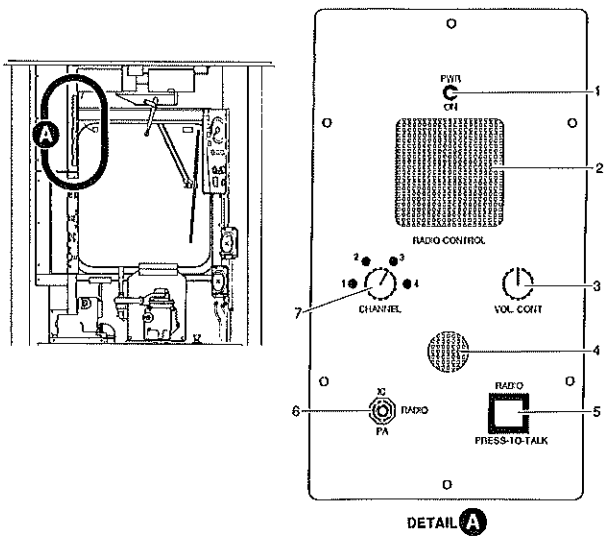
The radio and its mounting tray slide into the AAR mounting rack mounted on the electrical locker door. One cable with plug connector insures electrical connection between AAR mounting rack and radio.

Once the radio set is installed in the electrical locker, the system can be operated from the remote control head located on the Engineman's control compartment LH panel in the control trailer car.

7.2.2 AAR Radio Mounting Rack

The AAR mounting rack provides distribution of power and control connections via external cable wiring. When the radio set is installed on the mounting rack, all system circuits are automatically interconnected: power, communication control head, PA and IC interface.

A key lock permits securing the radio set into the mounting rack to prevent unauthorized personnel from tampering with the equipment.



1. Power On Indicating Light (BLUE)
2. Radio, Audible Alert Tone and IC Buzzer Monitor Speaker
3. Radio Volume Control Knob
4. Radio, PA and IC Microphone
5. Press-To-Talk (PTT) Push Button (WHITE)
6. Communication Mode Selector Toggle Switch (Spring Return to "Radio")
7. Radio Frequency Selector Knob with Red (LED) Channel Indicating Lights

Figure 7-1
Remote Control Head (Radio, PA and IC), Engineman's Control Compartment Left Hand Panel — Control Trailer Car

7.2.3 Remote Control Head (Fig. 7-1)

The remote control head is located on the Engineman's control compartment LH Panel in the control trailer car. In addition to radio control, it provides PA and IC interface.

A. Power Supply

When the No. 1 End vestibule of the control trailer car is used as an Engineman's control compartment, the remote control head becomes energized as the reverser key switch of the master controller is moved to an operating position (FORWARD, NEUTRAL or REVERSE). Refer to Sections 2 and 3.

B. Controls and Devices

The remote control head contains the following controls and devices:

(1) Blue "POWER ON" Indicating Light

This light comes ON when the panel is energized as described in Subsection 7.2.3 A.

(2) Communication Mode Toggle Switch

This three-position toggle switch permits selection of the communication mode desired. The switch is spring returned to the center RADIO position. The other two positions, PA and IC, permit use of the communication system in the public address and intercom modes of operation, without the need for the PA and IC control panel (located on the vestibule partition wall behind the Engineman) to be key energized, so long as the remote control head is energized.

In such cases, the switch serves as a Press-To-Talk (PTT) push button switch. It must be HELD in either position to transmit in the PA and IC modes, and RELEASED to receive in the IC mode. IC return speech will be heard on the PA and IC control panel speaker only.

(3) Radio Frequency Selector Knob

This switch permits selection of the desired frequency and/or channel for transmitting and receiving in the RADIO mode. The switch has four channel positions, numbered I, 2, 3 and 4, with four RED indicating lights (LEDs). When one of the predetermined channels is selected, its indicator will be ON provided the panel is energized. A plate to the left of the Control Head indicates channel assignment.

(4) Radio Monitor Speaker

This speaker permits hearing all radio transmissions on the channel selected. This speaker does not serve in the IC mode when the intercom system is used from the present panel. Refer to Subsection 7.3.2 B.

NOTE: If, for any reason, the synthesizer becomes "out of lock" (including selection of an unused channel) an alert tone will be heard in the speaker.

(5) Volume Control Knob

This control permits setting the desired listening level of the monitor speaker by turning the control knob (clockwise to increase) when signals are received.

(6) Microphone

This microphone serves for the RADIO, PA and IC modes of operation. It is necessary to speak directly towards the panel at a normal voice level.

(7) Press-To-Talk Push Button

This WHITE, Press-To-Talk (PTT) push button switch serves for the RADIO mode of operation only. The push button is depressed to transmit, and released to receive. The channel must be clear before transmitting. For the PA and IC method of transmission, see item (2) preceding.

The radio set is equipped with a "time-out" timer. The transmitter will automatically shut off after one minute of continuous operation. This is indicated by an alert tone which will be heard in the monitor speaker. Releasing the PTT push button switch will momentarily reset the timer.

7.2.4 92-Channel Radio

Car 1652 is equipped with a 92-channel radio, and paragraph 7.2.3 (above) does not apply.

7.3 PA AND IC SYSTEM EQUIPMENT — CONTROL TRAILER CAR AND BLIND TRAILER CAR

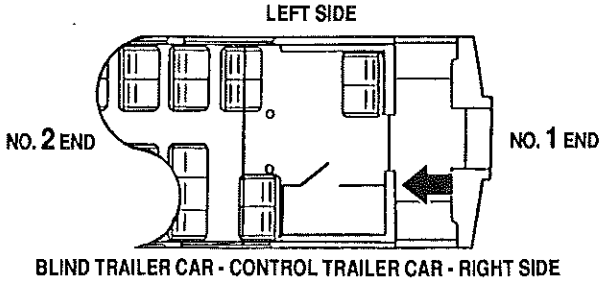
In addition to the ceiling-mounted PA speakers described in Subsection 7.I.3, the system equipment includes the following:

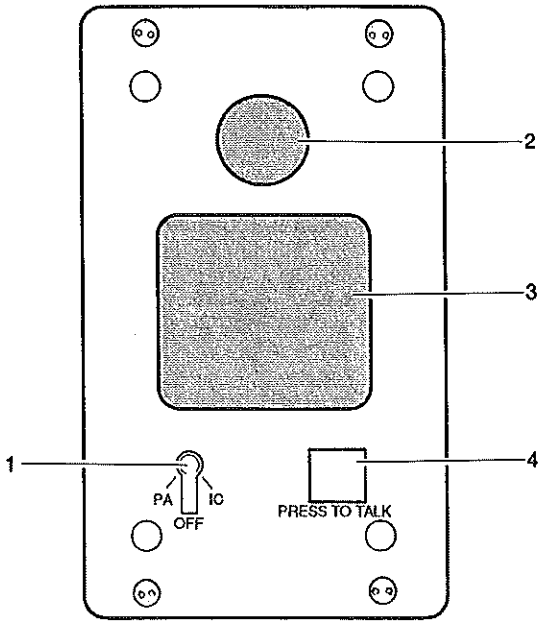
7.3.1 PA Amplifier and Mounting Rack

The PA amplifier is installed on an AAR mounting rack. In the control trailer car and the blind trailer car, the PA amplifier assembly is located at the rear of the electrical locker. Electrical input and output connections are accomplished by means of a cable and connector socket.

7.3.2 PA and IC Control Panels (Fig. 7-2)

The PA and IC control panels (Conductor's panels) which are located as described in Subsection 7.I.2, contain the following controls and devices:





1. Key Switch for Energizing Panel Mode Selection
2. PA and IC Microphone
3. Intercom Speaker
4. Push Button (Activates Microphone)

Figure 7-2
Public Address and Intercom Control Panel
(Conductor's Control Head)
— Control Trailer Car and Blind Trailer Car

A. Key Switch

This switch serves for energizing the control panel and/or selecting either the public address or the intercom mode of operation. The switch is actuated by the MBTA coach key. The key, which is turned clockwise to select the PA mode and counterclockwise for the IC mode, can only be removed in the OFF position. None of the controls and devices are operative with the key removed at that location. Key switch must be returned to OFF position at the end of each trip.

B. Intercom Speaker

This speaker permits hearing the voice of the other party when the key switch is placed in the IC position. The listening level of this speaker cannot be adjusted.

NOTE: The intercom signals are not heard over the ceiling-mounted PA speakers. In the Engineman's control compartment, the return IC speech will be heard over the PA and IC control panel speaker located behind the Engineman's station.

C. Microphone

This microphone serves for the PA and IC modes of operation. It is necessary to speak directly towards the panel at a normal voice level.

D. Press-To-Talk Push Button

This switch serves for PA and IC modes of operation. The push button is DEPRESSED to transmit and RELEASED to receive.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 8

HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

8.1 GENERAL DESCRIPTION

The control trailer cars and blind trailer cars are equipped with an integrated Heating, Ventilation and Air Conditioning system which is fully automatic and does not require any manual change over from winter to summer operation or from summer to winter operation. Once the system is activated, the cooling and heating functions will be controlled automatically in response to predetermined temperature requirements of the car interior, and also in response to outside conditions. The systems are identical on both types of cars with the exception of the following:

1. The Engineman's control compartment of the control trailer car has one heater unit on the Engineman's side and one heater unit on the Left Side of the No. 1 End vestibule.

2. Some of the conditioned air (heated or cooled as required) is drawn from the outlet of the No. 1 End overhead evaporator/heater/blower unit of the control trailer car, and is force fed into the Engineman's control compartment by means of a separate HVAC ceiling fan via associated ducting and diffusers. The fan is energized by the CEILING FAN switch on the Engineman's control compartment LH panel.

8.2 AIR DISTRIBUTION EQUIPMENT (FIG. 8-1)

Conditioned air is delivered inside the car by drawing fresh air into a mixing chamber at each end of the car. This fresh air is drawn through filters, forced across cooling and/or heating surfaces, and into a main air duct from which it is discharged through diffusers into the passenger seating area. This creates a slight positive pressure inside the passenger compartment. The positive pressure forces some of the compartment stale air out of the car through ceiling-mounted ventilation exhaust grilles, while the remaining air is recirculated.

8.2.1 Low-Ceiling Plenum Chambers

A plenum chamber is formed by the low-ceiling structure and panelling at each end of the passenger compartment. An overhead evaporator/heater/blower unit is installed in each chamber above the aisle. Two drop panels in the ceiling below the unit close off the chamber and provide access to the unit components. A recirculation air grille is mounted in the outboard panel. Two exterior fresh air intake grilles and ducts, one on each side of the car, lead into each end plenum chamber.

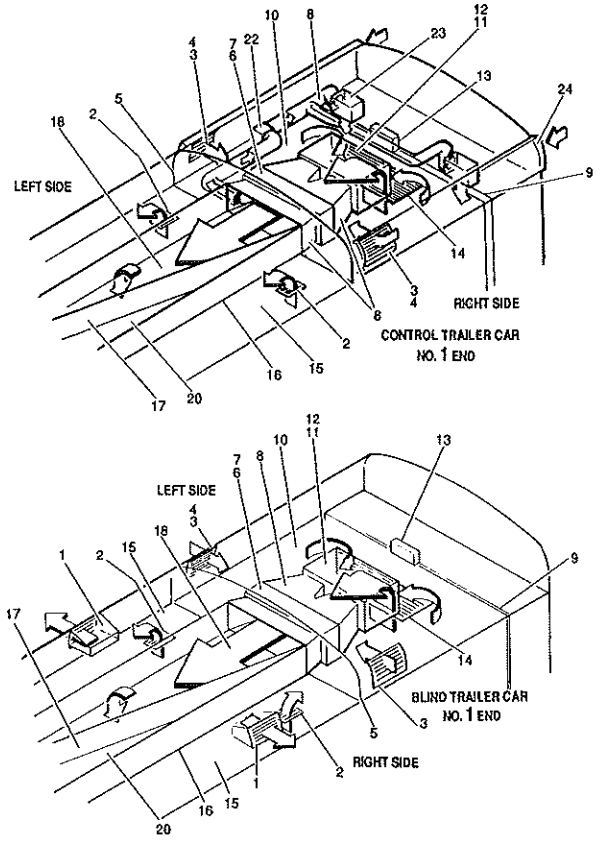
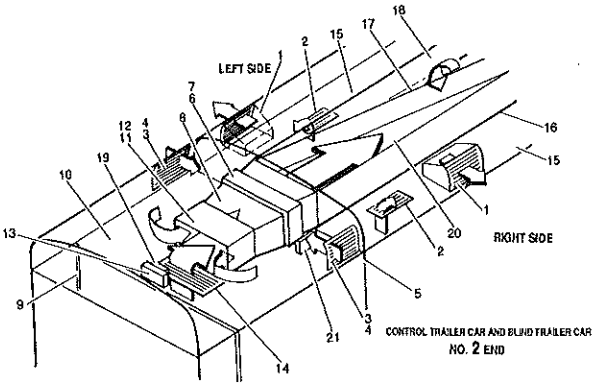


Figure 8-1 (Sheet 1 of 2)
HVAC Air Distribution and
Overhead Equipment Layout
— Control Trailer Car and Blind Trailer Car



1. Exterior Ventilation Exhaust Grille and Duct (Does not exist at No. 1 End of Control Trailer Car)
2. Passenger Compartment Ceiling Ventilation Exhaust Grille
3. Fresh Air Intake Grille and Duct
4. Fresh Air Filter
5. High Ceiling/Low Ceiling Transition Header
6. Overhead Evaporator Unit Assembly
7. Overhead Unit Heating Elements
8. Flexible Ducting
9. Vestibule Partition Wall
10. Low Ceiling Plenum (Mixing) Chamber
11. Overhead Unit Blower Assembly
12. Overhead Unit Inlet Filter
13. Odor/Fume Controllant Unit
14. Recirculation Air Grille
15. Ventilation Exhaust Chamber
16. Passenger Compartment Ceiling Diffuser
17. Main Air Duct Divider
18. No. 1 End Half of Main Air Duct
19. Return Air Temperature Sensor (RAT)
20. No. 2 End Half of Main Air Duct
21. Fresh Air Thermistor (FAT)
22. Engineman's Control Compartment HVAC Ceiling Fan (Control Trailer Car, No. 1 End only)
23. Engineman's Control Compartment HVAC Ceiling Diffuser (Control Trailer Car, No. 1 End only)
24. Scoop Assembly (Control Trailer Car, No. 1 End only)

Figure 8-1 (Sheet 2 of 2)
HVAC Air Distribution and Overhead Equipment Layout — Control Trailer Car and Blind Trailer Car

Fresh (outside) air is drawn into the plenum chamber, through the two associated fresh air intake grilles and ducts by the overhead unit blower. At the same time, the blower draws air from inside the car through the recirculation grille, into the chamber where it mixes with the fresh air. This air mixture is drawn out of the chamber by the unit blower, through filters which are installed at the overhead unit inlet. The air mixture is then forced across the evaporator coils/heating elements (either is operative as conditions require) and into the corresponding half of the main air duct. A panel is provided below each fresh air intake duct to access intake air filter for maintenance.

8.2.2 Odor/Fume Controllant Units

Fumes, odor, etc., are removed from the return air (recirculated air) by a solid type air refreshener unit which is mounted in the chamber, above the passenger compartment end door, in the overhead unit air stream, at each end of the car. This air refreshener consists of a solid fume/odor controllant similar to the active element of a solid air wick.

8.2.3 High-Ceiling Main Air Duct

A main air duct is built into the high-ceiling structure in the passenger seating area. This duct runs the full length of the high-ceiling area, and is divided lengthwise by a splitter which runs diagonally from one end of the duct to the other (from one overhead unit outlet to the other). This split duct arrangement permits a forced flow of fresh or conditioned air (cooled or heated as required) to be supplied into a common duct by the two overhead evaporator/heater/blower units which are located opposite each other at the extreme ends of the duct. Finally, the conditioned air, under slight pressure, is supplied to the passenger area through the two linear diffusers, flush-mounted into the ceiling panels which close off the main duct.

Each diffuser is routed along the continuous row of fluorescent lighting fixtures and is shaped to deflect the air towards the center of the aisle, as well as towards the sidewall.

8.2.4 High-Ceiling Ventilation Exhaust Grilles

On both sides of the car, the space located in the high ceiling, between the main air duct and the carbody sidewall forms an exhaust chamber. On the blind trailer car and the control trailer car, four interior ventilation exhaust grilles are flush-mounted into the ceiling, one at each end of each exhaust chamber.

On the blind trailer car, an exterior exhaust grille and duct lead into each exhaust chamber at both ends of the car. The blind trailer car has, therefore, four interior exhaust grilles and four exterior exhaust grilles.

On the control trailer car, however, there are no exterior exhaust grilles at the No. 1 End in order to improve the effectiveness of the ventilation when the car is running in lead position. Exterior exhaust grilles are provided only at the No. 2 End of the car. Scoop assemblies are provided at the No. 1 End to compensate for loss of pressure in the forward area of the car. The control trailer car has, therefore, four interior exhaust grilles and only two exterior exhaust grilles.

Positive pressure created by the fresh or conditioned (cooled or heated) air flow forces the smoke and stale air through the interior exhaust grilles, into both exhaust chambers, and out of the car through the exterior exhaust grilles. The air is exhausted due to the pressure differential existing between the inside and outside air.

8.2.5 Engineman's Control Compartment A/C Ceiling Fan and Diffusers

A fan is installed in the ceiling structure on the Left Side of the No. 1 End plenum chamber, near the overhead evaporator/heater/blower unit. The fan is connected to the outlet side of the overhead unit, and the conditioned air that is drawn from that point is discharged into the Engineman's control compartment through flexible ducting and grille type diffusers. The fan is fed 120 VAC power through the circuit breaker labelled CAB HEATING CONTROL, CHB, 20A, which is located on the Train Control Circuit Breaker Panel, and is further controlled by the CEILING FAN toggle switch which is located on the Engineman's control compartment LH panel.

8.3 AIR CONDITIONING EQUIPMENT

The electromechanical type components of the air conditioning system are capable of delivering 12 tons of refrigeration effect when handling a total air volume of 3600 CFM at rated conditions.

The system includes an undercar 12 ton compressor/condenser unit (A/C unit), with the refrigeration control box, a temperature control panel located inside the electrical locker, and two overhead 6 ton evaporator/heater/blower units, one at each end of the car, in the ceiling. The relative location of the system components is shown in Figures 3, 4, 7, 8, 8-2, 8-3 and 8-4.

By absorbing heat taken from the ambient air, the liquid refrigerant coming from the undercar A/C unit receiver vaporizes in each overhead evaporator. This cools the air before it leaves the overhead unit on its way to the main air duct, to be discharged into the passenger compartment. The refrigerant vapor leaving the overhead evaporators is returned to the A/C unit compressor where it is forced to higher temperature and pressure levels, and discharged into the A/C unit condenser. This compressed vapor is then liquified in the condenser by drawing outside air through the condenser coil surfaces. The liquid refrigerant returns to the receiver and the cycle is repeated.

8.3.1 Compressor/Condenser Unit (Fig. 8-2)

A 12 ton capacity compressor/condenser unit is installed undercar, on the Right Side, in proximity of the A/C UNIT label (between crossbearers XB-6 and XB-7).

A. Main Power Supply (Fig. 3-7)

The main A/C unit components are supplied 480 VAC operating power through circuit breakers located on the undercar mounted Main Power Breaker Panel. The A/C COMPRESSOR/CONDENSER No. 1, CC1B, 50A, breaker energizes and protects the motor circuits of the compressor and the condenser fan No. 1. The A/C CONDENSER No. 2, C2B, 20A, circuit breaker energizes and protects the condenser fan motor No. 2 circuits.

B. Compressor Crankcase Heater Power Supply (Fig. 3-10)

The 75 watt (rated at 74 VDC) heating element circuit of the compressor crankcase is fed 74/64 VDC power through the CRANKCASE HEATER, CCHB, 5A, circuit breaker which is located on the Car Lighting and Control Breaker Panel in the electrical locker in both types of cars.

C. Local A/C Unit Control Panel (Fig. 8-2)

This control panel complete with a hinged cover is installed behind the compressor/condenser unit frame, and can be easily accessed from underneath the car when it is over a pit. This control panel is intended mainly for local testing purposes, but it includes a three-position rotary selector switch which must be placed in the proper position for NORMAL operation. The selector switch settings are labelled HAND/AUTO/OFF.

NOTE: The complete system testing procedure is beyond the scope of the prerun information contained in the present Manual.

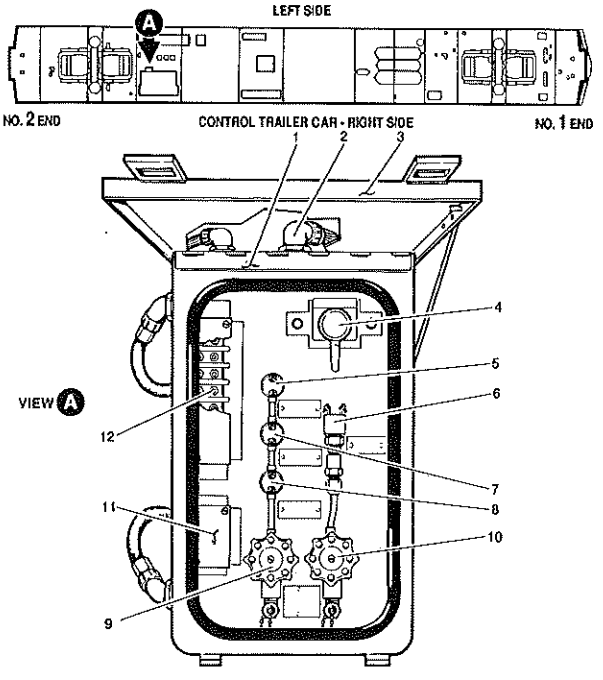
(1) Rotary Selector Test Switch

The switch has three positions labelled as follows:

HAND — This position permits bypassing the system thermostats so that the unit can be operated locally under manual control.

AUTO — For summer or winter operation, the switch must be placed in this position so that the compressor/condenser unit can operate under the HVAC system thermostatic controls.

OFF — In this position, the 480 VAC power supply is removed from the compressor/condenser motors to prevent startup and permit servicing of the unit.



1. Refrigeration Control Box
2. Electrical Entrance Fitting Hardware
3. Refrigeration Control Box Cover
4. Air Conditioning Rotary Test Switch (HTS)
5. High Pressure Switch (HPS)
6. Low Pressure Switch (LPS)
7. Modulation Pressure Switch (MPS)
8. Condenser Pressure Switch (CPS)
9. High Pressure Gauge Connection and Valve
10. Low Pressure Gauge Connection and Valve
11. Terminal Block (TB51)
12. Terminal Block (TB47)

Figure 8-2
Compressor/Condenser Unit and
Local A/C Unit Control Panel —
Control Trailer Car and Blind Trailer Car

8.3.2 Evaporator/Heater/Blower Units (Fig. 8-3)

There are two 6-ton capacity evaporator/heater/blower units (overhead units) installed in the low ceiling structure above the aisle, one at each end of the passenger compartment.

A. Power Supply

The blower motor of the No. 1 End overhead unit is supplied 480 VAC operating power through the A/C BLOWER No. 1 End, B1B, 15A, circuit breaker. The blower motor of the No. 2 End overhead unit is supplied 480 VAC operating power through the A/C BLOWER No. 2 End, B2B, 15A, circuit breaker.

B. Heating Elements

In addition to the cooling components, each overhead assembly is provided with built-in heating elements located downstream of the evaporator cooling coils. Refer to Section 8.4.

C. Return Air Temperature Sensor Assembly (RAT)

A return air temperature sensor is installed in the No. 2 End plenum chamber near the odor/fume controlant unit and recirculation grille. Refer to Section 8.5.

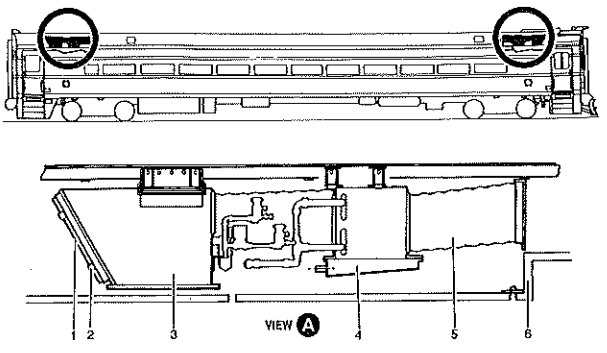
8.4 HEATING EQUIPMENT

The car heating system is a combination of FLOOR HEAT and OVERHEAD HEAT. The heating elements are supplied 480 VAC through the associated circuit breakers discussed in the following text:

8.4.1 Overhead Heat

Overhead heat is provided by a two-stage heating element assembly located downstream of each overhead A/C unit. The elements at the No. 1 End are energized and protected by the OVERHEAD HEAT, Stage No. 1, OH1B, 30A, circuit breaker, and the elements at the No. 2 End by the OVERHEAD HEAT, Stage No. 2, OH2B, 30A, circuit breaker. Both breakers are mounted on the Main Power Breaker Panel.

The elements serve for providing the most desirable proportion of heating during the REHEAT and NORMAL HEAT cycles, and are wired for two-stage operation. The controls of the overhead heaters are interlocked with the controls of their respective overhead unit blower motors to ensure that the heaters cannot be energized if the associated blower fan motors are not operating. In addition, for the purpose of guarding against operation of the heaters in the absence of an appropriate air flow (fan motor not operating), a flow sensing switch is incorporated in the control circuit. A thermal protection device is also incorporated so that the 480 VAC circuit breaker will TRIP and OPEN in the event of an overheat condition.



1. Replaceable Air Filter Element
2. Filter Element Retaining Clip
3. Blower
4. Evaporator/Heater
5. Flexible Duct
6. Low-Ceiling/High-Ceiling Transom

Figure 8-3
Evaporator/Heater/Blower Unit —
Control Trailer Car and Blind Trailer Car

The first 16 kW stage (8 kW at each end) and second 24 kW stage (12 kW at each end) of overhead heating have their contactor and relay circuits controlled by thermostats.

8.4.2 Floor Heat

Two continuous rows of heating elements are provided, one along each sidewall, below seat level. The elements are contained within heater guards which permit free convection of hot air up the sidewalls and out into the area between the seats. The elements are wired for two-stage operation and are supplied 480 VAC power through the FLOOR HEAT, Stage No. 1, FH1B, 20A, circuit breaker and the FLOOR HEAT, Stage No. 2, FH2B, 20A, circuit breaker which are mounted on the Main Power Breaker Panel. The two stages of floor heating have their contactor and relay circuits controlled by thermostats or a temperature sensor.

8.4.3 Engineman's Control Compartment Heat

An electric heating unit, equipped with a fan, is located on each side of the Engineman's control compartment in the control trailer car. The heater units (Right Side and Left Side) comprise heating element assemblies supplied 480 VAC power through the CAB HEATER NO.1 (CHRB) 15A circuit breaker and the CAB HEATER NO.2 (CHLB) 15A circuit breaker, both located on the Main Power Breaker Panel; as well as the CAB HEATING CONTROL (CHB) 20A circuit breaker which is mounted on the Train Control Circuit Breaker Panel.

Each heater/fan arrangement is further controlled by a three-position (OFF/LOW/HIGH) switch labelled CAB HEATER. For switch details and locations, refer to Section 2. The HVAC Selector Switch (HSS), located on the Car Lighting and Control Breaker Panel, must be placed in the NORMAL position for the cab heaters and fans to operate.

The cab heater units also incorporate thermal protection and overheat indication circuits. For each heater/fan arrangement, an AMBER indicating light is connected across a protective thermostat. This light provides an indication of heater fan failure. For locations refer to Section 2.

CAUTION: If one of these lights comes ON, the associated heater must be turned OFF immediately to prevent possible equipment damage.

The collision post door must be CLOSED for the heaters and fans to operate. The door is equipped with a cab heater cutoff switch (EDS) that deenergizes the cab heaters if the door is OPEN and latched over the controls.

8.4.4 Protective Heat

When the outside temperature drops below 41°F, the protective heat thermostat (PHT) energizes the protective heat relay circuit, which causes the side door threshold heaters (recessed into top of stepwell trap door) to be energized.

The physical arrangement of these 120 VAC, self-limiting heating tapes is discussed in Section 4.

This thermostatically controlled circuit cannot operate unless the PROTECTIVE HEATERS, PHB, 20A, circuit breaker has been placed in the ON position.

8.5 HVAC THERMOSTATIC AND TEMPERATURE SENSOR CONTROLS (FIG. 8-4)

A Fresh Air Thermistor, a Return Air Temperature Sensor and a Layover Heat Thermostat are used in the HVAC system. The Return Air Temperature Sensor is the only adjustable device - the others are factory preset and are not adjustable.

8.5.1 Fresh Air Thermistor Assembly (FAT)

This Thermistor is installed in the fresh air intake duct on the Right Side of the No. 2 End of the car. It controls the Return Air Temperature Sensor (RAT) for the following functions:

A. Winter Heat

Setting 45°F. When outside temperature falls below 45°F, Stage 1 and 2 of FLOOR HEAT and Stage 1 and 2 of overhead heat are energized.

When outside temperature is above 45°F, this function will reduce the heating capacity by cancelling Stage 2 of floor heat and Stage 1 of overhead heat.

B. Cooling Lockout

Setting 45°F. When outside temperature falls below 45°F, this function locks out air cooling.

8.5.2 Return Air Temperature Sensor (RAT)

A solid state Return Air Temperature Sensor is installed in the No. 2 End plenum chamber near the odor/fume controllant unit and above the recirculation air grille. A Thermistor, mounted on this temperature sensor board, controls the functions shown on the function chart of Figure 8-5, for the following inside car temperature settings:

A. Winter Heat Setting, 68°F

When the car interior temperature falls below 68°F, the Temperature Sensor (through its winter heat setting) will energize the required stages of FLOOR HEAT and overhead heat to maintain the car interior temperature at 68°F. The stage(s) and type(s) of heating required depends on the exterior temperature as sensed by the Fresh Air Thermistor (FAT). When the car interior temperature reaches 68°F, reduced heating capacity is required; therefore, only Stage 1 of OVERHEAD HEAT will still operate.

B. Modulated Cooling Setting, 70°F

When car interior temperature is above 70°F, the Temperature Sensor will control modulated cooling with reheat to maintain car temperature at 70°F.

C. Reheat, 73°F

When car interior temperature is above 73°F, reheat will be removed and only cooling will be applied.

D. Full Cooling Setting, 75°F

The Return Air Temperature Sensor will energize modulating valves at 75°F to put all evaporator sections in use to provide full cooling.

8.5.3 Layover Heat Thermostat (LHT) (Fig. 8-4)

This thermostat is mounted on the aisle side of the electrical locker. The control box is mounted on the Car Lighting and Control Breaker Panel which is also located in the electrical locker. When the HVAC Selector Switch (HSS) is placed in the LAYOVER position and car interior temperature is below 55°F, the Layover Heat Thermostat energizes Stage 1 and 2 of floor heat to maintain car interior temperature at 55°F.

Key to Figure 8-4

1. Layover Heat Thermostat
2. Electrical Locker
3. Air Filter Element
4. Exterior Fresh Air Intake Grille
5. Fresh Air Thermistor (Inside Fresh Air Duct, No. 2 End, Right Side Only)
6. Return Air Temperature Sensor
7. Solid Odor/Fume Controllant
8. Recirculation Air Grille

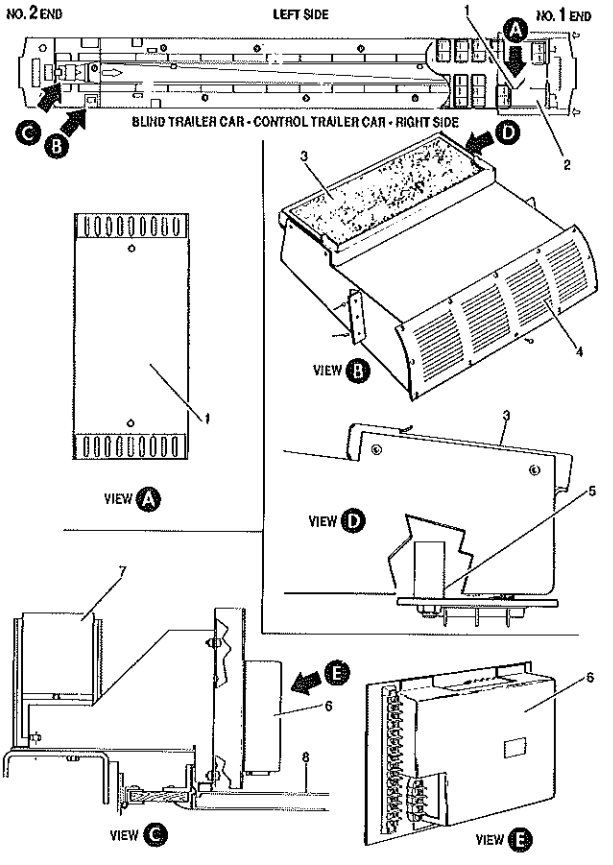


Figure 8-4
Interior Thermostat and Temperature Sensor Assemblies — Control Trailer Car and Blind Trailer Car

8.5.4 Protective Heat Thermostat (PHT)

The Protective Heat Thermostat is mounted inside the 480 VAC junction box, undercar. This thermostat is set at 41°F and energizes the side door threshold heaters when the outside temperature falls below 41°F.

CAUTION: The compressor crankcase heaters are not under the control of the 41°F Protective Heat Thermostat. For these heaters to operate, the associated circuit breaker protective heaters, PHB, 20A, must be placed in the ON position when the outside temperature is at or below 41°F.

8.6 HVAC MANUAL CONTROLS AND INDICATORS (FIG. 3-10)

All circuit breakers, switches and indicating lights which permit operating the system from inside the car, are located on the Car Lighting and Control Breaker Panel. All circuit breakers which have been discussed in the preceding Sections, are assumed to be in the ON position for normal operation.

8.6.1 HVAC Control Circuit Power Supply

HVAC control circuits are powered by 3-phase 120 VAC through the following breakers in the electrical locker:

A. HVAC CONTROL breaker, HCB, 10A.

B. Overhead blower breaker, OBCB, 10A.

C. Blower toggle switch BLS (ventilation-only switch)

HVAC control circuits are further protected by a blower interlock relay (BIR) circuit using a 3-phase monitor with "tripped" indicator light (3PM). See HVAC relay auxiliary panel in electrical locker.

8.6.2 HVAC Operating Mode Rotary Selector Switch

This four position selector switch (HSS), marked VENTILATION/NORMAL/OFF/LAYOVER, allows manual selection of any of the following operating modes:

OFF — In this position, all HVAC system functions except protective heat.

LAYOVER — In this position, the HVAC system will operate in the LAYOVER mode with Stage 1 and 2 of floor heating under control of the Layover Heat Thermostat device to maintain a minimum interior car temperature of 55°F. The ventilation overhead heating and cooling functions are interrupted.

NORMAL — In this position, the HVAC system will operate in the AUTOMATIC mode under control of the Temperature Regulator. Selection between HEATING and COOLING functions will be made automatically (cannot be made manually) as determined by outside and inside temperatures.

VENT — In conjunction with the Blower Switch in the ON position, ventilation only will occur in the car.

NOTE: The PROTECTIVE HEAT circuits (side door thresholds) will be energized if the outside temperature is at or below 41°F, provided the PROTECTIVE HEATERS (PHB) circuit beaker is in the ON position.

8.6.3 HVAC Operating Mode Indicating Lights

Two horizontal rows of four indicating lights are mounted on the panel.

The first row of lights are labelled:

1st stage, overhead heat; partial cool; 1st stage floor heat; OVER TEMP. NO. 1 END.

The second row of lights are labelled:

2nd stage, overhead heat; full cool; 2nd stage, floor heat; OVER TEMP. NO. 2 END.

8.7 HVAC FUNCTIONAL DESCRIPTION

With the HSS selector switch placed in the NORMAL position, the HVAC system heating and cooling modes of operation are controlled by the Return Air Temperature Sensor (RAT). Figure 8-5 is a graphic representation of the various heating and cooling functions as determined by the outside (fresh air) and inside (return air) temperatures.

8.7.1 Heating Mode of Operation (Fig. 8-5)

A. With Outside Temperature below 45°F

(1) The cooling lockout function locks out the cooling function until the outside temperature rises to 45°F again. Both COOL and FULL COOL indicating lights are OFF.

(2) Stage 1 and 2 of FLOOR HEAT and Stage 1 and 2 of OVERHEAD HEAT are energized to maintain the car interior temperature at 68°F. Stage 1 and 2 of overhead heat and Stage 1 and 2 of floor heat lights are ON.

(3) When the inside temperature rises above 68°F as detected by the Return Air Temperature Sensor, Stage 2 of overhead heat and Stage 1 and 2 of floor heat are deenergized but the blower continues operating to provide ventilation. Stage 1 of overhead heat will remain ON until temperature reaches 70°F inside the car.

B. With Outside Temperature Above 45°F

(1) Stage 2 of OVERHEAD HEAT and Stage 1 of FLOOR HEAT are energized to increase car interior temperature to 68°F, at which point OVERHEAD HEAT is deenergized and only Ventilation is energized.

(2) When interior temperature rises above 70°F, cooling will start until the interior temperature drops to 70°F.

Figure 8-5
Temperature/Function Chart

NOTE: Stage 2 of overhead HEAT and Stage 1 of floor heat lights will be ON below 68°F. Stage 1 of overhead heat light will be ON between 68°F and 70°F. The cycling ON/OFF of partial cooling light will occur at approximately 70°F.

8.7.2 Cooling Mode of Operation (Fig. 8-5)

A. With Outside Temperature Above 45°F

(1) If the car interior temperature rises above 70°F, MODULATED COOLING with REHEAT is established and Stage 1 of OVERHEAD HEAT will be energized. Partial COOL and Stage 1 of overhead heat lights will be ON.

(2) If the car temperature rises to 73°F, MODULATED COOLING will continue but without REHEAT (Stage 1 of OVERHEAD HEAT is removed). Partial Cooling light will be ON.

(3) If car temperature continues to rise to 75°F, FULL COOLING will be established at 75°F. Partial cooling and FULL COOLing lights will be ON.

B. With Outside Temperature Below 45°F

Cooling will be OFF regardless of interior temperature.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 10

TRUCKS AND ASSOCIATED SUBSYSTEMS

10.1 GENERAL DESCRIPTION (FIG. 10-1)

The carbody is carried by a pair of four wheel trucks which are of the inside bearing, fully equalized type, with pneumatic carbody suspension. The general arrangement of the complete truck assembly includes the truck frame, truck bolster, associated suspension, tread brake components, wheel and axle sets, etc. The one piece, cast steel, pedestal type truck frame is supported on single bar type equalizer beams by means of four sets of double nested, steel, coil springs. The truck frame supports a cast steel truck bolster through a central bearing pivot. Protection against total separation of the truck frame from the truck bolster is accomplished by means of a locking center pin.

An air spring assembly is mounted at each end of the truck bolster to support the carbody. The truck bolster is connected to the carbody through two longitudinal bolster anchors, one on each side of the car. This carbody to truck bolster connection arrangement allows the truck bolster and carbody to move vertically and transversely relative to each other, but not longitudinally or in swivel. Two safety straps are suspended from the carbody and are passed beneath the truck bolster to protect against accidental separation of truck and carbody.

10.2 PNEUMATIC SUSPENSION SYSTEM (FIG. 10-1)

The suspension system consists of one air spring assembly at each corner of the car (two per truck), in which pressure is controlled by a three leveling valve system. At the No. 2 End, one valve per air spring (per car side) controls the height of the carbody with respect to the truck bolster (truck bolster air reservoir separated in half). At the No. 1 End, one valve controls the height and pressure of both air springs together, the truck bolster air chambers being cross-connected externally.

The air spring inflation is automatically controlled by the leveling valves which detect variations in spring height due to changes in passenger load. The valves regulate the flow of pressurized air to or from the springs and prevent the latter from deflecting into their limit stops under extreme conditions. Each pair of air springs are arranged so that failure of one spring deflates the other and prevents carbody lean. A compensating valve at the No. 2 End (two valves) transfers air pressure from one side to the other.

NOTE: One of the carbody leveling valves ties in with the Variable Load Valve which forms part of the D-5-A Operating Unit. This valve serves to limit full service and emergency brake cylinder application pipe control pressure to the J-1.2-1 Relay Valve in direct proportion to the air spring pressure present. This will insure a braking effort proportional to the weight on-board (passenger load).

When the air springs are deflated for any reason, the carbody weight rests on rubber bumpers which are not used under normal operating conditions. However, even with deflated springs, the car can be operated with safety although the ride will be very firm. The pneumatic suspension interfaces with the brake system. See Section 5.

10.2.1 System Air Supply

Pressurized air at 130-140 PSI from a branch pipe of the trainlined Main Reservoir Equalizing Pipe (not from the car brake system) is used for the pneumatic suspension subsystem.

10.2.2 System Cutout Cocks

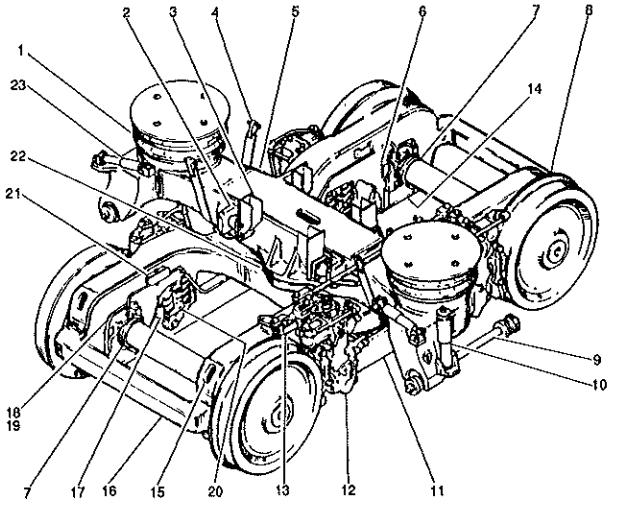
A cutout cock is provided at each truck to permit isolating the system in the event that a major air leak develops en route. The cock is installed upstream from the leveling valve in the MR/EP branch line at each truck, and is readily accessible from outside the car, near the air spring cutout label.

10.2.3 Pre-Run Visual Check of Air Spring Inflation (Fig. 10-1)

The air springs can be visually checked for inflation during the pre-run inspection by comparing the relative position of the bolster anchor rods at the side of the car. If the rods are level, the springs are inflated properly. If the carbody end of the rod is lower than the truck end, the height of that particular air spring is incorrect. If such is the case, report the condition to the Mechanical Department personnel or the Dispatcher.

10.3 TREAD BRAKE UNIT (FIG. 10-1)

The truck is equipped with tread brake units which are mounted directly adjacent to each car wheel. The tread brake unit is a pneumatically applied self contained device with the majority of the operating parts enclosed in a housing. The units accommodate high friction composition brake shoes and have a "built in" automatic slack adjusting feature which maintains brake cylinder piston travel and brake shoe clearance within predetermined limits.



1. Air Spring Assembly
2. Truck Bolster Lateral Bumper
3. Car Mounted Bolster Bumper
4. Safety Strap
5. Truck Bolster
6. Pedestal Liner
7. Magnetic Pickup Toothed Ring
8. 32 in. Diameter Wheels
9. Bolster Anchor Rod
10. Vertical Shock Absorber
11. Equalizer Beam
12. Tread Brake Package Unit
13. Handbrake Rigging (No.1 End Truck, Left Side Only)
14. Pedestal Tie Bar
15. Lifting Point
16. Truck Frame
17. Equalizer Spring Nest
18. Equalizer Seats (not visible on this view)
19. Fabreeka Pad (not visible on this view)
20. Spring Seat
21. Magnetic Pickup Junction Box
22. Central Bearing
23. Lateral Shock Absorber

Figure 10-1
Truck Equipment Arrangement
— Control Trailer Car and Blind Trailer Car

10.4 HANDBRAKE RIGGING (FIG. 10-1)

Handbrake rigging components, which include levers, rods, brackets, etc., are installed on the Left Side of the No. 1 End truck. The mechanical pull created by the operation of the handbrake unit is exerted on the truck-mounted rigging components which transmit a mechanical force to the two tread brake units, one per axle, on that side of the truck. The mechanical chain type handbrake unit which is located in the No. 1 End vestibule, is described in Section 5.

WARNING:

BEFORE MAKING ANY POWER JUMPER CONNECTIONS, VERIFY THAT THE 480 VAC POWER HAS BEEN CUT OFF IN THE LOCOMOTIVE OR AT THE SHOP/WAYSIDE SUPPLY. HANDLE ALL JUMPERS WITH CARE AND IN ACCORD WITH MBTA SAFETY RULES AND REGULATIONS FOR THE PROTECTION OF ALL PERSONNEL AROUND OR UNDER "SET-OUT" (NOT COUPLED TO LOCOMOTIVE) CAR(S). MAKE SURE THE HANDBRAKE IS APPLIED OR THAT THE WHEELS ARE BLOCKED IN THE CASE OF MADE-UP TRAINS. MAKE SURE THE LOCOMOTIVE CREW IS AWARE OF PERSONNEL MOVEMENT.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 11

PRE-RUN INFORMATION

11.1 GENERAL

Before a car or train consist is put into service, it must be inspected and set up to ensure safe operation. The following procedures are provided as a reference to assist the maintenance and/or yard personnel in performing these tasks. Refer to the appropriate Sections for the arrangement and exact locations of the components requiring attention. See consist set-up and car checklist plate (Figure 11-6).

IMPORTANT: Suggested-only procedures follow. MBTA rules and instructions must prevail at all times. Side door motorized equipment checks and operations are required only when electric side door operation mode is used.

11.2 MECHANICAL COUPLING PROCEDURE (FIG. 11-1)

For coupling the cars to form a consist, or coupling the locomotive to the train, proceed as follows:

1. Open either or both coupler knuckles if the cars are on a straight track; open both knuckles if on a curved track.

2. Couple cars and check the TELLTALE recess of each coupler. No portion of the toggle must obstruct the recess.

NOTE: The recess is an inverted "U" shaped notch or slot located in the lower edge of both sidewalls of the lock hole shroud. When the recesses are entirely unobstructed by the toggles, the couplers are properly locked.

3. Check and ensure that the uncoupling rod(s) is (are) in the DOWN and LOCKED position.

4. After coupling each pair of cars, STRETCH THE COUPLING, to be absolutely certain that the couplers are properly locked.

5. Connect all pneumatic and electrical trainlines as discussed in the following text.

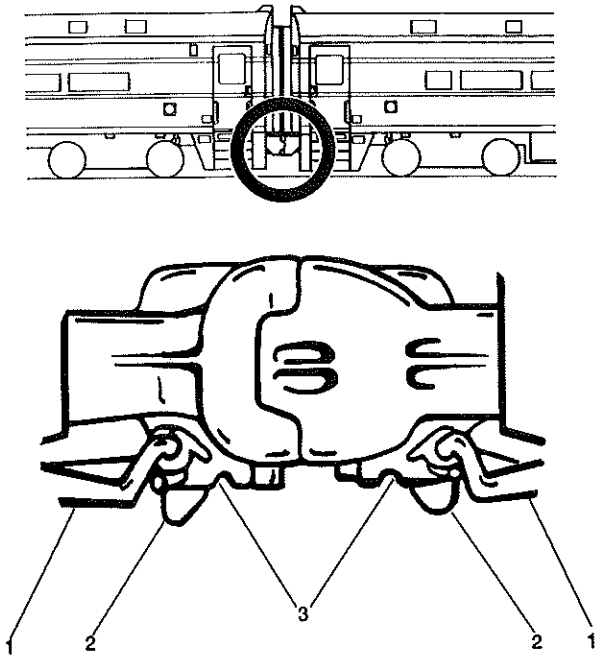
6. Extend and anchor each vestibule safety curtain to the adjacent car.

11.3 PNEUMATIC TRAINLINE CONNECTION PROCEDURE (FIG. 5-3 AND 5-4)

To make the LOCOMOTIVE-TO-TRAIN, CAR-TO-CAR, and END-OF-TRAIN connections, proceed as follows:

TO BE SUPPLIED

NOTE: Instruction plate is located on back of Car Lighting and Control Breaker Panel access door in electrical locker.



1. Uncoupling Rod
2. Toggle
3. Telltale Recesses Entirely Unobstructed

Figure 11-1
Side View of Properly Locked Couplers

1. Between each pair of coupled vehicles (cars or locomotive) connect the BP and MR/EP trainline end hoses on one vehicle to the corresponding hoses on the other vehicle.

2. Connect the BP and MR/EP trainline end hoses to their respective dummy couplings at the extreme end of the control trailer car, and verify that the end cutout cocks are properly CLOSED.

CAUTION: In the next step, on coupled vehicles, once an end cutout cock is OPENED, the operator must proceed without too much delay in OPENING the second cock on the adjacent car (or locomotive) to minimize trainline air loss.

3. OPEN all BP and MR/EP trainline end cutout cocks at the ends of all coupled vehicles (cars and locomotive) except at the extreme end of the trailing car.

11.4 ELECTRICAL TRAINLINE CONNECTIONS AND ARRANGEMENT (FIG. 1-7, 1-8, 11-2 AND 11-3)

A. In addition to the mechanical and pneumatic connections between cars, certain electrical jumper cables must be connected between all cars and electrical power supply car, or auxiliary power source (shop/wayside power supply).

B. Electrical jumper cables and receptacles are provided at each end of the cars for the locomotive-to-train, car-to-car and end-of-train electrical connections. When the jumper cables are connected to their corresponding receptacles throughout the train, this forms four continuous trainlines which are explained in Subsection 11.4.1.

11.4.1 Train Consist Configuration (Fig. 11-2);

The following electrical trainline connection instructions apply to the normal push-pull train configuration, where the control trailer car is located at the end of the train farthest away from the locomotive and where "X" number of cars are arranged in the consist.

The four continuous trainline arrangements are as follows:

A. Head End Power Trainlines (Red);

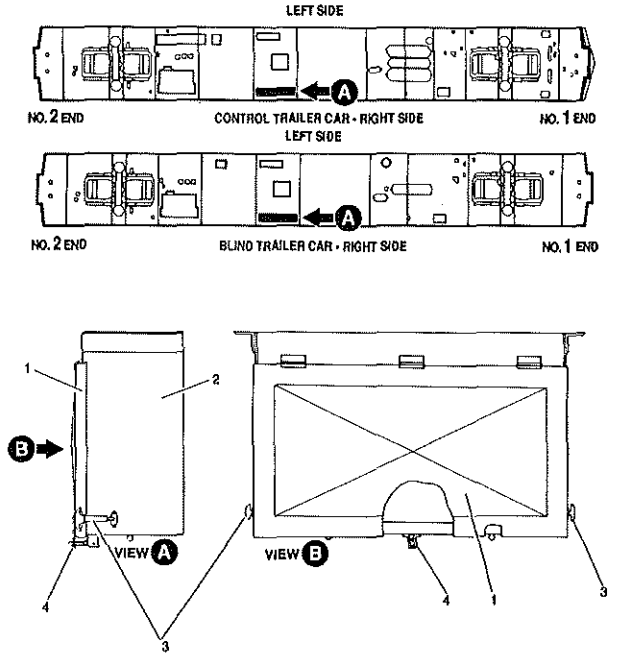
Two (one each side of car) Head End Power trainlines with 6-pin jumper plugs are used for supplying 480 VAC, three phase, 60 Hz power from the locomotive to the cars.

A 480 VAC Head End Power (HEP) trainline jumper is connected to a receptacle coded RED below coupler level, near a mating receptacle coded RED on each side and at both ends of the car, thus making a total of four HEP jumpers and receptacles per car.

RECEPTACLE COLOR CODE

BK — BLACK, LOCOMOTIVE CONTROL
BL — BLUE, DOOR CONTROL AND COMMUNICATION
RD — RED, 480 VAC HEP

Figure 11-2
Electrical Trainline Connections (Top View)
— Control Trailer Car and Blind Trailer Car



1. Jumper Box Hinged Access Door
2. Jumper Box Assembly
3. Door Retainer (shown in retaining position)
4. Spring-loaded Door Safety Latch

Figure 11-3
Jumper and Hose Storage Box, Undercar — Control Trailer Car and Blind Trailer Car

A similar arrangement of HEP jumpers and receptacles coded RED is provided at each end of the locomotive. Shorter cables should be used at the extreme end of the consist to provide a loop circuit and to reduce damage caused by debris.

NOTE: Shorter HEP jumper cables are provided with the Control Trailer Car (at No. 1 End). If the control trailer car is at the end of the consist, the free end of the jumper must be inserted into the RED adjacent receptacle (END-OF-TRAIN connection).

WARNING: BEFORE MAKING "HEP" POWER JUMPER CONNECTIONS, VERIFY THAT THE MAIN POWER CIRCUIT BREAKERS ON THE LOCOMOTIVE OR SHOP/WAYSIDE POWER SUPPLY WHICH CONTROL THE 480 VAC POWER TO THE TRAINLINES, ARE "OFF". THE JUMPERS ARE TO BE HANDLED WITH CARE IN ACCORD WITH ALL RAILROAD SAFETY RULES AND REGULATIONS. ANY DAMAGED JUMPER OR RECEPTACLE MUST NOT BE USED, AND THE MATTER REPORTED TO THE PROPER AUTHORITY.

To establish HEP Trainline connections, with the 480 VAC power supply shut off, proceed as follows:

(1) 120 VAC, 74 VDC and 64 VDC Circuit Breakers;

(a) Control Trailer Car

Place all 120 VAC and 74 VDC circuit breakers, located on the Car Lighting and Control Breaker Panel and on the Control Panel inside the electrical locker in the OFF position.

(b) Blind Trailer Car

Place all 120 VAC and 64 VDC circuit breakers, located on the Car Lighting and Control Breaker Panel and on the Control Panel inside the electrical locker in the OFF position.

(2) 480 VAC Circuit Breakers;

Place all 480 VAC circuit breakers, located on the Car Main Power Breaker Panel in the underframe enclosure of each car, in the OFF position.

(3) LOCOMOTIVE-TO-TRAIN Connections;

Four HEP removable jumper cables which are part of the locomotive equipment are used for the LOCOMOTIVE-TO-TRAIN connections.

— Connect the four removable HEP cables of the locomotive to the RED mating receptacles at the end of the adjacent trailer car.

(4) CAR-TO-CAR Connections;

Four HEP jumper cables are also used for the CAR-TO-CAR connections.

— Connect all HEP jumpers to the RED mating receptacles between each pair of coupled vehicles.

(5) END-OF-TRAIN Connections;

The END-OF-TRAIN connections (extreme end of the control trailer car) are made by inserting the free end of each shorter HEP jumper of the No. 1 End into its adjacent RED mating receptacle (loop connection).

— Looping the 480 VAC power trainline control wires closes the return circuit to the Locomotive, thus permitting the power trainlines to become energized.

CAUTION: Verify that the retaining lugs on the receptacle covers and jumper plugs are correctly engaged at all locations.

NOTE: The cars are equipped with an interlock circuit that requires that all jumpers between cars be connected and that the jumpers on the trailing end of the last car be looped to their adjacent receptacle. If any of the 480 VAC jumpers are disconnected, or improperly connected, the power to all cars will be shut off.

B. Locomotive Control Trainline (Black);

The Locomotive Control trainline is routed along the Right Side of each car with duplicate receptacles at each end.

Two locomotive control trainline (live) receptacles coded black are located at each end of the car, one on each side.

(1) Locomotive-to-Train Connections;

To make the LOCOMOTIVE-TO-TRAIN connections, a similar procedure as used for the HEP cables applies for the LCTL cable.

— Connect one jumper end plug to the mating receptacle coded black on the end of the car, and the other end to the mating receptacle coded BLACK on the locomotive.

(2) Car-to-Car Connections;

To make the CAR-TO-CAR connections, connect the jumper to the BLACK receptacle at the No. 2 End of one car to the BLACK mating receptacle at the No. 1 End of the adjacent car.

CAUTION: Verify that the retaining lugs on the receptacle covers are correctly engaged in the mating grooves on the jumper cable plugs at all locations.

C. Door Control and Communication Trainline (Blue);

The Door Control and Communication Trainline is routed along the Left Side of each car with duplicate receptacles at each end. This trainline with 27 pin jumper plug also accommodates a number of 64/74 VDC control circuits. Some circuits can be used to provide battery power from the control trailer car in emergency conditions (lack of 480 VAC).

Two door control and communication trainline (live) receptacles coded BLUE are located at each end of car, one on each side.

(1) Locomotive-to-Train Connections;

To make the LOCOMOTIVE-TO-TRAIN connections, the procedure is the same as for the other jumper control cable previously described.

— Both cable plugs must be connected in their BLUE mating receptacles on the car End and the locomotive.

(2) CAR-TO-CAR Connections;

To make the CAR-TO-CAR connections, connect the jumper to the BLUE receptacle of one car No. 2 End to the BLUE receptacle at the No. 1 End of the adjacent car. It is also possible to connect No. 1 to No. 1 Ends and No. 2 to No. 2 Ends.

CAUTION: Verify that the retaining lugs on the receptacle covers are correctly engaged in the mating grooves on the jumper cable plugs at all locations.

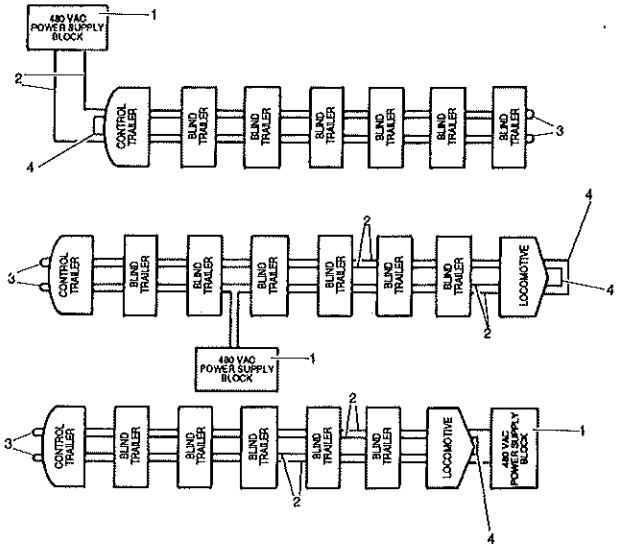
11.4.2 Shop/Wayside Power Supply Connection; (Fig. 11-4)

If the cars or train consist must be powered from a 480 VAC shop/wayside power source, connect the HEP jumpers as shown schematically in Figure 11-4.

11.4.3 Power Distribution Panels and Devices;

Power is supplied at the appropriate voltages through circuit breakers, switches, and other control devices which direct it to the various car support systems, subsystems and components. These control devices are grouped with associated indicators in the following panels and/or locations:

A. Battery Charger Panel (control trailer car), Low Voltage Power Supply Unit (blind trailer car) and/or Control Devices located on underframe on both types of cars. Discussed in Section 3, Electrical Distribution and Lighting Systems.



1. Typical Location, 480 VAC Power Supply
2. Two HEP Jumpers for Trainline, one on each side
3. HEP Jumpers Coded RED, Looped
4. Special Loop Circuit Jumper

Figure 11-4
Shop/Wayside 480 VAC
Power Supply Connections
— Control Trailer Car and Blind Trailer Car

B. Main Power Breaker Panel located underframe (both types of cars). Discussed in Section 3, Electrical Distribution and Lighting Systems (Figure 11-5).

C. Car Lighting and Control Breaker Panel located on the aisle side of the electrical locker (both types of cars). Discussed in Section 3, Electrical Distribution and Lighting Systems.

D. Train Control Circuit Breaker Panel located inside electrical locker on control trailer car only. Discussed in Section 3, Electrical Distribution and Lighting Systems.

E. Door Control Relay Panel located in the No. 2 End vestibule (both types of cars). Discussed in Section 4, Door System.

F. Electrical Locker Panel and/or Control devices (inside locker) at No. 1 End of control trailer car. Discussed in Section 3, Electrical Distribution and Lighting Systems.

G. Vestibule Ceiling Panels located at both ends (both types of cars). Discussed in Section 3, Electrical Distribution and Lighting Systems.

H. Engineman's Control Compartment Panels and/or Control Devices located in the No. 1 End vestibule of the control trailer car. Discussed in Section 2, Engineman's Control Compartment.

I. Side Entrance Door Panels and/or Control Devices located in both vestibules and outside (both types of cars). Discussed in Section 4, Door System.

J. Local Panel and/or Control Devices of Air Conditioning Unit located underframe (both types of cars). Discussed in Section 8, Heating, Ventilation and Air Conditioning System.

K. HVAC System Contactor Panel and/or Control Devices located in the electrical locker (both types of cars). Discussed in Section 8, Heating, Ventilation and Air Conditioning System.

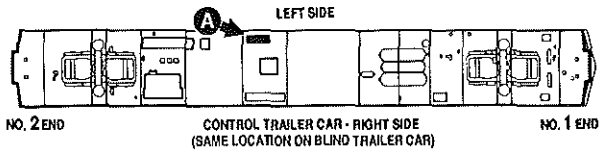
L. Local Panel of Wheel Slide Controller located in electrical locker (both types of cars). Discussed in Section 5, Brake System and Pneumatic Subsystems.

11.5 INSPECTION AND SETUP FOR SERVICE (FIG. 11-6)

These instructions assume that the train is made up and properly supplied with air and electrical power and that electrically-powered side doors are in use.

11.5.1 Exterior of Cars or Consist

Proceed along the length of the exterior of the train consist and perform the following checks and/or setup procedures:



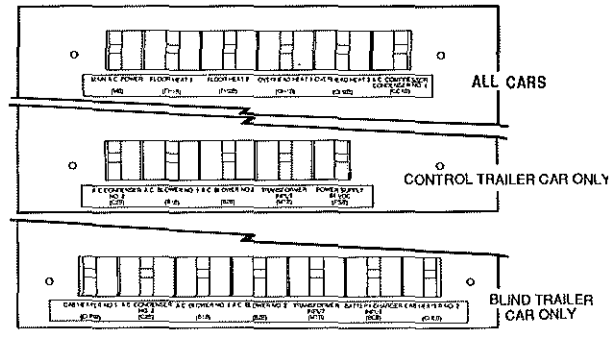
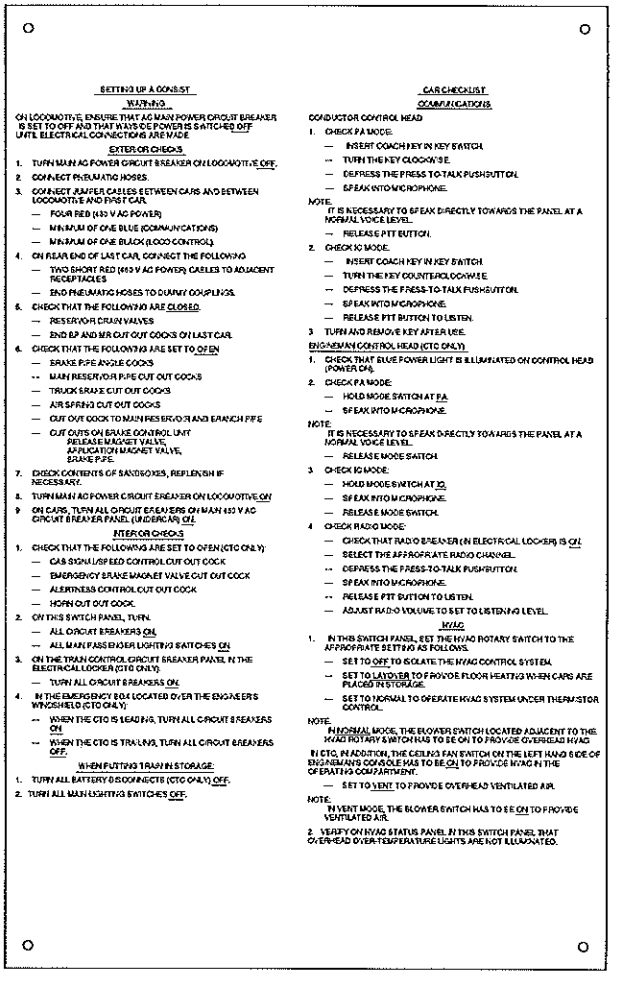


Figure 11-5
Main Power Breaker Panel
— Control Trailer Car and Blind Trailer Car



SETTING UP A CONSIST

WARNING

ON LOCOMOTIVE, ENSURE THAT AC MAIN POWER CIRCUIT BREAKER IS SET TO OFF AND THAT WAYSIDE POWER IS SWITCHED OFF UNTIL ELECTRICAL CONNECTIONS ARE MADE

EXTERIOR CHECKS

1. TURN MAIN AC POWER CIRCUIT BREAKER ON LOCOMOTIVE OFF.
2. CONNECT PNEUMATIC HOSES.
3. CONNECT JUMPER CABLES BETWEEN CARS AND BETWEEN LOCOMOTIVE AND FIRST CAR.
   - FOUR RED (480 V AC POWER)
   - MINIMUM OF ONE BLUE (COMMUNICATIONS)
   - MINIMUM OF ONE BLACK (LOCO CONTROL)
4. ON REAR END OF LAST CAR, CONNECT THE FOLLOWING:
   - TWO SHORT RED (480 V AC POWER) CABLES TO ADJACENT RECEPTACLES
   - END PNEUMATIC HOSES TO DUMMY COUPLINGS.
5. CHECK THAT THE FOLLOWING ARE CLOSED:
   - RESERVOIR DRAIN VALVES
   - END BP AND MR CUT OUT COCKS ON LAST CAR.
6. CHECK THAT THE FOLLOWING ARE SET TO OPEN:
   - BRAKE PIPE ANGLE COCKS
   - MAIN RESERVOIR PIPE CUT OUT COCKS
   - TRUCK BRAKE CUT OUT COCKS
   - AIR SPRING CUT OUT COCKS
   - CUT OUT COCK TO MAIN RESERVOIR AND BRANCH PIPE
   - CUT OUTS ON BRAKE CONTROL UNIT RELEASE MAGNET VALVE, APPLICATION MAGNET VALVE, BRAKE PIPE.
7. CHECK CONTENTS OF SANDBOXES, REPLENISH IF NECESSARY.
8. TURN MAIN AC POWER CIRCUIT BREAKER ON LOCOMOTIVE ON
9. ON CARS, TURN ALL CIRCUIT BREAKERS ON MAIN 480 V AC CIRCUIT BREAKER PANEL (UNDERCAR) ON.

INTERIOR CHECKS

1. CHECK THAT THE FOLLOWING ARE SET TO OPEN (CTC ONLY):
   - CAB SIGNAL/SPEED CONTROL CUT OUT COCK
   - EMERGENCY BRAKE MAGNET VALVE CUT OUT COCK
   - ALERTNESS CONTROL CUT OUT COCK
   - HORN CUT OUT COCK.
2. ON THIS SWITCH PANEL, TURN:
   - ALL CIRCUIT BREAKERS ON.
   - ALL MAIN PASSENGER LIGHTING SWITCHES ON.
3. ON THE TRAIN CONTROL CIRCUIT BREAKER PANEL IN THE ELECTRICAL LOCKER (CTC ONLY):
   - TURN ALL CIRCUIT BREAKERS ON.
4. IN THE EMERGENCY BOX LOCATED OVER THE ENGINEER'S WINDSHIELD (CTC ONLY):
   - WHEN THE CTC IS HEADING, TURN ALL CIRCUIT BREAKERS ON.
   - WHEN THE CTC IS TRAILING, TURN ALL CIRCUIT BREAKERS OFF.

WHEN PUTTING TRAIN IN STORAGE:

1. TURN ALL BATTERY DISCONNECTS (CTC ONLY) OFF.
2. TURN ALL MAIN LIGHTING SWITCHES OFF.

CAR CHECKLIST

COMMUNICATIONS

CONDUCTOR CONTROL HEAD

1. CHECK PA MODE:
   - INSERT COACH KEY IN KEY SWITCH.
   - TURN THE KEY CLOCKWISE.
   - DEPRESS THE PRESS-TO-TALK PUSHBUTTON.
   - SPEAK INTO MICROPHONE.

NOTE:
IT IS NECESSARY TO SPEAK DIRECTLY TOWARDS THE PANEL AT A NORMAL VOICE LEVEL.

   - RELEASE PTT BUTTON.
2. CHECK IC MODE:
   - INSERT COACH KEY IN KEY SWITCH.
   - TURN THE KEY COUNTERCLOCKWISE.
   - DEPRESS THE PRESS-TO-TALK PUSHBUTTON.
   - SPEAK INTO MICROPHONE.
   - RELEASE PTT BUTTON TO LISTEN.
3. TURN AND REMOVE KEY AFTER USE.

ENGINEMAN CONTROL HEAD (CTC ONLY)

1. CHECK THAT BLUE POWER LIGHT IS ILLUMINATED ON CONTROL HEAD (POWER ON).
2. CHECK PA MODE:
   - HOLD MODE SWITCH AT PA.
   - SPEAK INTO MICROPHONE.

NOTE:
IT IS NECESSARY TO SPEAK DIRECTLY TOWARDS THE PANEL AT A NORMAL VOICE LEVEL.

   - RELEASE MODE SWITCH.
3. CHECK IC MODE:
   - HOLD MODE SWITCH AT IC.
   - SPEAK INTO MICROPHONE.
   - RELEASE MODE SWITCH.
4. CHECK RADIO MODE:
   - CHECK THAT RADIO BREAKER (IN ELECTRICAL LOCKER) IS ON.
   - SELECT THE APPROPRIATE RADIO CHANNEL.
   - DEPRESS THE PRESS-TO-TALK PUSHBUTTON.
   - SPEAK INTO MICROPHONE.
   - RELEASE PTT BUTTON TO LISTEN.
   - ADJUST RADIO VOLUME TO SET TO LISTENING LEVEL.

HVAC

1. IN THIS SWITCH PANEL, SET THE HVAC ROTARY SWITCH TO THE APPROPRIATE SETTING AS FOLLOWS:
   - SET TO OFF TO ISOLATE THE HVAC CONTROL SYSTEM.
   - SET TO LAYOVER TO PROVIDE FLOOR HEATING WHEN CARS ARE PLACED IN STORAGE.
   - SET TO NORMAL TO OPERATE HVAC SYSTEM UNDER THERMISTOR CONTROL.

NOTE:
IN NORMAL MODE, THE BLOWER SWITCH LOCATED ADJACENT TO THE HVAC ROTARY SWITCH HAS TO BE ON TO PROVIDE OVERHEAD HVAC.

IN CTC, IN ADDITION, THE CEILING FAN SWITCH ON THE LEFT HAND SIDE OF ENGINEMAN'S CONSOLE HAS TO BE ON TO PROVIDE HVAC IN THE OPERATING COMPARTMENT.

   - SET TO VENT TO PROVIDE OVERHEAD VENTILATED AIR.

NOTE:
IN VENT MODE, THE BLOWER SWITCH HAS TO BE ON TO PROVIDE VENTILATED AIR.

2. VERIFY ON HVAC STATUS PANEL IN THIS SWITCH PANEL THAT OVERHEAD OVER-TEMPERATURE LIGHTS ARE NOT ILLUMINATED.

NOTE: Instruction Plate is located on back of Car Lighting and Control Breaker Panel access door in Electrical locker.

Figure 11-6
Consist Setup/Car Instruction Plate

A. Verify that all mechanical couplings on locomotive and cars are secured properly.

B. Verify that all MR/EP trainline and BP trainline end cutout cocks are in the OPEN position, except at the extreme end of the control trailer car (and locomotive) where the cutout cocks should be in the CLOSED position with the end hoses connected to the dummy couplings.

C. Verify that all brake subsystem cutout cocks, air spring line, brake cylinder line, main reservoir line, combined dirt collector/cutout cock, etc., are in the appropriate position (see Section 5).

D. Verify that all pneumatic system drain cocks are in the CLOSED position.

E. Verify that all locomotive-to-train, car-to-car, and end-of-train electrical jumper connections are properly made.

F. Verify that all the 480 VAC circuit breakers, located on the Main Power Breaker Panel, in the undercar enclosure are in the ON position.

G. With the back cover open on the undercar A/C unit control panel, verify that the operation mode rotary selector switch (HTS) is in the AUTO position.

11.5.2 Interior of Cars in Consist

Proceed along the length of the interior of the train consist and perform the following checks and/or setup procedures in each car:

A. Verify that the safety bar at the extreme end car coupled to the locomotive is secured and that the collision post door at the No. 1 End of the control trailer car is closed and dogged.

B. Verify that both walkway plates are laying flat and are secured properly.

C. Extend and anchor each safety curtain to the adjacent car.

D. In all car vestibules, verify that the passenger compartment end doors operate properly. In the center of each car, verify the presence and condition of the fire extinguisher. At No. 2 End of passenger compartment, verify the presence and condition of emergency tools.

E. On the Car Lighting and Control Breaker Panel, in the electrical locker, verify that all 64/74 VDC and 120 VAC circuit breakers are in the ON position (For manual door operation, Door Operators Breaker DOB remains OFF). In addition:

(1) Lighting switches as conditions dictate.

(2) Door unlatch switch in the ON position.

(3) Door Control Zone switch in the THRU position.

(4) HVAC Selector Switch (HSS) in the NORMAL position.

(5) Test the lamp circuits of the HVAC indicating lights (PUSH-TO-TEST).

F. At the Door Control Relay Panel, verify that the Door Control Zone switch is in the THRU position.

G. At each Master Side Door Control Panel, test indicating lights, commands and motorized door operations. If manual mode used, slide each side door open and close.

H. Ensure the side door mechanical locks are properly set.

I. Ensure that all handbrakes are fully released.

11.6 CONTROL TRAILER CAR AIR BRAKE AND OPERATING CONTROL SETUP

In the following instructions, it is assumed that the additional circuit breakers on the control trailer car Train Control Circuit Breaker Panel, the air supply cutout cocks on the control trailer car and the brake controls and switches in the locomotive have been positioned properly.

11.6.1 Control Trailer Car as Leading Unit (Fig. 2-4 to 2-8)

To condition the control trailer car for leading, the train being stopped:

A. Place ENGINE RUN (ERB) and GENERATOR FIELD (GFB), and ELECTRO-PNEUMATIC BRAKE (EPB) circuit breakers in ON position.

B. Move the master controller key to the FORWARD position, and proceed as follows:

C. Place the following circuit breakers in ON position on the Train Control Circuit Breaker Panel: Number Boards (CNB), Gauge Lights (GLB), Headlights (HLB), Windshield Heater (WHB), and Radio (RB).

D. Place the CAB SIGNAL SYSTEM (TCB) circuit breaker in the ON position.

E. Place the ALERTOR (ACB) circuit breaker in ON position and also the SPEED RECORDER (SRB) circuit breaker in ON position. Then acknowledge. Check that the speed audible alarm and overspeed light are in OFF position.

F. Check the operation of the following equipment: ceiling HVAC fan, cab heaters, windshield wipers, windshield heaters, headlights, undercar bell, train sanding, radio and communication system.

G. Check the lamp circuit of all indicating lights (PUSH-TO-TEST).

H. Verify that the following indicating lights are OFF: DYNAMIC BRAKE RESET, WHEEL SLIP, TRACTION POWER AND BRAKE ON, BRAKE RELEASED, ALERTOR RESET, HEATER FAN FAILURE, ELECTRO-PNEUMATIC BRAKE.

I. Verify that the HEAD END POWER ON indicating light is ON.

J. Observe the air pressure gauges: ER should be zero PSIG; BP should be zero PSIG; MR should be fully charged (130 PSIG, compressor running); and BC should be Emergency (71-76 PSIG).

K. Check that the BRAKE APPLIED, PCS OPEN and DOOR CLOSED indicating lights are ON.

NOTE: An Emergency brake application should have occurred. Make sure pneumatic venting devices have reset before proceeding.

L. The 26-C automatic brake valve being in the HANDLE OFF position, insert the brake valve handle and move it to the RELEASE position.

M. Observe the air gauges: ER should increase to 110 PSIG. If this pressure is not reached, report to Maintenance personnel.

N. Move the 26-C brake valve to the EMERGENCY position; ER and BP air pressure gauges should reduce to zero PSIG.

O. Verify that the PCS OPEN indicating light is ON.

P. Cut in the 26-C brake valve by manually depressing the cutoff pilot valve handle and turning it 180 degrees clockwise to the PASS position.

Q. Move the 26-C brake valve to the RELEASE position. Observe that the BRAKE RELEASED indicating light on the Right Side panel is ON. Check that the PCS OPEN and BRAKE APPLIED indicating lights are OFF.

WARNING: THIS ACTION WILL CAUSE PNEUMATIC BRAKE TO RELEASE. MAKE SURE THAT ALL HAND BRAKES ARE RELEASED BEFORE ATTEMPTING TO MOVE THE TRAIN. FAILURE TO COMPLY COULD RESULT IN INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT. PERFORM INITIAL TERMINAL AIR BRAKE TEST (AS PER AUTHORITY RULES) PRIOR TO MOVING TRAIN.

NOTE: When BRAKE RELEASED light is turned ON, the brakes are released and no handbrakes are applied.

R. Check that all doors are closed and the DOOR CLOSED indicating light is ON. (If power doors connected).

NOTE: An open local door will keep the DOOR CLOSED indicating light ON.

S. Move the master controller throttle handle from the IDLE position to 1 or a higher position.

NOTE: The locomotive power may be turned OFF by placing the GEN. FIELD circuit breaker in OFF position.

11.6.2 Control Trailer Car as Trailing Unit

To condition the control trailer car for the trailing mode, the train being stopped, proceed as follows:

A. Move the master controller throttle handle to the IDLE position.

B. Make a FULL SERVICE brake application.

C. Turn the REVERSER KEY switch of the master controller to the KO (key out) position, and remove the key.

D. Verify that the EMERGENCY SHUT DOWN switch (ESS) remains in the RUN position.

E. Verify that the following equipment controls are in the OFF position: ceiling HVAC fan, control trailer car heaters, windshield heaters, windshield wiper, headlights, undercar bell, etc.

F. Move the 26-C brake valve handle to the EMERGENCY position.

G. Move the 26-C brake valve to the HANDLE OFF position and verify that the Brake Pipe has reduced and remains at zero PSIG.

H. Remove the 26-C brake valve handle and place it in the handle storage box.

WARNING: BEFORE THE BRAKE VALVE IS CUT OUT, THE BRAKE CYLINDER GAUGE MUST INDICATE THAT THE FULL PRESSURE (71-76 PSIG) IS EFFECTIVE IN THE BRAKE CYLINDERS. THIS PRECAUTION WILL HELP PREVENT UNINTENTIONAL MOVEMENT OF THE TRAIN AND POTENTIAL PERSONAL INJURY. MAKE SURE THE GAUGE IS FUNCTIONING ACCURATELY.

I. Cut out the 26-C brake valve by manually depressing the cutoff valve knob and turning it counterclockwise to the OUT position. Verify that the handle is securely in position by observing it pop back out and resist turning.

J. Place the GENERATOR FIELD (GFB) circuit breaker and the ENGINE RUN (ERB) circuit breaker in the OFF position. Keep the ELECTRO-PNEUMATIC BRAKE (EPB) circuit breaker in ON position.

K. Place the following circuit breakers on the Train Control Circuit Breaker Panel in the OFF position: RADIO (RB), CAB SIGNAL SYSTEM (TCB), ALERTOR SYSTEM (ACB), HEADLIGHTS (HLB), GAUGE LIGHTS (GLB), WINDSHIELD HEATER (WHB), and NUMBER BOARD (CNB).

L. Place the MARKER LIGHT circuit breaker in ON position, including the Marker Light switch.

M. Turn vestibule ceiling light switch ON.

N. Observe the air gauges: ER pressure is zero PSIG; MR pressure is 130 PSIG or greater (compressor running); and BC pressure is 71 to 76 PSIG.

CAUTION: If these conditions do not prevail, do not leave control trailer car unattended. If car and/or train is to be left unattended for several minutes or longer, a suitable number of handbrakes must be applied.

11.6.3 Control Trailer Car for "Hauling Dead"

To condition the control trailer car for "hauling dead" in the train, the train being stopped, proceed as follows:

A. If Brake Pipe and Main Reservoir air pressures are present, make a brake application by moving the 26-C automatic brake valve to the HANDLE OFF position (if no MR air pressure is available, the handbrake must be applied).

NOTE: Equalizing Reservoir pressure and Brake Pipe pressure should reduce to (or approach) ZERO. Verify that full Brake Cylinder pressure is present.

B. Follow procedure described in Paragraph 11.6.2 for conditioning Control Trailer Car as Trailing Unit.

C. Open the BP Air cutout cock called "Dead Engine" (Car) fixture cutout cock under the control trailer car (near C-1-3-8 strainer and check valve). Cutout cock is normally closed.

NOTE: This will allow BP trainline air flow to the MR/EP and to the brake valve for CHARGING the brake equipment in the mode of operation where no MR/EP pressure is available.

11.7 CONTROL TRAILER CAR AND BLIND TRAILER CAR TOWING INSTRUCTIONS

NOTE: A cripple train is a train taking unserviceable (crippled) rolling stock to a shop for repair.

The purpose of the following text is to define the safe limits of moving a control trailer car or a blind trailer car in freight or cripple trains. The scope includes setup of the car prior to movement and speed limits imposed. The Carrier's rules will dictate operating procedures and are not covered here.

11.7.1 Securement

A. When the car is to be left unattended and not part of a consist, apply the handbrake.

B. When the car is to be left unattended, close all traps and doors.

C. Ensure all air hoses not connected to another car are held up by safety chains and have dummy couplings installed.

D. Power and control jumpers not connected to another car should be removed and placed inside the jumper box.

NOTE: This is not true for the end car of a train in revenue service. The HEP jumpers at the No. 1 End of the control trailer car must be looped in their receptacles coded RED.

E. Ensure that the air to each truck and the air bags is cut in, unless cut out due to damage of components or piping part of the air system (leveling valve linkage properly connected).

F. Prior to movement, ensure the handbrake is released.

11.7.2 Location in Consist

A. Freight: Place the car at the end furthest from the locomotive(s). Where operation of trains includes use of a caboose at the rear of the train, the blind trailer car will be placed immediately in front of the caboose. Position the Graduate/Direct Release Cap of the 26-C Brake Valve service portion (undercar) in the Direct Release position.

B. Passenger: Cars may be placed in any position within a consist of passenger cars, including self-propelled diesel or electric cars using AAR standard "H" type knuckle couplers. Position the Graduate/Direct Release Cap of the 26-C Brake Valve service position (undercar) in the Graduated Release position.

11.7.3 Connections

A. After a hitch is made between couplers or with a compromise coupler, ensure the knuckle is locked and the cutting handles are in the secure position.

B. Attach all brake pipe hoses with those on adjoining equipment.

C. Main reservoir and equalizing pipe hose does not need to be connected if the control trailer car or the blind trailer car is at the end of the train.

D. After all air hoses are connected, ensure the rearmost hose angle cock is closed when used at end of train. The handle should be perpendicular to the pipe. Open all angle cocks in the consist except the two at the ends of the train.

E. Wheel slip (decelostat) circuits are operating as long as there is power. There is no need to turn this circuit ON or OFF.

F. On control trailer car only, open the BP air cutout cock called "Dead Engine" fixture cutout cock near (C-1-3-8) strainer and check valve (normally closed).

11.7.4 Inspections

A. Ensure the handbrakes are released.

B. Ensure the service and emergency brakes function in accordance with practices for predeparture tests.

C. Inspect air bags to be sure they are inflated, unless damage prevents this.

D. Inspect to ensure contacting buffers (bottom cross members on diaphragms) have at least 3 inches of height overlapping with adjoining equipment buffers. This is not applicable to freight cars.

11.7.5 Restrictions

A. There are no restrictions placed on consists containing control trailer cars or blind trailer cars in good operating condition.

B. When one or more pairs of air bags are deflated, consult the operating timetables for applicable speeds.

C. The Dispatcher should be notified immediately of defective car(s).

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 12

EN ROUTE INFORMATION

12.1 GENERAL

This Section contains the operating procedures to be performed en route by the operating personnel regarding the systems and/or devices which require attention. Coverage is limited to systems and/or devices for which the operation is not self-evident. These instructions assume that all circuit breakers, switches, control devices, etc., have been placed in the appropriate positions as discussed in Section 11, Pre-Run Information. Refer to the appropriate Sections for the arrangement and exact locations of the components requiring attention.

IMPORTANT: The following procedures are suggested, and are not to be assumed to be complete. Overall train, power, brake and operating instructions as issued by the Carrier must prevail.

12.2 DOOR CONTROLS (POWER MODE)

The following is the description for POWER side door En Route operations. Conversion of equipment setup and connections from manual operation is assumed completed and tested for safe and normal electric operation.

CAUTION: A side door cannot be opened manually (manual mode, or with emergency handle) or electrically (power mode), if the key-actuated mechanical lock (rear wall of vestibule) has been placed in the LOCKED position.

12.2.1 Opening Side Doors from Exterior Crew Key Switch (Fig. 4-3)

NOTE: The door operators and door control circuit breakers must be in the ON position. Local door operator cutout switch must be in normal position.

A. Lift the spring closed hinged cover of the exterior crew key switch, and insert the MBTA coach key.

B. Turn key CW to the DOOR OPEN position.

C. Return key to OFF and remove it.

D. At a low level location, stand on the first step, actuate the trap door latch, and raise the trap door to its upper latched position.

NOTE: A door left open after the car is entered in this manner can be closed from any vestibule Master Side Door Control Panel and its associated key switch on that side of the train. The door can also be closed by turning the coach key CCW to the DOOR CLOSE position in the same crew key switch as used to open the door. Either method of door closing requires that the trap door be closed.

12.2.2 Opening Side Doors from Vestibule Master Side Door Control Panel (Fig. 4-4)

To open side doors on the same side of the train from any Master Side Door Control Panel on that side of the train and within the same control zone, proceed as follows:

A. Insert the MBTA coach key in the key switch of the Master Side Door Control Panel, and turn it CW to energize panel.

B. Depress the OPEN button marked THIS DOOR ONLY for the adjacent door.

C. Depress the OPEN buttons for the remote doors.

D. At a LOW LEVEL location, depress the foot released latch of the trap door, and raise the latter to its upper latched position.

12.2.3 Closing Side Doors from Vestibule Master Side Door Control Panel (Fig. 4-4)

A. At a low level location, lower trap door and latch it in the DOWN position.

B. Depress the CLOSE buttons for the LEFT and RIGHT trainline doors.

C. Verify that the GREEN panel lights (one LEFT and RIGHT) for the doors having been closed come ON to indicate that the doors are CLOSED and LOCKED.

D. Depress the CLOSE button marked THIS DOOR ONLY for the adjacent door, and verify that its associated GREEN panel light goes ON to indicate that the door is CLOSED AND LOCKED. If the light remains OFF, the local door is not CLOSED properly.

12.2.4 Bypassing Defective Side Door Operator Circuits (Fig. 4-2)

To isolate the door operator from the door system by means of the operator bypass toggle switch in the event of a malfunction, proceed as follows:

A. Push the malfunctioning side door to its FULLY CLOSED and LOCKED position manually.

B. Open the associated door operator access panel located in the passenger compartment.

C. Place the toggle switch in the CUTOUT position at that operator location or the Remote Cutout Switch located in the electrical locker.

D. Rotate mechanical lock assembly (rear vestibule wall) to locked position.

WARNING: WHEN A MALFUNCTION REQUIRES THAT A DOOR OPERATOR BE BYPASSED IN THE PRECEDING MANNER, THE DOOR PANEL MUST BE MANUALLY CLOSED AND THE KEY OPERATED MECHANICAL LOCK ASSEMBLY MUST BE ROTATED TO THE "LOCKED" POSITION. THE LOCK WILL PREVENT THE DOOR PANEL FROM BEING ACCIDENTLY OPENED.

12.2.5 Breaking Side Door Control Trainline into Zones (Fig. 4-5)

If it is desired to deadhead certain cars within the train, as for example on off-peak trains, select a group of cars at the front or rear of the train for deadheading.

A. If the group is at the head end, go to the last door that is to remain closed and turn the adjacent DOOR CONTROL ZONE switch to CUTOUT position. All doors to the rear of that door will continue to function when actuated by any Master Side Door Control Panel to the rear.

B. If the group is at the rear end, go to the first (forward) door that is to remain closed and turn the adjacent DOOR CONTROL ZONE switch to CUTOUT position. All doors forward of that door will continue to function when actuated by any Master Side Door Control Panel forward of that point.

C. At the end of the trip, turn all DOOR CONTROL ZONE switches back to THRU position.

12.2.6 Bypassing Side Door/Traction Interlock Circuit in Control Trailer Car (Fig. 4-5)

If the locomotive is unable to produce traction power due to a false DOOR OPEN or UNLOCKED signal being transmitted to the control trailer car, the circuitry can be bypassed by means of the Bypass Door Interlock toggle switch as follows:

WARNING: IT MUST BE ASCERTAINED (PHYSICAL CHECK) THAT ALL TRAIN DOORS HAVE BEEN "CLOSED" AND "LOCKED" BEFORE THE TRACTION INTERLOCK CIRCUIT IS BYPASSED IN THIS MANNER, AND THE CIRCUMSTANCES MUST BE REPORTED TO THE AUTHORIZED PERSONNEL.

A. The train should be stopped with the brakes applied and the reverser key switch in the NEUTRAL position. Locate the switch labelled SBDI in the electrical locker of the control trailer car.

B. Break the seal (lead and wire) of the switch and place it in the BYPASS position to allow the train to continue normally.

12.2.7 Bypassing Side Door No-Motion Circuit in Blind Trailer Car (Fig. 4-5)

If the train doors CANNOT BE OPENED due to a defective no-motion relay circuit, the circuitry can be bypassed by means of the Side Door No-Motion Bypass toggle switch as follows:

WARNING: THE NO-MOTION RELAY CIRCUIT MUST NOT BE BYPASSED IN THIS MANNER WHILE THE TRAIN IS MOVING AND THE CIRCUMSTANCES MUST BE REPORTED TO THE AUTHORIZED PERSONNEL.

A. The train should be stopped with the brakes applied (and the reverser key switch in the NEUTRAL position in the Control Trailer Car). Locate the switch labelled DOOR NO-MOTION (SBDN) in the electrical locker.

B. Break the seal (lead and wire) of the toggle switch and place it in the BYPASS position to allow OPENING the doors.

C. RECLOSE the side doors and place the switch in the NORMAL position before moving the train, and install the seal. As soon as possible, inform the appropriate personnel of the problem.

12.2.8 Overriding Body End Door Unlatch Circuit (Fig. 4-5)

The train crew can override the trainlined electromagnet circuit of the body end door latch/catch assemblies by means of the DOOR UNLATCH toggle switch on the door control panel within the electrical locker of any car.

NOTE: The DOOR UNLATCH switch of a car can only control the two body end doors of that particular car.

A. To allow the end doors of a car to be unlatched for closing automatically upon traction power order from the leading unit, control trailer car or locomotive, the switch must be kept in the NORMAL position.

B. To prevent the doors from being REMOTELY CLOSED, the switch must be placed in the CUTOUT position.

12.2.9 Opening Side Door Locally for Train Entering the Station or Leaving the Station

A. High Level Platform

With the trap doors closed, placing the key in a Master Side Door Control Panel allows a crew member to open the adjacent side door by means of the center RED button, and observe the loading platform while the train is entering and leaving a station. The crew member can then respond to any unusual situation by voice or signal bell communication with the engineman. During high level platform operation, this will be the only door allowed to open while the train is moving.

B. Low Level Platform

The door control system functions in such a way that only those doors which have been opened by the use of a key-energized Master Side Door Control Panel, therefore by an authorized Railroad employee, and have had their trap doors lifted, can be open. This means that only those doors that are required for loading and unloading passengers are removed from "door closed" protection. All other doors still remain under the "door closed" protection system. The door control system also assures the "door closed" protection is automatically reinstated for that door station whenever the trap door is closed, and the traction power is removed momentarily until the door is completely closed. Do not attempt to open remote doors from more than one Master Side Door Control Panel.

12.2.10 Required Position and/or Condition of Door System/Traction Breakers, Switches and Devices

For NORMAL train operation, the proper position and/or condition of door system/traction breakers, switches and devices are as follows in each car.

DEVICES	POSITION
A. DOOR OPERATORS breaker (DOB) (OFF position when manual mode)	ON
B. DOOR CONTROL breaker (DCB) **(MUST BE ON** when manual mode)	ON
C. DOOR CONTROL ZONE switch(es)	THRU
D. Side Door Mechanical Lock(s)	UNLOCKED
E. Side Door Operator CUTOUT switch(es) and Remote Cutout switch(es)	NORMAL
F. Trap Door(s) and switch(es)	CLOSED
G. Side Door Emergency Handle(s)	RESET

DEVICES	POSITION
H. Body End DOOR UNLATCH switch(es)	NORMAL
I. Side Door No-Motion Bypass (SBDN) switch (For manual door operation, switch is placed in Bypass)	NORMAL
J. Side Door/Traction Interlock Bypass (SBDI) switch	NORMAL

12.3 HEATING, VENTILATION AND AIR CONDITIONING CONTROLS (FIG. 3-10)

Once the HVAC system is activated, the cooling and heating functions will be controlled automatically without intervention. To turn the system ON, proceed as follows:

A. In addition to the circuit breakers discussed in Section 11, place the four-position rotary selector switch, labelled HVAC, in the NORMAL position.

B. Place the two-position toggle switch labelled BLOWER in the ON position.

C. Observe the indicating lights which are labelled 1st stage Floor Heat, 2nd stage Floor Heat, 1st stage Overhead Heat, 2nd stage Overhead Heat, Partial Cool, Full Cool, Overtemp No.1 End, Overtemp No.2 End.

D. If ventilation only is desired, set the HVAC rotary selector switch to VENT and leave BLOWER toggle switch ON.

E. If the outside temperature is 45°F or below, verify that the PROTECTIVE HEATERS (PHB) and COMPRESSOR CRANKCASE HEATER (CCHB) circuit breakers are in the ON position.

12.4 PUBLIC ADDRESS AND INTERCOM CONTROLS (FIG. 7-1 AND 7-2)

The public address and intercom control panels are used as follows:

12.4.1 Using Public Address System

A. To make an announcement from the PA and IC control panel (Conductor's panel), proceed as follows:

(1) Insert the MBTA coach key into the panel keyway, and rotate the key CW to the PA position.

(2) Depress the push button switch labelled PRESS TO TALK (PTT) and, speaking into the microphone, make the announcement clearly and distinctly at a normal voice level.

(3) After the announcement has been completed, return the key to OFF and remove it.

B. To make an announcement from the remote control head (Engineman's panel) while the No. 1 End vestibule is being used as an operating compartment, proceed as follows:

(1) Verify that the master controller reverser key switch is in an operating position (FORWARD, NEUTRAL or REVERSE).

(2) Depress the COMMUNICATION MODE spring-return toggle switch and hold it in the PA position while speaking directly toward the panel at a normal voice level.

(3) After the announcement has been made, release the switch lever to permit its spring-return to the RADIO position.

12.4.2 Using Intercom System

A. To hold a private conversation from car to car, proceed as follows:

(1) Page the person you wish to speak to over the PA system as described previously, and release the PTT.

(2) Rotate the key CCW to the IC position, and wait for the person's answer.

(3) The paged party should then insert the key in the nearest PA and IC panel (Conductor's panel), depress the PTT switch, and speak into the microphone to acknowledge the call.

(4) Conversation is carried on by alternately depressing the PTT switch to talk and releasing it to listen.

NOTE: All IC conversations in the control trailer car operating compartment will be heard over the PA and IC panel located behind the Engineman.

B. To hold a private conversation from car to car operating compartment (control trailer car), proceed as follows:

(1) It is not necessary to page the Engineman over the PA; merely rotate the key to the IC position, depress the PTT switch, and carry on the communication as described previously.

(2) In the operating compartment, the conversation can be carried on by alternately lifting the COMMUNICATION MODE switch toggle to the IC position and releasing to listen.

12.5 CONTROL TRAILER CAR RADIO CONTROLS (FIG. 2-5 AND 7-1)

When the No. 1 End vestibule is used as an operating compartment, the remote control head (RADIO, PA and IC) can be energized by placing the master controller key switch in an operating position (FORWARD, NEUTRAL or REVERSE).

12.5.1 Receiving with Control Trailer Car Radio

A. Turn the CHANNEL rotary selector switch to the desired frequency.

B. Turn the VOLUME control knob CW and set it to the desired listening level when the signals are heard over the monitor speaker.

12.5.2 Transmitting with Control Trailer Car Radio

A. Turn the CHANNEL rotary selector switch to the desired frequency.

B. Listen to make sure that the channel is clear.

C. When the channel is clear, depress the PTT switch button and identify yourself and the station being called.

D. Speak directly towards the panel at a normal voice level.

NOTE: The transmitter will shut off after one minute of continuous operation. This is indicated by an alert tone from the speaker. Release the PTT button momentarily to reset the timer.

E. Release the PTT button to listen.

12.6 HANDBRAKE (FIG. 5-6)

To operate the handbrake which is installed in the No. 1 End vestibule, proceed as follows:

12.6.1 Applying Handbrake

A. Operate the "apply" hand lever upward (pumping action) until the resistance felt indicates that the brake is applied.

B. Do not manipulate the trip (release) lever in any way while the brake is being set.

C. Return the "apply" hand lever to its retainer spring clip, as far back as it will go, and leave it in that position.

WARNING: IF HANDBRAKE APPLICATION CANNOT BE ASSURED, AND ACCIDENTAL MOVEMENT OF THE CAR MUST BE PREVENTED, USE WHEEL CHOCKS.

12.6.2 Releasing Handbrake

A. Do not manipulate the "apply" lever in any way while the brake is being released.

B. Pull outward and upward on the trip (release) lever until the chain weight and its rubber snubber come up against the bottom of the brake housing.

C. If the weight does not come up to the housing, reach in and pull down on the rear chain which runs from the handbrake through the floor.

CAUTION: Since a car must never be operated with the handbrake partially applied, make sure the chain weight/rubber snubber are up against the bottom of the housing. If not, the brake must again be fully set and then released. If full release cannot be assured, damage may result from car operation.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 13

SHUTDOWN INFORMATION

13.1 SHUTTING DOWN CARS WITH IMMEDIATE TURNAROUND

13.1.1 Control Trailer Car

At the end of a service run with immediate turnaround, when the Engineman's operating station is changed from the control trailer car to the locomotive, one must complete the Air Brake and Operating Control Setup procedure of the Control Trailer Car converted as a Trailing Unit.

13.1.2 All Cars

Complete the Inspection and Setup for Service procedure described in Section 11.

NOTE: Vestibule lights, platform lights, and passenger compartment lights should remain ON as conditions dictate.

13.2 SHUTTING DOWN CARS FOR LONG TERM LAYOVER WITHOUT POWER

A. On all cars, place all 120 VAC and 74/64 VDC circuit breakers in the OFF position on the Car Lighting and Control Breaker Panel inside the electrical locker.

B. On all cars, place all 480 VAC circuit breakers in the OFF position on the undercar Main Power Breaker Panel.

C. On control trailer car only, place all circuit breakers in the OFF position on the Train Control Circuit Breaker Panel inside the electrical locker.

D. On control trailer car, place the battery disconnect switch in the OFF position.

13.3 UNCOUPLING PROCEDURE

To uncouple cars, the 480 VAC power being cut OFF, proceed as follows:

A. Close all pneumatic trainline end cutout cocks, disconnect all end hoses, and secure the latter with the dummy couplings.

B. Disconnect all trainline jumper cables. Secure the free ends of the HEP jumper cables by connecting the plugs into the dummy receptacles at both ends. Store the control trainline jumpers in the jumper box located on the Left Side at the No. 2 End of each car.

WARNING: BEFORE UNCOUPLING A "SET OUT" (SINGLE) CAR, THE HANDBRAKE MUST BE APPLIED OR THE WHEELS MUST BE BLOCKED AT BOTH ENDS OF THE CAR TO PREVENT ACCIDENTAL MOVEMENT.

C. Take in coupler slack (place in BUFF).

D. With slack in, lift and rotate the uncoupling lever to the UP (RELEASE) position (on either side).

E. Keeping the lever in the RELEASE position, pull car away from consist.

NOTE: The vestibule safety curtains will automatically unlatch and retract when cars are uncoupled.

SECTION 14

EMERGENCY INFORMATION

14.1 OPENING BODY END DOORS (FIG. 1-1, 1-2 AND 4-1)

The body end door can be pushed OPEN manually from inside the compartment, whether the door has been locked or not, without the use of the MBTA coach key. If the train is moving at more than 3 MPH, in order for the door to be held by the mechanically engaged latch and catch assembly, it will be necessary to place the DOOR UNLATCH SWITCH (DUS) in the CUTOUT position. (In the electrical locker).

Push the door to the FULLY OPEN position so that it can be held there by means of the mechanically engaged latch and catch assembly.

14.2 OPENING SIDE ENTRANCE DOORS FROM INSIDE THE CAR (DOORS IN POWER MODE) (FIG. 4-1 AND 4-2)

From inside the car, there are two methods to mechanically disengage a door operator from a related side door, allowing manual opening in an emergency or in case of door operator malfunction: In the end vestibule, passengers or train crew may pull the ceiling emergency handle or, in the passenger compartment, the train crew may open the door operator access door and rotate the emergency reset handle (coded RED) on the door operator.

Open access door to adjacent door pocket to reach door operators. To access door operator 1R in the electrical locker, remove retaining hardware and swing open the HVAC panel.

NOTE: Emergency handles release side door about one inch. Door can then be pushed FULLY OPEN manually.

14.3 OPENING SIDE ENTRANCE DOORS FROM OUTSIDE THE CAR (DOORS IN POWER MODE) (FIG. 4-3)

In an emergency, the vestibule side entrance doors can be OPENED manually from outside the car at four locations. An emergency handle is accessible through a breakable glass in a recessed enclosure near each side door. The glass is marked with RED lettering which reads EMERGENCY DOOR HANDLE.

To break glass, strike it with a hard object. Pull handle and the side door will unlock, but will open about 1 inch only. Push door FULLY OPEN manually.

14.4 OPENING EMERGENCY ESCAPE WINDOWS FROM INSIDE THE CAR (FIG. 1-3)

In an emergency, four window assemblies can be opened from the passenger compartment at the following locations on all cars:

L-11, R-8, L-4 and R-1.

To open the window in an EMERGENCY, proceed as follows:

A. Pull the first handle marked EMERGENCY EXIT, which is attached to the rubber filler strip, until the strip is fully disengaged from the center of the larger rubber seal strip which surrounds the window.

B. After the filler strip has been "zippered out" of the seal strip completely, pull the second handle marked PULL GLASS (fixed onto glass with screws) and pull the glass into the car to disengage it from the rubber glazing strip.

C. Once the glass panel is disengaged from the seal, turn the glass and push it out of the car.

14.5 EMERGENCY TOOL SET (FIG. 1-3)

A set of emergency tools is mounted in a flush type enclosure located above the L-11 emergency window. The tool set consists of a sledge hammer, a pinch/pry bar and a metal cutting saw. The enclosure is closed off by means of a removable polycarbonate panel that carries the words EMERGENCY TOOLS painted in RED.

To remove the panel, pull via the hole to remove it from the holding rubber.

14.6 FIRE EXTINGUISHER (FIG. 1-3)

A fire extinguisher is mounted in the center of the passenger compartment above the luggage rack on the Right Side. The fire extinguisher, which is of the dry chemical type that can be used on all types of fires, is readily accessible by opening the hold down clamp.

WARNING: FOLLOW THE INSTRUCTIONS GIVEN ON THE NAMEPLATE OF THE FIRE EXTINGUISHER. IN CASE OF FIRE IN ANY ELECTRICAL EQUIPMENT, POWER MUST BE REMOVED IMMEDIATELY. ALERT PUBLIC FIRE DEPARTMENT WHETHER EQUIPMENT IS ENERGIZED OR NOT.

14.7 FUSEES AND TORPEDOES

The fusees and torpedoes are kept in a storage box which is located in the electrical locker of both types of cars. The box is mounted on the interior surface of the locker access door. Use these devices as required by operating rules.

14.8 EMERGENCY BRAKE VALVE (FIG. 1-1, 1-2 AND 5-5)

Both types of cars are provided with two emergency brake valves which are located at diagonally opposed corners of the passenger compartment. The No. 1 End valve is recessed into the electrical locker transverse partition, while the No. 2 End valve is recessed into the transverse partition wall. In the control trailer car only, a supplementary valve is located on the Left Side of the No. 1 End. Each emergency brake valve is equipped with an operating "T" handle color-coded RED, and the valves are discussed in Section 5.

To apply brakes in an Emergency, pull handle DOWNWARD.

Once the train has come to a full stop, reset the brake valve handle in the UP position to permit brake equipment recovery.

14.9 EMERGENCY LIGHTING (FIG. 3 AND 7)

The emergency lighting system includes a safety feature for cases where the 480 VAC is shutdown.

Four of the high-ceiling fluorescent fixtures and one in each vestibule incorporate a fluorescent emergency lighting unit or "Power Pack". In the absence of 120 VAC, a control circuit will provide fluorescent lighting at the six positions shown on Figures 3 and 7. One tube of each fixture will operate from its respective 6 VDC battery. Each fluorescent lamp, which is independent, will stay ON from 1 to 1-1/2 hours depending on the state of the 6 VDC battery.

WARNING: AS THE BATTERY REACHES A DEEP DISCHARGE STATE, THE FLUORESCENT LAMP WILL ENTER A FLASHING MODE BEFORE GOING COMPLETELY "OFF".

TO PREVENT DISCHARGING BATTERIES DURING NORMAL CAR OPERATION, TURN MAIN LIGHTING BREAKER IN SWITCH PANEL "OFF" WHENEVER HEAD END POWER IS SHUT DOWN.

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 15

TROUBLE SHOOTING

15.1 GENERAL

The present Section is devoted to the troubleshooting of various operational problems that may occur en route. It suggests action that may be taken by the crew or maintenance personnel in response to equipment malfunction in order to allow the train to continue.

In all cases, it is assumed that circuit breakers, switches and other control devices were previously set for normal operating conditions as described in Section 11, Pre-Run Information. Safety devices automatically protect the equipment in case of faulty component operation. In some instances, manual resetting of circuit breaker(s) or other devices may be necessary to restore a lost function. Only the devices which are liable to trip and to require resetting will be mentioned. In other instances, automatic resetting may take place and a time delay is usually required.

CAUTION: To prevent damage to the equipment circuitry, circuit breakers and/or overloads MUST ONLY be reset ONCE.

Before starting the trouble shooting procedure, a thorough visual inspection should be made to determine if the malfunction is being caused by some obvious defect (i.e., foreign obstruction, damaged component, etc.).

15.2 TROUBLE SHOOTING TABLE

The following table and/or charts do not list all the symptoms and probable causes, only those most probable. Various combinations of malfunctions are also possible. Experienced personnel should learn to recognize and evaluate all symptoms of malfunctions in order to effect proper corrective actions. The procedures are complete only up to the point of being correctable en route. Carrier regulations must be followed when resetting equipment or continuing with functions disabled.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
A. ELECTRICAL DISTRIBUTION EQUIPMENT (See Section 3)		
1. No AC power available throughout the train.	1a. 480 VAC trainline(s) incomplete or faulty.	1a. Check Car-to-Car, Car-to-Locomotive and End-of-Train (looped) Head End Power jumper connections. Correct as required to re-establish trainline(s).
2. HEP ON indicating light not ON in control trailer car operating compartment.	2a. Control trailer car 480/120 VAC circuit breaker tripped in control trailer car undercar Main Power Breaker Panel.	2a. Check and reposition breaker ON. Report condition if tripping again.
	2b. 480 VAC HEP trainline(s) incomplete or faulty.	2b. Check Car-to-Car, Car-to-Locomotive and End-of-Train (looped) jumper connections. Correct as required.
	2c. Locomotive 480 VAC HEAD END POWER equipment tripped or not operating properly.	2c. Proceed as in Steps A.2a and A.2b above.
3. No AC power available in one car only.	3a. MAIN POWER circuit breaker tripped at undercar Main Power Breaker Panel.	3a. Check and reposition breaker ON.
4. No 120 VAC power on one car only.	4a. TRANSFORMER circuit breaker tripped at undercar Main Power Breaker Panel.	4a. Check and reposition breaker ON.
5. No 64 VDC power available throughout the train in emergency condition.	5a. Control Trailer Car or Locomotive circuit breakers tripped.	5a. Remove the fault. Check battery circuit breaker in control trailer car and locomotive and correct.
6. No 64 VDC supplied by the power supply in one blind trailer car only when 480 VAC is present.	6a. If the green LED (located on the exterior of the side panel of the Power Supply, undercar) is OFF, check the fuses in the power supply.	6a. Correct the fault or change the fuse as required.
	6b. If the fuse is good, check the power supply input circuit breaker.	6b. Verify the equipment and correct as required.
B. BATTERY CHARGER (See Chapter 3)		
1. No 64 VDC supplied by battery charger.	1a. BCCB circuit breaker is OFF.	1a. Reposition circuit power breaker ON. Report condition if tripping again.
	1b. CB1 and CB2 circuit breakers are OFF in battery charger.	1b. Reposition circuit breakers ON. Report condition if tripping again.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
2. "IL101" Status normal LED indicator, outside battery charger, is OFF.	2a. Press "LT" push button.	2a. If "IL101" LED indicator remains OFF, battery charger is defective.
C. LOCOMOTIVE CONTROL EQUIPMENT (See Section 2 and 3)		
1. No traction power when master controller is moved into an operating position in control trailer car operating compartment.	1a. GENERATOR FIELD circuit breaker not properly positioned (Engineman's LH panel in control trailer car).	1a. Reposition circuit breaker to ON position. Report condition if tripping.
2. Same as step 1 with PCS OPEN indicating light ON.	2a. Safety or train control brake application.	2a. Reset brake equipment and release brakes.
	2b. Trainline side door OPEN or not CLOSED properly. DOORS CLOSED indicating light OFF at Engineman's console.	2b. (If manual mode, check DCB is ON). Check exterior signal light(s) for door(s) OPEN. Close or isolate defective door. See Step D.3f.
	2c. DOOR INTERLOCK relay and/or TIME DELAY RELAY (DITD) circuit defective.	2c. Bypass INTERLOCK circuit by means of DOOR INTERLOCK sealed toggle switch in electrical locker.
	2d. LOCOMOTIVE CONTROL trainline incomplete or faulty.	2d. Check Car-to-Car and Car-to-Locomotive jumper connections and correct as required.
3. Dynamic Brake light illuminated in control trailer car.	3a. Dynamic Brake in Locomotive is faulty.	3a. Push the dynamic brake light push button.
4. Intermittent (red) WHEEL SLIP light indications in control trailer car operating compartment.	4a. Normal WHEEL SLIP correction under severe conditions.	4a. No action usually required. Refer to Locomotive Manual.
5. Excessive (red) WHEEL SLIP light indications.	5a. Possible locked or sliding locomotive wheels.	5a. Check locomotive wheels as per Locomotive Instructions Manual.
6. BRAKE APPL. light remains ON in movement.	6a. Any brake is ON.	6a. Verify outside Brake Ind. Light of each car. Handbrake may be applied on one car.
D. DOOR EQUIPMENT (AUTOMATIC MODE) (See Section 4)		
1. No trainline operation of side doors throughout the train.	1a. DOOR CONTROL AND COMMUNICATION trainline incomplete or faulty.	1a. Check Car-to-Car and Car-to-Locomotive communications jumper connections. Correct as required to reestablish trainline.
	1b. NO-MOTION circuit not operating properly.	1b. Bypass DOOR NO-MOTION circuit by means of sealed toggle switch.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
2. Side doors fail to operate beyond a particular car in the train.	2a. DOOR CONTROL AND COMMUNICATION trainline incomplete or faulty.	2a. Check jumper connections at point where trainline is interrupted.
	2b. DOOR CONTROL circuit breaker tripped on that particular car.	2b. Check breaker and reposition ON.
	2c. One or both ZONE switches in the CUTOUT position on that particular car.	2c. Check and reposition ZONE switch(es) in THRU position.
3. Side door system will not function from any of the four MASTER SIDE DOOR CONTROL panels of one car.	3a. No power to door operators and/or MASTER SIDE DOOR CONTROL panels. DOOR OPERATOR or DOOR CONTROL circuit breaker tripped.	3a. Check breaker and reposition ON at car Lighting and Control Breaker Panel.
	3b. Door operator MOTOR CUTOUT toggle switch in CUTOUT position.	3b. Place toggle switch in NORMAL position at door operator location.
	3c. Door operator EMERGENCY lever actuated (RELEASED) and/or EMERGENCY switch OPEN.	3c. Reset EMERGENCY lever in NORMAL operating position at operator location.
	3d. Door operator fuse blown.	3d. Replace fuse at first opportunity.
	3e. Trap door OPEN or not completely CLOSED and/or trap door switch OPEN.	3e. Verify that trap door is CLOSED completely at that particular door.
	3f. Non correctable electrical or mechanical problems.	3f. Place appropriate door switch in CUTOUT position in electric locker and engage mechanical lock at that door.
4. Side doors will operate from three MASTER SIDE DOOR CONTROL panels, but not from the fourth in one car (adjacent door does not OPEN or CLOSE).	4a. MASTER CONTROL panel not activated. Coach key not IN or not fully turned to ON position.	4a. Insert and/or turn key to full ON to feed power to panel push buttons.
E. BRAKE EQUIPMENT (See Section 5)		
1. Main Reservoir is not being charged to (or maintained at) NORMAL operating pressure on control trailer car.	1a. Train MR/EP end cutout cock(s) not positioned properly. Any car.	1a. Check and position end cutout cocks properly. Make sure cocks at extreme ends of train are CLOSED completely and intercar cocks are OPEN.
	1b. Main Reservoir or associated drain cocks not CLOSED properly. Any car.	1b. Check and CLOSE drain cocks on all cars.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	1c. Locomotive compressor not operating properly, or its associated drain cock(s) not CLOSED.	1c. Check locomotive compressor and drain cock(s). Correct as required.
2. Brake Pipe is not being charged to (or maintained at) NORMAL operating pressure on control trailer car.	2a. Low (or lack of) Main Reservoir pressure. Any car.	2a. See previous Steps 1a. through 1c.
	2b. Train BP end cutout cock(s) not positioned properly. Any car.	2b. Check and position end cutout cocks properly. Make sure cocks at extreme ends of train are CLOSED completely and intercar cocks are OPEN.
	2c. Setup of brake valve incorrect. Control trailer car and/or locomotive.	2c. Check for proper brake valve setup (leading and/or trailing condition) at each end of train.
	2d. Brake valve not placed in proper position in control trailer car.	2d. Check positioning of control trailer car brake valve.
	2e. One (or more) B-3-B emergency valve(s) exhausting air. Any car.	2e. Check and RESET (up position) brake valve(s).
3. Brakes fail to release on one (or more) car(s).	3a. BP cutout cock CLOSED at brake control unit. Any car.	3a. Locate car with brakes applied. OPEN cutout cock and pull control reservoir release valve.
	3b. Handbrake(s) is(are) applied (No. 1 End truck only). Any car.	3b. Release handbrake(s).
4. Brakes fail to apply on one (or more) car(s).	4a. Truck brake (isolation) cutout cock(s) OPEN. Any car.	4a. Check and CLOSE truck brake cutout cock(s).
	4b. BP cutout cock CLOSED at brake control unit. Any car.	4b. Locate car with brakes released and OPEN cutout cock.
5. Brakes fail to release throughout the train.	5a. Brake valve not positioned properly. Control trailer car.	5a. Check positioning of brake valve.
	5b. BP pressure too low as indicated on BP gauge. Control trailer car.	5b. Recharge BP (control trailer car brake valve).
	5c. Brake equipment NOT RESET after a SAFETY CONTROL brake application. Control trailer car.	5c. RESET brake equipment (control trailer car brake valve).
	5d. (Not Applicable)	5d.
	5e. Brake equipment NOT RESET after an EMERGENCY application (brake valve or B-3-B initiated). Control trailer car.	5e. RESET brake equipment (control trailer car brake valve and/or B-3-B).

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
6. Loss of WHEEL SLIDE protection feature on one (or more) car(s).	6a. WHEEL SLIDE circuit breaker tripped at Switch Locker and Circuit Breaker Panel. Any car.	6a. Check and reposition breaker ON on affected car(s).
	6b. WHEEL SLIDE toggle switch in OFF position.	6b. Place to ON position.
	6c. WHEEL SLIDE control fuses blown (OPEN).	6c. Replace fuses at first opportunity.
7. Loss or degraded TRAIN CONTROL (ATC) application in control trailer car.	7a. Penalty brake magnet valve cutout cock not positioned properly. Control trailer car.	7a. OPEN magnet valve cutout cock above operating compartment ceiling.
8. Loss or degraded ALERTOR CONTROL (ATC) application in control trailer car.	8a. Alertor magnet valve cutout cock not positioned properly. Control trailer car.	8a. OPEN magnet valve cutout cock above operating compartment ceiling.
F. CAB SIGNAL/ATC EQUIPMENT (See Sections 2 and 6)	**WARNING: TRAIN MUST "NOT" LEAVE A TERMINAL WITH SYSTEM BYPASSED. USE OF BYPASS (PER RULES) ONLY IF SYSTEM FAILS EN ROUTE.**	
1. Control trailer car signal system does not operate (no indication of aspect display unit).	1a. ATC System circuit breaker tripped at Train Control Circuit Breaker Panel. Control trailer car.	1a. Check and reposition breaker ON. Report condition if tripping again, and proceed with Step 1c.
	1b. Fuses in ATC shelf or in F42 Converter blown out in electrical locker. Control trailer car.	1b. Replace fuse. Report condition if fuse blows out again, and proceed with Step 1c.
	1c. Failure in ATC shelf related to the FOR signal or in the aspect display unit (circuitry defective).	1c. Bypassing ATC system, with cutout cock related to the penalty brake magnet valve in No. 1 End vestibule ceiling (cock must be in CUTOUT position), will allow train to continue. Report condition.
	1d. Reverser key in REVERSE position.	1d. If this direction is required, a bypass of ATC system may be required.
2. Permanent NO-CODE indication (20 MPH) on aspect display unit in signalled territory.	2a. Track receivers disconnected from undercar ATC equipment box with control devices set for normal operation.	2a. Proceed as in Steps F.1c.
3. One of control trailer car signal aspects not illuminated on aspect display unit.	3a. Bad aspect bulb.	3a. Replace bulb at first opportunity.
4. Constant audible alarm.	4a. Circuitry defective in ATC Shelf.	4a. Proceed as in Steps F.1c.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
5. Cab Signal ACKNOWLEDGEMENT not effective within time allowed (audible alarm still sounding).	5a. Cab Signal ACKNOWLEDGING switch not operating properly or defective ACKNOWLEDGING circuitry in ATC shelf.	5a. Proceed as in Steps F.1c.
6. Absences of warning time delay feature when an overspeed or change to more restricting signal occurs.	6a. Defective circuitry in ATC shelf.	6a. Proceed as in Steps F.1c.
7. Constant OVERSPEED and/or PENALTY brake indication (OVERSPEED indicator ON and flashing).	7a. Defective circuitry in ATC shelf.	7a. Proceed as in Steps F.1c.
8. No velocity zero indication (ZERO SPEED indicator OUT on aspect panel) when train speed is below 3 MPH.	8a. Bad indicator bulb.	8a. Replace bulb at first opportunity.
	8b. Defective circuitry in ATC shelf.	8b. Proceed as in Steps F.1c
9. No OVERSPEED indication during an overspeed condition (or flashing during penalty brake).	9a. Defective circuitry in ATC shelf.	9a. Proceed as in Step F.5a.
10. Speedometer lighting turns OFF.	10a. ATC System circuit breaker tripped at Train Control Circuit Breaker Panel. Control trailer car.	10a. Reposition breaker ON. Report condition if tripping again.
G. ALERTNESS SYSTEM		
1. Alertness System does not operate, magnet valve remains deenergized.	1a. Alertor System circuit breaker tripped on Train Control Circuit Breaker Panel. Control trailer car.	1a. Check and reposition breaker ON. Report condition if tripping again, and proceed with Step 1c.
	1b. Fuse in Control Box blown out in electrical locker. Control trailer car.	1b. Replace fuse. Report condition if blow out again and proceed with Step 1c.
	1c. Failure in Alertor Control Box or Alertor Alarm Box.	1c. Bypass Alertor system with cutout cock in No. 1 End vestibule ceiling. Cock must be in cutout position.
2. Alertor reset switch is not lit and audible alarm sounds.	2a. Bad bulb.	2a. Replace bulb at first opportunity.
	2b. Circuitry defective in Alarm Box.	2b. Proceed as in Step 1c.
3. Constant audible alarm.	3a. Circuitry defective in Alarm Box.	3a. Proceed as in Step 1c.
4. System operative throughout first timing cycle but not recycled by reset switch.	4a. Alertor reset switch defective.	4a. Replace reset switch.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	4b. Circuitry defective in Control Box.	4b. Proceed as in Step 1c.
5. Magnet valves remain deenergize on brake released condition when alertor system operative.	5a. Diode D15 open.	5a. Replace diode.
	5b. Magnet valve defective.	5b. Replace magnet valve.
	5c. Pressure switch defective.	5c. Replace pressure switch.
H. SPEED RECORDER		
1. Speed Recorder system not operative.	1a. Speed Recorder Circuit Breaker (SRCB) tripping in Train Control Circuit Breaker Panel.	1a. Check and reposition circuit breaker ON. Report condition if tripping again.
	1b. Speed Recorder fuse blown out.	1b. Replace fuse. Report condition if blowing out again.
2. Speed Recorder tape does not advance.	2a. Circuitry defective.	2a. Report condition.
3. Speed Recorder tape advances but recorder stylus remains at either the upper or lower limit switch position.	3a. Circuitry defective.	3a. Report condition.
J. COMMUNICATION EQUIPMENT (See Section 7)		
1. Neither PA, nor IC operation from any CONTROL HEAD (ENGINEMAN or CONDUCTOR) between cars.	1a. DOOR CONTROL AND COMMUNICATION trainline incomplete or faulty.	1a. Check Car-to-Car and Car-to-Locomotive Communications jumper connections. Correct as required to reestablish trainline.
2. Neither PA nor IC operation from CONTROL HEAD in one car.	2a. COMMUNICATION SYSTEM circuit breaker tripped in that particular car.	2a. Check and reposition breaker ON (Switch Locker Circuit Breaker Panel).
	2b. Failure in the control head and/or in the amplifier.	2b. Report condition.
3. Neither RADIO, nor PA, nor IC operation from Engineman's console. Control trailer car.	3a. RADIO and/or COMMUNICATION SYSTEM circuit breakers tripped at Switch Locker Breaker Panel. Control trailer car.	3a. Check and reposition breaker RCB or CSCB ON. Report condition if tripping again.
	3b. Master Controller REVERSER KEY SWITCH not positioned properly.	3b. Place REVERSER KEY SWITCH in operating position (FORWARD, NEUTRAL or REVERSE).
	3c. Failure in control head and/or in amplifier.	3c. Report condition.

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
K. HVAC EQUIPMENT (See Section 8)		
1. A/C compressor does not start.	1a. TEST rotary selector switch not positioned properly at undercar Local Control Panel.	1a. Check and place switch in AUTO position.
	1b. A/C COMPRESSOR and CONDENSOR No. 1 circuit breaker tripped.	1b. Check and reposition breaker ON at undercar Main Power Breaker Panel.
	1c. Compressor and condenser fan motor overload stripped.	1c. Manually OPEN and CLOSE circuit breaker to reset lockout circuit.
	1d. HVAC control fuses blown (OPEN).	1d. Replace fuse at first opportunity (No. 1 End vestibule ceiling).
	1e. Overhead blowers not operating and/or associated circuit breaker(s) tripped at Car Lighting and Control Breaker Panel and Main Power Breaker Panel	1e. In Electrical Locker, Check if 3PM "tripped" indicator is OFF, for good 3-phase power. Undercar Power Panel Check/Reset HVAC and OVERHEAD BLOWERS breaker. Check/Reset both A/C BLOWER breakers. Check/Reset HVAC relay contactors.
2. No cooling (nor heat) in car but evaporator blowers are running.	2a. System circuit breakers tripped but BLOWER switch ON.	2a. Check positioning of breakers and devices as outlined in "G", Steps 1a through 1d, and reposition for normal operating conditions.
3. Temperature too low (cold), in carbody with a warm ambient temperature.	3a. Temperature sensor and/or Fresh Air thermostats is/are defective.	3a. Operate system in the ventilation mode to maintain a more acceptable temperature level. Report condition.
	3b. OVERHEAD HEAT (reheat) breakers are tripped.	3b. Check breakers in box undercar (Main Power Breaker Panel).
4a. Check for doors NOT CLOSED properly or other cause of outside air infiltration.	4. Temperature too high (warm) in carbody.	4a. Excessive COOLING LOAD on system due to doors being OPEN.
	4b. Temperature sensor and/or Fresh Air thermostats is/are defective.	4b. Determine cause and correct. Operate system in the ventilation mode to maintain a more acceptable temperature level. Report condition.
	4c. One of the OVERHEAD BLOWERS is not running.	4c. Check if both blowers are running. If not, check associated breaker at Main Power Breaker Panel.
5. No heating in car (no overhead heat and/or no floor heat).	5a. Temperature sensor defective.	5a. Determine cause and correct. Operate system in ventilation mode. Report condition. 5b. Replace fuses at first

TROUBLESHOOTING CHART		
SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	5b. HVAC control fuses blown (OPEN).	opportunity (No. 1 End vestibule ceiling).
	5c. Associated HEAT circuit breakers tripped at undercar Main Power Breaker Panel.	5c. Check FLOOR HEAT No. 1, FLOOR HEAT No. 2, OVERHEAD HEAT "B" and OVERHEAD HEAT "A" breakers and reposition ON.
	5d. OVERHEAD BLOWERS not running (overhead heaters cannot be energized without blowers).	5d. In Electrical Locker, check 3PM "tripped" indicator is OFF, for O.K. 3-phase power. Undercar Power Panel Check/Reset HVAC and OVERHEAD BLOWERS breaker. Check/Reset both A/C BLOWER breakers. Check/Reset HVAC relay contactors
	5e. Air flow switches not operating properly (overhead heaters cannot be energized without switches being activated).	5e. Determine cause and correct.